REPORT OF THE 2022 SKIPJACK TUNA DATA PREPARATORY MEETING

(Online, 21-25 February 2022)

1. Opening, adoption of agenda and meeting arrangements

The 2022 Skipjack Tuna Data Preparatory Meeting of the Tropical Tuna Species Group ("the Group") was held online from 21 to 25 February 2022. Drs David Die (United States) and Rodrigo Sant'Ana (Brazil), the Coordinator for Tropical Tunas and the Rapporteur for the western Atlantic skipjack stock (SKJ), respectively, opened the meeting and served as Co-Chairs.

The Executive Secretary, Mr. Camille Jean Pierre Manel, and the SCRS Chair, Dr Gary Melvin (Canada), welcomed the participants to the meeting. The Group Co-Chairs proceeded to review the agenda which was adopted after some changes (**Appendix 1**).

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

Sections	*Rapporteur*
Items 1, 11	M. Ortiz
Item 2.1	L.G. Cardoso
Items 2.2 and 2.3	L. Ailloud
Items 2.4 and 2.5	A. Norelli
Item 3	C. Palma, C. Mayor, J. García
Item 4	A. Urtizberea
Item 5	A. Kimoto
Item 6	R. Sant'Ana, M. Lauretta, A. Justel
Item 7	S. Cass-Calay
Item 8	D. Gaertner
Item 9	G. Merino
Item 10	D. Die

2. Review of historical and new data on skipjack biology (including analysis of AOTTP data)

2.1 Age and growth

SCRS/2022/024 presented new results on age and growth from age readings of dorsal fin spines collected in two periods between January 2014 - May 2016 (Period I) and January 2017 - August 2018 (Period II) in southeastern Brazil. Age validation was carried out by analyzing the percentage variation of the edge type and the seasonal average of marginal increment. The formation of a translucent band occurred in late autumn and early winter for both periods. The growth parameters did not show differences between sexes within each period but differed between the sampled periods.

The Group noted that vascularization in the spine center might lead to underestimation of age (if the observed rings are indeed annual), but the authors clarified that they have accounted for this in the presented age determinations.

SCRS/2022/024 also explored exploitation rates, which indicated differences between periods, 0.35 in period I and 0.50-0.52 in Period II. The authors pointed out that the results could be showing an increase in fishing effort on the species between the periods, indicating that the stock is at the 50% limit of its exploited biomass, and they recommend further studies on the species and factors that may affect its biomass production.

The Group discussed whether the growth and exploitation rates differences were from real changes or due to sampling issues regarding different size ranges sampled in each period.

SCRS/2022/025 presented a comprehensive study on population parameters of SKJ in the southwestern Atlantic Ocean (SWA) from southeastern Brazil, including growth, reproductive parameters, total mortality estimates, and the species feeding ecology. The authors argued that the results showed that a SKJ in this region used shelf break and slopes waters off the Brazilian coast. SKJ in the SWA has bioecological peculiarities that corroborate behavioral patterns described in the literature for the region, but share similarities with studies from other oceanic areas, influenced by different environmental conditions and fishing efforts. Such results provide updated information on the SKJ population attributes in the SWA like size at maturity, total mortality, and growth. A model for the SWA SKJ spatial dynamic was presented based on the feeding ecology, size samples, and reproductive parameters.

The Group discussed whether data from a broader region should be considered to complete the proposed model.

SCRS/P/2022/001 provided an overview of results from the AOTTP regarding movement, growth and mortality of skipjack. New information includes evidence of connectivity between the Azores and the West coast of Africa, evidence of underestimation of age when daily increments are used for ageing, growth estimates from AOTTP tagging data, and estimates of nuisance parameters related to natural mortality (tag reporting, tag shedding, tag mixing and tag induced mortality).

The Group investigated how growth information from AOTTP data compared with published growth curves (**Table 1**) and found the tagging data more compatible with a higher *k* (>0.4; **Figure 1**). When L_{INF} is kept fixed at 95cm FL, the fit of the Fabens model (Fabens, 1965) based on AOTTP tagging data alone estimates *k* at 0.4 (**Figure 2**). This rate of growth is larger than the rate of growth obtained from the analysis of spine data (SCRS/2022/024; *k*=0.11-0.25). Preliminary results from an ongoing comparative analysis of spines and otoliths in the Indian Ocean (Luque *et al*., 2021) indicates the two structures, even when obtained from the same fish, show little agreement beyond age 0: otolith age estimates suggest a very fast initial growth with a transition to slower growth at around age two (similar to what is observed with the tagging data), whereas the fin spine ageing method suggests growth is linear. Preliminary otolith age validation work from the same study provides some evidence that opaque bands observed in small skipjack are annual (based on fish tagged with oxytetracycline at 48-53cm SFL and recaptured up to 1.65 years later). Those results are in agreement with the AOTTP validation results presented in SCRS/P/2022/001.

Though the tagging data appear informative regarding *k*, they are not currently informative regarding the mean asymptotic length, L_{INF}, due to the relatively small fish sizes at release and restricted times at liberty. Other sources of data may be more informative on L_{INF}: catch at size data from LL vessels show evidence of fish lengths 110-133cm. The Group questioned the validity of some of these extreme values (>120 cm) and suggested that large size fish with similar sizes reported across multiple fleets (110-120 cm) may be a more reliable representation of L_{MAX}. Though these fish are not likely to represent L_{INF} they may be useful for setting the upper limit (~2% largest fish) of the variability in size at age for the oldest fish.

2.2 Natural mortality

SCRS/2022/024 provided estimates of natural mortality (M=0.23-0.28) using the Barefoot Ecologist Toolbox based on von Bertalanffy parameters estimated using spines collected in the Southwest Atlantic and an assumed life span of eight years.

SCRS/2022/025 provided estimates of natural mortality (M=0.37-0.58) using catch curve analysis of samples collected in the SW Atlantic.

SCRS/P/2022/001 did not provide any estimates of M but indicated that the groundwork of estimating auxiliary parameters typically confounded with M (tag induced mortality, tag reporting, tag shedding, tag mixing) has been done and may now allow for M estimation to proceed.

The Group compared the M-at-length values assumed for each of the three tropical tunas, postulating that M for similarly sized yellowfin, bigeye and skipjack should be comparable given their close association. The comparison showed good agreement over the size range 45-70cm (**Figure 3**). Given the uncertainty in natural mortality of eastern and western Atlantic skipjack, the Group looked at the range of M-at-age vectors estimated for skipjack across oceans (**Figure 4**). When the M-at-length vector for skipjack (Gaertner, 2015 and Anon., 2015) is converted into an M-at-age vector, varying assumptions about growth have a very large impact on the predicted M on age 1 and 2 fish (see **Figure 4**). As such, the Group suggested that a range of plausible growth curves be used to develop alternative hypotheses for M-at-age to cover the range of uncertainty. The Group also noted that the scarcity of very large individuals in the population could indicate senescence but that more research is needed to test it.

2.3 Reproduction and sex-ratio

SCRS/2022/025 reported new information on reproduction for fish captured in the Southwest Atlantic. The authors provided an estimate of length at first maturity at 45.5 cm fork length (FL) and found no significant differences between sexes. High condition factors observed in the southern area (off the Brazilian coast) suggest that the area is principally used for feeding and growth, where maturing females gain body mass before the northward migration to the spawning grounds. Monthly differences in the hepatosomatic index also indicate a temporal pattern of feeding in the southern area and migration to the southeastern region for reproduction.

Reproduction was also explored in SCRS/2022/026. The authors indicated the smallest mature specimen was observed at 46 cm FL in waters near St Helena.

No new information was presented on sex-ratio.

2.4 Length-weight relationship and its variability

The Group reviewed research since the last skipjack assessment and two length-weight relationships were presented to the Group. The Group highlighted Saber *et al.* (2019) because it included a Mediterranean recreational length-weight relationship. 470 skipjack between 53 and 77 cm SFL were estimated to have a length weight relationship of $RW = 1.368147e\text{-}05\ SFL^{3.122}$ (R2 = 0.96).

SCRS/2022/025 was presented length-weight relationships for the Southwest Atlantic. This analysis estimated relationships for two areas along the Southeast coast of Brazil to be $W= 0.0128*FL^{3.1363}$, R2 = 0.9039., $W = 0.0028*FL^{3.5075}$, R2 = 0.9642. When combined, the relationship was: $W = 0.004*FL^{3.4217}$, R2 = 0.9461.

SCRS/2022/021 described the life history of skipjack caught in St Helena. As a volcanic island with seamounts that produce local upwelling, St Helena's productive seas and baitfish attract tropical tuna species. Rod and reel vessels intermittently catch skipjack around the island margin and seamounts. Total SKJ catch between 2015-2021 was 178.4 t, generally not exceeding 10 t annually. SKJ can be abundant during intermittent "runs" between December/January-June, historically peaking in March-June. However, SKJ has low local demand, and given export is not currently occurring, SKJ has reduced catch levels. Catch, tagging, and biological data have been collected since 2015 which provide some information on length-weight relationships. Measured individuals (n=1108) ranged in length from 36 to 68 cm (mean 48.6; median = 47.0), and weight from 0.81 to 7.62 kg (mean = 2.45; median = 2.11). The length-weight trend was comparable to other CPCs such as Brazil. However, highlights that regional and local length-weight relationships are important for understanding SKJ. SKJ tagging information on St. Helena is provided in section 3.3.

Since the 2014 stock assessment used a single, Atlantic-wide length-weight relationship (W(kg) = 7.480E10-6 * FL (cm) ^ 3.253, Cayré and Laloë, 1986), the possibility of creating separate length-weight relationships for the eastern and western stocks was considered. The Group was reminded of Gaertner, 2015 which was presented at the 2014 stock assessment and contained a table of length-weight relationships (Gaertner, 2015). All length-weight relationships from Gaertner, 2015, Saber, 2020, SCRS/2022/021, and SCRS/2022/025 were compiled in **Table 2**. All Atlantic Ocean length-weight relationships were graphed in **Figure 5** with the presented parameters highlighted in **Figure 6**. All points from the two presented papers were graphed against the length-weight relationship used in the 2014 skipjack stock assessment in **Figure 7**.

2.5 Movement and stock structure

SCRS/2022/032 presented genetic population trends for skipjack tuna in the Atlantic Ocean using samples from Venezuela, Brazil, the Azores, St Peter and St Paul Archipelago, Senegal, Cote d'Ivoire, and Gabon. The population had high genetic diversity in agreement with the IUCN conservation status of least concern. However, the Azores may have less gene flow than others. This research was preliminary and many group members committed to provide additional genetic samples including the United States, St Helena, and the EU. There were no recommendations to alter the stock structure based on this preliminary work.

SCRS/2022/034 presented a systematic review of tropical tuna speeds, temperature preferences, oxygen preferences, and FAD-related parameters from the scientific literature. This document suggested a summary of the means and standard deviation of each parameter for movement models. As an update to habitat preferences, the paper suggested skipjack tuna preferred higher temperatures between 19.3°C and 27.9°C and were able to dive into oxygen-poor zones (1 ml/L). The document demonstrated that SKJ has an average continuous residence time around FADs of 2.6 days which is half the continuous residence time of bigeye and yellowfin (7.7 days, 6.8 days). All species sense a FAD from 5.4 nautical miles away and take 23.8 days to colonize it. Other tropical tuna preferences are reported in the document.

This presentation raised questions about gaps in the literature and the parameters used in recent studies. Future studies on skipjack movement in the Atlantic with satellite tags were recommended due to a lack of published literature. Additionally, the Group suggested that future reviews of FAD behaviors should differentiate between anchored and drifting FADs because the type of FAD influences the described parameters. SCRS/2022/026 described colonization time as a minimum of 20 days which was similar to the proposed 23.8 days.

SCRS/P/2022/003 presented potential hot spots for skipjack in southern Brazil based on tagging and vessel activity. Data from 9 years of pole and line vessel activity was compared to Sea Surface Temperature (SST), upwelling, chlorophyll, and other factors to determine if there was a relationship between oceanographic features and skipjack catch. The paper identified cyclonic gyres as key locations for skipjack gathering in high chlorophyll, high temperature, pockets along the isobath. There is a strong seasonal signal each summer as skipjack follows the productive gyres North into warm waters as cool waters intrude from the South, then return to the South in the winter. This trend is highly dependent on wind stress, wind strength, and La Niña, but is predictable. Data on diving behavior on SKJ from satellite tags were also presented. SKJ remains on the surface at night (mode 40 m depth) but can dive up to 250 m during the day, associated with feeding on vertical migratory prey.

The Group discussed how the relationship between tuna and gyres may affect CPUE estimates and stock structure. It was noted that fishers are familiar with many of the trends observed in the study and actively use gyres to increase catch by targeting high prey areas where the skipjack moves slowly. CPUE in this area may be more indicative of how easy it is to find fish rather than the abundance.

The presentation of SCRS/P/2022/001 (in section 2.1) provided comments on skipjack migrations based on the AOTTP tagging trajectories. There was demonstrated connectivity between the Azores and Gulf of Guinea, which had not been observed in the ICCAT historical tagging data. The paper confirmed there was minimal or no exchange between the eastern and western stocks of SKJ (**Figure 8**). However, the separation between the two stocks was less clear for tags released very close to the boundary (0°, 35° West) sparking concern over fleets fishing across both regions. The Group recommended that a more detailed analysis of movement in that specific area be carried out in the future to determine if the boundary should be further refined.

3. Review of fishery statistics and tagging

The Group reviewed the most up-to-date information presented by the Secretariat on skipjack fishery statistics (T1NC: Task 1 nominal catches; T2CE: Task 2 catch & effort; T2SZ: Task 2 size samples; T2CS: Task 2 catch-at-size reported - CPC based estimations) and conventional tagging data, for both stocks (SKJ-E: eastern Atlantic, SKJ-W: western Atlantic). In addition, the most recent estimations of CATDIS on tropical species for the period 1950-2020 were also presented to the Group. After a careful revision (detailed in this section) all the scrutinized information was adopted by the Group for the assessment, and all the updates were stored in the ICCAT database system (ICCAT-DB).

Three documents were presented to the Group updating information on fisheries which result in the improvements of Atlantic skipjack Task 1 and Task 3 statistics. These are briefly discussed below.

SCRS/2022/030 provided a detailed review of the Brazilian baitboat fishery on tropical tunas, where more than 75% of the total catches of the western Atlantic skipjack tuna stock are caught by this fishery along the southeastern coast of Brazil. This fishery has been well sampled but occurs in a restricted area concerning the entire stock distribution preventing a comprehensive analysis of the fish sizes' spatial distribution. However, a dataset on spatially distributed size samples (> 7 million measured fish) provided an opportunity to analyse the spatial distribution of skipjack sizes across the western Atlantic. Overall, the larger mean sizes occurred offshore and a little further North and South of the tropical latitudes, from 30ºN to 30ºS. The smaller mean sizes were observed in areas closer to the coast and at higher latitudes in the southern and northern hemispheres.

SCRS/2022/035 provided a detailed study of the skipjack fishery in the Canary Islands during the period from 1926 to 2020. The skipjack has been fished in the Canary Islands since ancient times, as shown by the records in the books of old tuna canning factories that existed in La Gomera in the last century. This species is caught by small scale vessels (< 10 GRT), in coastal areas by free-school fishing mode. It is also caught offshore by bigger boats (> 50 GRT), using the "pesca a la mancha" fishing technique. Skipjack catches in the Canary Islands have always been important for artisanal fishing communities, representing more than 35% of total tuna catches in many years. The main fishing season of skipjack has always been in the summer months (2nd and 3rd quarter mainly). In the last twenty-five years (1995-2019), no significant changes were observed in the length distribution of SKJ. The smallest fish are around 35 cm, the average size of 53.83 cm and the maximum size of 95 cm for the entire series analysed. Skipjack sizes in the catch show seasonality; the largest number of small skipjack are caught in May, June, July, and August, while the largest skipjack are fished during the winter (December, January, and February). This suggests that the schools of the smallest skipjack become available to the fishery in May, June and July, and remain in the area for at least another six months, feeding and growing to become the larger specimens that are then caught during the winter months.

SCRS/2022/038 provided the methodology used to obtain the estimations of "faux poisson" catches of the European purse seine (PS) fleets (EU-France, EU-España) over the period 2015-2020 for the major and small tuna species: yellowfin (YFT), bigeye (BET), skipjack (SKJ), frigate tuna (FRI) and little tuna (LTA). The new catch data series (in the form of T1NC) for the period 2015-2020 was submitted to ICCAT. For the purpose of consistency, the same methodology of estimation was used for the previous estimates provided before 2015, with the exception that for the computation of the tuna catch composition, which was estimated based on the average of the port survey during the period 2015-2020. The tuna composition and catch pattern of the "faux poisson" were very similar between EU-FR and EU-SP.

3.1 Task 1 (catches) data

The Secretariat informed the Group that only minor SKJ data updates were made to T1NC since the 2021 SCRS annual meeting. Only catches for the period 1950-2020 were analysed (only one CPC reported preliminary estimates for 2021). Following the 2021 SCRS recommendation, the Secretariat also presented the new T1NC dashboard (screenshot **Figure 9**) with interactive querying facilities aiming to easily explore the yearly T1NC dataset. The Group welcomed this new tool and recommended the participants to use it during the meeting to find potential inconsistencies in the catches. The Group also discussed the need to improve the metadata and the ICCAT coding system linked to the statistical datasets available on the ICCAT website. The Secretariat informed that, this is an ongoing task and reiterated its commitment to continue making progress over the next few years.

During the meeting, several changes to T1NC were made. The revised PS catch series of "faux poisson" presented in document SCRS/2022/038 (EU-France and EU-España, 2015-2020) was adopted by the Group and incorporated into T1NC, after allocating these annual catches to the ICCAT SKJ sampling areas (using the T2CE yearly proportions of PS FAD catches in each sampling area). A proposal to estimate "faux-poisson" for the other PS FAD fleets was detailed in SCRS/P/2022/002. A summary of this proposal is presented below.

Methodology to estimate "faux poisson" for non-EU PS fleets with FAD fishing activity

European catches of "faux poisson" (FP) are the longest time series of FP documented in ICCAT. Based on the assumption that FP catch proportion was similar among the purse seine fleets fishing with FADs, EU scientists proposed to use the T2CE FAD component of non-EU CPCs to estimate the catch fraction of FP based on the EU fleet FP ratio of catch. A preliminary review of the FP tuna composition in Spanish and associated fleets shows similar patterns, supporting the assumption of similar FP catch proportion among CPCs.

The Group acknowledges the need to fill the gaps in the data series regarding the FP catch. However, some CPCs have already reported these data to ICCAT (although, reported as Tuna unclassified). Therefore, the methodology proposed should be only applied to selected years and those PS fleets that have PS-FAD operations and have not reported FP catches.

Methodology

Step 1. (Standardization of catch under FAD): standardize T2CE under FAD (t2_FAD_ST) keeping the maximum catch reported to ICCAT between T1NC (t1) using file "t1nc-ALL20220224.xlsx", and T2CE (t2) using file "t2ce-ETRO_PS1991-20_byschool.xlsx":
t1 = sum of catch of the tuna species (BET, FRI, LTA, SKJ, YFT)
t2 = sum of catch of the tuna species (BET, FRI, LTA, SKJ, YFT)
t2_FAD = sum of catch **under FAD** of the tuna species (BET, FRI, LTA, SKJ, YFT)

$$Raising\ factor\ t2\ = \frac{t2}{\max\,(t1, t2)}$$

$$t2\_FAD\_ST = \frac{t2\_FAD}{Rasing\ factor\ t2}$$

Step 2. Computation of the proportion of FP catch EU (p_FP_FAD_EU) based on FAD catch by year (i)

$$p\_FP\_FAD\_EU_i\ = \frac{catch\_FP\_\ EU_i}{t2\_FAD\_ST_i}$$

Step 3. Estimate catch Faux poisson by year (i) and by non-EU target CPCs (j)

$$Catch\_FP\_pred_{ij}\ =\ p\_FP\_FAD\_EU_{ij}\ \times t2\_FAD\_ST_{ij}$$

Preliminary estimates of FP (five species: BET, YFT, SKJ, FRI, LTA) for the non-EU fleets were obtained during the meeting (**Table 3 EU, Table 4 non-EU**) and added to T1NC. Overall, the Group expressed some concerns on the way this approach can be used for all CPCs with PS FAD fishing activity, and that a clear definition of "faux poisson" for each CPC with PS FAD fishing activity (present and past) is required. The Secretariat would contact each CPC to review and validate these preliminary estimates by each CPC by 18 March 2022.

Based on a revision of Venezuela PS catches (SCRS/2022/039) where there is no evidence of SKJ-E catches, the historical SKJ-E catches of Venezuela in the period 2001-2003, were moved and merged with the western stock (SKJ-W) catches. These reallocations of catches will be confirmed by Venezuela later on.

No additional corrections were made to T1NC. The adopted total catches of SKJ in both stocks (SKJ-E and SKJ-W) were presented in **Table 5.** The SKJ catch trends by stock and gear are presented in **Figures 10** and **11.** The temporal-spatial distribution of SKJ catches (CATDIS 1950-2020) is shown by gear and decade 1990-2000 and lustrum 2005-2020 (**Figure 12**), and by trimester for the PS FAD in the period 2015-2020 (**Figure 13**).

3.2 Task 2 (catch-effort and size samples) data

All the existing information on T2CE, T2SZ, and T2CS were made available to the Group. This includes detailed catalogs with important metadata on each series, the data itself in standard SCRS formats, and some special extractions (e.g. T2CE detailed dataset with PS catches by fishing mode FAD/FSC) used by the Tropical Tunas Species Group. A detailed analysis of T2SZ was presented in document SCRS/2022/027 (details in section 5).

Brazil informed that a revision of its T2CE and T2SZ data for BB fisheries (presented in SCRS/2022/030) is ongoing, and that, at a later stage this recovered new information will be reported to ICCAT. Similarly, Spanish scientists indicated that BB Canary skipjack size samples (T2SZ) data (SCRS/2022/035) will be reported to ICCAT.

No additional improvements were reported to the Group.

The SCRS catalogues for SKJ-E and SKJ-W are presented in **Tables 6** and **7**, respectively. The Group reiterated the importance of the SCRS catalogues as an instrument to identify gaps and inconsistencies by CPCs in both Task 1 and Task 2 datasets. They were developed by the SCRS (Commission endorsement) for that purpose and the SCRS continues to recommend the ICCAT CPCs to use them to identify data deficiencies.

3.3 Tagging data

The Secretariat provided a presentation on the progress of the ICCAT conventional tagging on skipjack tuna (including AOTTP) with a particular focus on the tagging related activities (releases and recoveries) throughout the ICCAT Convention area.

The Secretariat informed the Group that post-AOTTP tagging activities related to increasing awareness regarding tag recoveries, tag seeding, tag rewarding, and ageing of tagged specimens are being funded. Two contracts were signed with teams based in Senegal and Côte d'Ivoire. Discussions are also ongoing with the teams in the field to facilitate these activities that throughout 2021 were voluntarily carried out in Brazil, St Helena, and the Canary Islands. The Secretariat also informed the Group that a contract was signed with the University of Maine, the United States in October 2021, for the total amount of €98,000. The aim is to continue the tagging activities off the Northwest Atlantic following the closure of the AOTTP programme. The objective is to deploy an additional 1400 tags (419 on YFT, 343 on BET, and 638 on SKJ) and continue the awareness and recovery activities and pay the rewards until the end of 2022. These activities are being funded through a voluntary contribution provided by the United States.

In addition, the Secretariat presented a new dashboard on SKJ conventional tagging using the most up-to-date conventional tagging information available in ICCAT (ICCAT historical tagging plus the AOTTP tagging). This dashboard, and the evolution of previous dashboards developed by the Secretariat in recent years, allows for more dynamic and interactive analyses of conventional tagging data. The updated datasets on conventional tagging of tropical tunas were also made available to the Group in excel files. The number of tagged SKJ released and recovered by year is presented in **Table 8.** The number of SKJ recoveries grouped by the number of years at liberty is presented in **Table 9**. Five additional figures summarise geographically the SKJ conventional tagging available in ICCAT. The density of releases in 5x5 squares (all SKJ in **Figure 14**, only AOTTP in **Figure 15**), and the density of recoveries in 5x5 squares (all SKJ in **Figure 16**, only AOTTP in **Figure 17**). The SKJ apparent movement (arrows from release to recovery locations) is presented in **Figure 18.** In addition, document SCRS/2022/021 summarizes the AOTTP tagging activity for skipjack in waters surrounding St Helena, where there have been 1,757 SKJ tagged of which 45 individuals have been recaptured giving a recovery rate of 2.6% in, with time at liberty generally less than 60 days.

The Group acknowledged the Secretariat's continuous progress on tagging activities, with a particular focus on the continuation of the AOTTP tag seeding activities. On the other hand, the Group expressed some concern on the outcomes of the AOTTP symposium research documents publication process, and therefore recommended that additional efforts should be made to ensure the dissemination of the results of the AOTTP programme.

4. Fishery indicators

The average weight by gear type is a very useful indicator to help interpret the outputs of the production models as these models do not consider changes in the size distribution with time. In the past assessment (2014) the average weight by gear type was obtained from the catch at size and the length weight relationship. The 2022 Tropical Tunas Workplan did not request the estimates of catch at size by gear and therefore it was not calculated for this meeting.

The Group noted that the maps of the spatial distribution of catches in SCRS/2022/027 by gear can be very useful indicators apart from giving some guidance to the Commission (**Figures 19, 20** and **21**).

The Group also noted the expansion after 2010 of the eastern fishery of purse seiners with an increase in catches in the equatorial area, with some extending towards the west beyond the stock boundary between the eastern and western stocks (**Figure 22**). It was also found that the size range of SKJ catches by EU and Ghana PS FAD are similar in the East and West Atlantic stock areas (40-50cm SFL, **Figures 23** and **24**) that are smaller than fish caught by PS in the West stock area mainly by Venezuela PS non-FAD fisheries (45-60 cm). The Group discussed whether the definition of the stock boundary was appropriate in the Equatorial area, however, the Group decided to use the current stock boundary for the stock assessment.

5. Size samples and estimation of catch-at-size and catch-at-age

The Secretariat presented document SCRS/2022/027 on the preliminary analyses of Task 2 size samples and catch distribution for East and West skipjack stocks. Skipjack size samples were collected since the 1960s, but sufficient sampling is only available since the 1980s. A larger proportion of size samples are from the purse seine and baitboat fisheries for both stocks, with limited number of samples from other gears like longline or handlines. Overall, the size frequency distributions indicate that purse seine catch smaller fish compared to the baitboat fleets, and this trend seems to be more accentuated with the increase of PS-FAD associated fisheries in the eastern stock since the 1990s. The spatial distribution of the catch and size samples indicate that in the tropical area there is a continuity of the fisheries in the eastern Atlantic were overlaps with the current stock boundary between East and West SKJ stock units. As the main eastern purse seine fisheries have spatially expanded in recent years, some of the EU and associated PS fleets catches are just West of the eastern stock spatial boundary around the Equator. The Group noted some inconsistencies in the reporting of catches to each stock area in Task 1 and Task 2 CE prior to 2015. Similarly, some of the newer handline fisheries off Brazil are catching skipjack on both sides of the stock boundary in this region. The Group suggested that eastern PS fleets and Brazil should consider revising the reporting of these catches and size information to be consistent with the current stock units.

Although few catches and samples are from the longline fisheries (almost all as bycatch), the spatial distribution of catches suggest also a continued availability of skipjack around the equatorial area. The size samples from longlines also indicate that large size skipjack are available to these fisheries. In recent years, fish between 80 to 120 cm SFL have been reported from some of the main longline fleets operating particularly in the tropical and South Atlantic areas, as well as in the Gulf of Mexico. The Group noted that these large-size fish are informative for the stock assessment to estimate natural mortality using L_{MAX}, and to estimate the selectivity for longline fleets assuming an asymptotic curve.

The document presented a preliminary fleet structure for the fisheries of skipjack, using as a base the fleet structure of the YFT and BET previous assessments, to integrate the skipjack fleet structure into the Multispecies MSE for tropical tunas operating models (OM). It was noted, that these preliminary fleet structures for both East and West skipjack stocks will be reviewed by the Group and to be linked with available size data, and indices of abundance to generate the proper input for the different assessment models and MSE OMs. It was also noted the large catches of skipjack off Mauritania and Senegal by purse seine in recent years and suggested a further review to consider including them together with the EU purse seine fleets in the fleet structure.

The Group discussed the necessity of the estimated catch at size (CAS) that Task 2 size samples are raised to the corresponding total Task 1 nominal catches (T1NC) in weight. The Secretariat made it clear that producing such data would require a few weeks. It was requested that the Secretariat provide CAS before the skipjack stock assessment session in May 2022 by using the length-weight relationship agreed in Section 2.4.

There are no plans to use a catch at age in the assessment so no attempts will be made to calculate it.

6. Indices of relative abundance

The Group reviewed three new indices for consideration in the assessment of eastern (E-SKJ), and six total CPUE series for consideration in the western skipjack assessment (W-SKJ). The newly developed E-SKJ indices included an acoustic buoy echo-sounder biomass index, an EU fleet purse seine index, and a biomass index generated from estimates of yellowfin tuna biomass and catch proportion of SKJ. In addition, three historic baitboat indices, and a Mediterranean rod and reel tournament index were reviewed for E-SKJ. The six indices considered for W-SKJ included a Brazilian baitboat index, Brazilian handline index, Venezuela purse seine index, U.S. longline observer index, Gulf of Mexico larval survey, and a historic period Brazilian baitboat index. In general, the Group recognized the quality of the work presented during the meeting. Discussions on data quality and methods for standardization used by each analyst were held during the presentations. Among these were topics on catch rate covariates, model structure and assumptions, spatial distributions, among other points.

Spatial distributions of both the E-SKJ and W-SKJ stocks, boundaries, overlap, and assumptions of stocks referenced by the different fishery indicators were discussed in detail. A main focus was on the boundaries of the stocks in the equatorial region. The assignment of catches is done by stock area, but some fleet operations are continuous across the stock delineation boundary, potentially confounding the interpretation of the indices and catch statistics.

The Group made several recommendations for revisions to some of the indices presented, some of which were completed during the meeting. The recommended changes included removal of a catch proportion covariate for the Venezuelan purse seine index, construction of a seasonal index for the EU purse seine index, and separation of the Brazilian data and index to the West area management delineation. The Group agreed that future work should seek new knowledge of stock units and distributions to better assign individual indices to defined stocks.

Key discussion points and determinations for use in the stock assessment for each index are summarized below based on the CPUE evaluation discussions during the meeting (**Table 10**). The index values and associated CVs for E-SKJ are listed in **Table 11**, and W-SKJ indices are listed in **Table 12**. **Figure 25** plots the E-SKJ indices, and **Figure 26** shows the W-SKJ indices.

East-SKJ relative abundance indices

Catch ratio YFT/SKJ index (SCRS/2022/031): The Group expressed concern that using the stock assessment model biomass outputs for one species to generate an abundance index for another species goes against best practices, even if the species co-occur. This index is based on the hypothesis that variations in the ratio of catchability are accounted for by the model and that skipjack biomass trends can be derived from trends in the catch ratios and the yellowfin tuna vulnerable biomass. However, the Group acknowledged that it may be worth exploring the use of the index in sensitivity runs. The Group determination is to initially use this index for sensitivity analyses.

EU Echosounder index (SCRS/2022/026): It was determined that the acoustic biomass estimates from the echosounder likely primarily measures E-SKJ, evidenced by the catch compositions observed in purse seine FAD. It was noted that the index references both juveniles and adults, unlike the other tropical (YFT, BET) tunas in which primarily juveniles are observed. The Group determination is to use this index for E-SKJ, including both surplus production and age-structured models.

EU PS VAST index (SCRS/2022/028): The Group requested revision of the presented index to be derived in quarterly timesteps, and the analyst indicate this work could be completed intersessionally. The Group highlighted the application of the spatial-temporal models to account for different sources of variance as a general good practice approach. The Group determination was to use this index in the stock assessment.

Mediterranean RR index (Saber et al., 2019): This historical index was presented at previous Group meetings, but was not considered for a prior E-SKJ stock assessment (2014). In general, the data represent a small area of the stock, are a relatively short time series, SKJ is not a targeted species, and associated fishery catches are small. The Group determination is not to use the index in any of the stock assessment runs.

Azores BB, Dakar BB, and the Canary Islands BB: These historical indices are based on Task-2 CE data, were developed during the 2014 SKJ assessment meeting, and were used in the models. The Group determination was to initially use these indices in a continuity model.

West-SKJ relative abundance indices

US LL observer data index (SCRS/2022/037): The Group commented on the relatively large spatial area in the NW Atlantic covered, continuous and updated time series, observer collected data, and larger sized SKJ observed. The Group determination was to include this index in both surplus production and age-structured assessment models.

US GOM Larvae index (SCRS/2022/040): The Group noted the long-term fishery independent time series as being potentially informative for the Gulf of Mexico, but expressed concern over the limited spatial coverage compared to the W-SKJ spawning habitat. In addition, annual sampling occurred over an approximate two-month timeframe during late spring, whereas W-SKJ is thought to have a protracted spawning season over several months. The Group's determination was not to use this index in any stock assessment models.

BRA BB 2000-2021 index (SCRS/2022/029): The index is associated with a major harvesting fleet that catches a significant proportion of W-SKJ landings and covered a relatively long time series. Both historical and recent period standardized indices were reviewed. It was noted that the historic period was not likely to have expanded to the East area, and the index could be used as provided. The Group determination was to use both, the historic period index for years 1981 to 1999 BRA BB 1981-1999 Early index (Carneiro *et al.*, 2015), and the recent period index for years 2000 to 2020 in the W-SKJ assessment models (surplus production and age-structured models).

BRA HL Schools index (SCRS/2022/036): The Group discussed the development of the fishery and how the catchability of the fleet may have changed across the time series. It was noted that the fleet is associated with a significant proportion of W-SKJ catches. The Group expressed concern, however, that much of the catch and effort has occurred in the E-SKJ stock area, raising the possibility that W-SKJ and E-SKJ abundance trends may be confounded in the index. The analyst noted that, although no location information is available in the data prior to 2018, fishing effort through 2016 is understood to have occurred entirely within the W-SKJ stock boundary. The Group recommended redoing the standardization including data through 2016, and the data during 2018-2020, restricted to the W-SKJ stock area. The Group determination was to include this index in surplus production and age-structured models for W-SKJ.

VEN PS index (SCRS/2022/039): The Group recommended revision to the model structure used to remove the catch proportion variable that may be confounded with changes in abundance or biomass. The analyst completed the revisions during the meeting and presented a revised index to the Group. The Group decided to use this index in stock assessment models for W-SKJ, including surplus production and age-structured models.

6.1. Detailed descriptions of individual indices

East-SKJ

The Chair shared with the Group a paper that had been presented during a recent Tropical Tunas Species Group meeting on standardized catch rates of skipjack from the Spanish Mediterranean recreational fishery for the period 2006-2018 (Saber *et al.* 2019). The study presents data from the western Mediterranean, which are interpreted to be an extension in the distribution of the eastern stock of skipjack towards the Mediterranean Sea in recent years. It was noted that this index represents a small recreational fishery and that the Group should evaluate whether it is representative of the whole stock.

SCRS/2022/031 presented an abundance index for eastern skipjack based on the ratio of skipjack to yellowfin tuna in samples from purse seine associated sets and the abundance of yellowfin tuna vulnerable to the purse seine FAD associated fishery, as estimated in the uncertainty grid of the latest yellowfin tuna SS3 stock assessment. The ratio in the catch was modelled using GAMs and a lognormal approach. After exploration of different models, it was decided to include only a spatial term to account for the relative changes in catchability between both species, a time categorical variable that represents the abundance of skipjack and an offset, given by the estimated vulnerable biomass of yellowfin tuna.

The Group inquired about the differences in SKJ proportion in coastal areas and high seas areas. The model suggests that BET and SKJ ratios are lower in coastal areas, while YFT occurrence is higher in those areas. This aligns with previous studies presented to the Group.

The Group showed concern about using outputs from stock assessments as inputs for other analyses, with potential problems as documented in Brooks and Deroba (2015). The author agreed and noted that this type of indices may still be a good alternative in some cases, as it can be used to compensate for issues that may affect other available indices (e.g. effort creep) or be applied to bycatch species.

SCRS/2022/026 presents an index of abundance of skipjack tuna in the eastern Atlantic Ocean derived from echosounder buoys for the period 2010-2020. These instrumental buoys inform fishers remotely in real-time about the accurate geolocation of the FAD and the presence and abundance of fish aggregations underneath them. Echosounder buoys have the potential to be used as observation platforms to evaluate abundances of tunas and accompanying species using acoustic detections and logbook species composition data. Current echosounder buoys provide a single acoustic value without discriminating the species or size composition of the fish underneath the FAD. Therefore, it has been necessary to combine the echosounder buoys data with species composition from logbooks to develop a specific indicator of abundance for skipjack.

The authors clarified that environmental variables were evaluated but removed because they did not have a significant effect or explained less than 5% of the total variability; and that the same had occurred for the indices used in the latest YFT and BET assessments. Similar longterm trends were noted across the three species. There was some discussion on how environmental factors may affect the species and that this should be investigated further in the near future.

The Group also requested some clarification regarding the 90% percentile cutoff used in the analysis. This same cutoff value was used in the YFT and BET indices. In order to set a non-arbitrary cutoff value that could integrate not only the information of the buoy and the different layers but also the oceanographic information and all other information that may be available, the authors have recently started working on incorporating Machine Learning algorithms that will better characterize the relationship between the acoustic signal and the biomass. A recent publication by Precioso *et al*., 2022 will be used as a reference in this work.

The Group noted that there is still some concern on how species composition is integrated in the index. The authors agree that there is room for improvement, but noted that purse seine catch composition remains at present the best available source of information on species composition, in particular, logbook data in the case of SKJ.

The authors presented preliminary indices by region for the areas of “Cabo Verde”, “Mid-Atlantic & East Equator” and “Angola”. These indices are a prediction of the overall index for the different areas, they were not computed as separate analyses due to time constraints. The divergence between the nominal and standardized values are partly explained by that fact. There were no significant differences between the main index and three regional ones, but the Group noted the marked upward trend in the last period of the southeastern (“Angola”) index.

SCRS/2022/028 presented an index which applied a Vector Autoregressive Spatio-Temporal (VAST) model to EU purse seine fleet catches and effort in the East Atlantic tropical region. The authors clarified how Component 1 of the method considers both number of sets on non-owned FADs, as well as the number of any other sets, but that the latter is used as a covariate in the equation.

The Group suggested that these results be compared with the indices produced for the EU PS fleet in the past, i.e. with and without the VAST methodology. The Group also requested that a table summarizing the number of observations (e.g. number of sets by time period) be added to the SCRS document. The Group asked the authors to rerun the model to estimate a seasonal time series, and the analyst indicated this work would be done intersessionally.

West-SKJ

SCRS/2022/037 presented an index of relative abundance from the U.S. pelagic longline observer program. The spatial area covered included the northern Gulf of Mexico and NW Atlantic regions. A standardized continuous time series was presented for the period 1987 to 2020.

The Group discussed the relatively high inter-annual variability and hypothesized that this could be due to population fluctuation in the northern region related to changes in availability due to oceanographic conditions. Future work may help elucidate the effects of the environment on skipjack availability to the fleet.

SCRS/2022/040 presented a fishery independent index of larval skipjack tuna in the Gulf of Mexico utilizing NOAA Fisheries ichthyoplankton survey data collected from 1982 through 2019 from mid to late April through the entire month of May and sometimes all or part of June. Indices were developed using standardized data (i.e. abundance of 2 mm larvae under 100 m2 of sea surface sampled with bongo gear). The number of stations sampled during this period ranged from 51 to 186. The number of specimens collected in bongo tows per year ranged from 1 to 63 and ranged in length from 2.0 to 9.8 mm. The indices of larval abundance were developed using a zero-inflated delta-lognormal models, including the following covariates: time of day, month, area sampled, and year. Index values are low in the mid to late 1980s, and show a fluctuating increase as the time series progressed. Differences between the current index and the previous index are probably due to a change in the pseudo-mortality curve, which back calculates the number of 2 mm-larvae. Future research will include an investigation of the change in the pseudo-mortality curve of the course of the time series. In addition, data from summer surveys will be investigated for index development to better cover the spawning season.

Finally, the Group is concerned that this index only represents the spawning stock biomass for the Gulf of Mexico and not the entire western stock.

SCRS/2022/029 presented a composed dataset based on Brazilian baitboat port samplings, logbooks, and observers data collected onboard that was used in this document to provide a CPUE standardization to the western stock of skipjack. Information from 2,894 fishing trips was analyzed; this information corresponds to 57.7% of all fishing trips conducted by the fleet between 2000 and 2021. Baitboats have been fishing offshore of Brazil since 1981, unfortunately, the information available for the early period (1981 to 1999) does not have the same spatial resolution and details compared to the recent period. For the CPUE standardization, Hierarchical Bayesian models structured through the Integrated Nested Laplace Approximations (INLA) were applied. This approach allows to understand the spatial, temporal, and seasonal trends in the abundance index estimated for some species and/or populations. The response variable for models was the skipjack catches plus one divided by fishing days. As the proportion of zero catches was quite small (less than 1.6% of the trips), the probability distribution for the likelihood was the lognormal distribution. The INLA frameworks allow the configuration of distinct structures functions for random and/or temporal, seasonal and spatial variables. Three different spatial, temporal, and seasonal interactions were tested. The best fit model was the one with spatial structure repeating over the years with a cyclic spatial correlation between seasons (quarters) with an autoregressive function of order 1. All diagnostics showed a satisfactory behavior. The estimated lognormal index showed two distinct periods. The first one between 2000 and 2012, in general, marked by a stable trend over the years, with a spike in the last year of this period. And the second period, between 2012 and 2021, was marked by a steep one-way downward trend with a small stabilization trend in the last four years of the period. The authors presented some hypotheses that could be influencing the downtrend observed in the last period, as is: (a) there is a real reduction in the biomass of the recent years as an answer of the stock to the historical removals; (b) there is some influence over the availability of the species to the fishing effort in the area commonly used by this fleet and this is reflecting in an underestimation of the relative abundance index, and; (c) there is some unreported information that could imply an underestimation of the relative abundance index for the recent years.

SCRS/2022/039 detailed information from Venezuelan purse seiner logbooks which was used to estimate a standardized catch rate for skipjack tuna in the Caribbean Sea and adjacent western Atlantic for the period 1987-2020, using a Generalized Linear Model with a delta lognormal approach. For this, logbooks registers were used (1987-2020) considering as categorical variables year, season/quarter, area, association with whales, association with whale shark, seiner capacity and help (help by baitboat, without help) during the fishing set. As indicators of overall model fitting, diagnostic plots were evaluated. Standardized skipjack tuna catch rates during the early period (1987-2002), was relatively stable, thereafter catch rates decreased until 2007. Later, CPUE increased again until 2015, decreasing after this point and stabilizing its values for the last three years of the time series.

The Group asked the authors to rerun the standardization without a species proportion term, as this may be confounded with abundance. This and other recommendations were done during the meeting and the new results were presented (the presentation and SCRS document were updated to include the new results). By applying the SCRS group recommendations, the model improved the estimation of the CPUE standardized index.

In the analysis presented in SCRS/2022/036, port sampling and logbook records from the Brazilian handline tuna fishery in associated schools in the western tropical Atlantic, from 2010 to 2020, were used to generate a standardized CPUE series, by a Bayesian generalized linear model, using Integrated Nested Laplace Approximation (INLA) approach. The data set included 876 fishing trips, comprising 15,314 days at sea, and records of catch in kilograms by species. Two main parametric covariates (i.e. factors) were considered. The factor "year" included data from 2010 to 2020 and "month", with two 12 levels, while "fishing boat" was included as a random effect. The standardized catch rate series shows a stable trend until 2016 followed by an increase in 2017 and remaining relatively stable up to 2020. The apparent rise in catch rates in recent years, i.e. after 2017, might be related to unaccounted factors (i.e. explanatory variables) that potentially could increase the catchability, such as the increase of landings due to the demand for this species in the Brazilian canning company. Also, it was observed the entrance of larger fishing boats with more fishing capacity in this fleet in 2017. These changes directly might influence catchability and consequently the estimation of the relative abundance of skipjack tuna caught by this fleet.

6.2 Combined indices

No combined indices were presented.

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

The Group made the following decisions regarding the structure and formulation of assessment models to be considered in the development of management advice for skipjack tuna. A number of decisions remain to be made and will need to be resolved and reported intersessionally (within two weeks of the meeting closing).

For the surplus production models (e.g. JABBA, MPV, ASPIC):

Stock definitions:
The stock definitions used for the previous assessment (2014) will be retained.

Time-step:
Surplus production models will use an annual time-step, and annual indices of abundance.

Intrinsic rate of growth (*r*):
The prior distribution on (*r*) will be estimated for the East and West skipjack stocks using the Euler-Lotka formulation and methods described in McAllister *et al*. (2001). Monte Carlo resampling (with replacement) will be used to incorporate uncertainty in life history parameters and corresponding estimation of the distribution of *r*. The life history information in **Table 1** and from FishLife will be considered in this evaluation.

For surplus production models that do not include a prior on *r* (e.g. MPV, ASPIC), the minimum and maximum values of *r* will be informed using the analysis conducted for JABBA, and described above.

Carrying Capacity (K):
JABBA framework provides two options to input priors for K (carrying capacity); One based on the proposition made by Meyer and Millar (1999), later corroborated by Brodziak and Ishimura (2012), and the second based on the mean and coefficient of variation of a lognormal distribution or as ranges of minimum and maximum of plausible values for a uniform distribution as described by Froese *et al*. (2016). Both options are regular choices in assessments (a complete review can be observed in Winker *et al.* (2018)).

In this sense and assuming the decisions made in the last two skipjack stock assessments (Anon., 2009; Anon., 2015), two approaches could be used here to define vague and uninformative priors to K; (1) based on a uniform distribution with maximum bounds equal to 10 times the maximum observed catch and minimum bounds equal to the maximum observed catch in the time series, and; (2) based on a lognormal prior with a large CV of 100% and a central value that corresponds to eight times the maximum total catch, which is consistent with parameterization procedures followed when using other platforms such as Catch-

MSY (Martell and Froese, 2013) or SPiCt (Pederson and Berg, 2017) or even as used in South Atlantic albacore stock assesment using JABBA's model (Winker *et al*., 2020).

Index usage:
For eastern Atlantic surplus production models, the Group recommended using only the EU Buoy Acoustic Index (Echosounder) and the EU PS VAST indices in base model configurations. The influence of adding the EU Catch Rate Index should be considered in sensitivity runs only. The Group also recommended that continuity models be developed that consider the inclusion of all historical baitboat indices (**Table 11**).

For western Atlantic surplus production models: the Group recommended using the USLL, the BRA BB historic index from 1981-1999, the BRA BB index (2000+) the BRA HL up to 2016, and the VEN PS. The influence of adding the US GOM Larval Survey index should be considered in sensitivity runs only (**Table 12**).

The influence of the indices of abundance should be also evaluated using a jack-knife analysis, which evaluates trends in biomass and fishing mortality produced by the removal of each index, individually. A detailed rationale and summary of the recommendations for index usage can be found in Section 6.

The Group recognizes that deviations from these recommendations may be necessary to ensure model performance; such changes should be properly justified and presented at the assessment meeting.

Model Diagnostics:
For any model to be considered (by the stock assessment team) for inclusion in the development of management advice, typical diagnostics must be made available to allow evaluation of model quality and stability. These must include but are not limited to, a table of parameter estimates and their uncertainty, jitter of starting parameters (when applicable), fits to model key inputs, hindcast and retrospective analyses, and likelihood profiles on key model parameters (Carvalho *et al*., 2021).

Projections:
Catches in 2021 and 2022 will be estimated using two approaches: 1) a 3-year average of recent landings and 2) the 2020 catches.

For age structured models (e.g. SS3):

Stock Definitions:
The stock definitions used for the previous assessment (2014) will be retained.

Time step:
Age structured stock assessment models should use quarterly time steps and quarterly indices of abundance if possible. Annual time steps are also acceptable.

Index usage: Same as described above for surplus production models.
Projections: As above for surplus production models.

Model diagnostics: As above for surplus production models.

Numerous decisions related to the development of age-structures models are pending due to time constraints. These include:

- Fleet setup
    - Fleet structure
    - Length compositions
    - Functional shape of selectivity functions (e.g. dome-shaped, logistic, spline) and time varying aspects (e.g. time-blocks)
- Life history – Growth and mortality
    - Growth parameters (e.g. L_{INF}, *k*, t0, CVs)

  - Maximum age
  - Natural mortality (e.g. Lorenzen)
  - Length-weight relationship

- Life history – Reproduction

  - Maturity
  - Fecundity
  - Spawner-Recruit relationship (e.g. functional form, steepness (h), recruitment variability (sigma-R))

The stock assessment teams dedicated to each of the three topics will meet during the next two weeks to develop proposals, which will be reviewed by the Group during an upcoming webinar (details pending, open to all interested person that were part of the current meeting). Anyone interested in participating in these deliberations should contact the Chair of this meeting. Each stock assessment team should clearly lay out the specifications of the base model runs (as they relate to the topics assigned) and any alternative scenarios to be added to the possible uncertainty grid for the development of management advice or explored as sensitivity runs.

8. Research recommendations

The Group notes the lack of 1°x1°by month for surface fisheries Task 2 CE data from several CPCs, or inconsistencies between Task 1 and Task 2. To obtain a better definition of stocks boundaries, the Group reiterates that CPCs should fully comply with the ICCAT data submission requirements.

The Group recommends that activities of the AOTTP continue to be funded by the Commission (e.g. tag-seeding experiments for estimating reporting rate of tunas recovered after the end of the tagging operations at sea, payment of tag rewards, continuation of ageing of available samples in the laboratories).

With regards to the "faux-poisson" estimations obtained from the method proposed by the Group (details in section 3.1), it is recommended that each CPC with PS FAD fishing activities use a similar approach (taking into account their own specificities on how "faux-poisson" is defined) to estimate the "faux-poisson" component of Task 1 catches for the 5 main species (BET, SKJ, YFT, LTA, and FRI). An alternative method to obtain those catches may also be accepted if properly justified (e.g. better approach, inappropriate method, others).

Due to the uncertainty in age validation (preliminary results show otolith daily increments may underestimate age, while spine annual rings may overestimate age, and annual increments in otoliths appear promising but remain difficult to interpret), the Group encourages the continued analysis of AOTTP hard parts (spines, otoliths, vertebrae) for ageing, including OTC marked samples. This should include an evaluation of the potential latitudinal (and/or seasonal) variation in growth observed in tagging data, and an exploration of integrated growth modeling approaches to combine information from tagging, hard parts, and, potentially, length frequency data.

To evaluate mixing and connectivity between different areas of the Atlantic and their consequences in terms of stock structure, it is recommended to provide genetic samples from the Gulf of Mexico and other areas in the Atlantic to the genetic study currently being conducted by Brazilian scientists.

In addition to the previous recommendation, due to the overlap of the western edge of the fishing ground of purse seiners operating traditionally in the eastern Atlantic and the fishing grounds of the Brazilian handline fishery, the Group recommends analyses of tagging data, size structure, and genetics to evaluate the current spatial boundary between the eastern and western SKJ stocks.

Bearing in mind the multispecies characteristics of the tropical tuna fisheries, the Group recommends developing reference fishing mortality points for juvenile yellowfin and bigeye tunas.

The Group recommends a review of all the data on length-weight relationships with a view to estimate regional and or seasonal relationships to be used in the estimation of catch at size and potentially for the establishment of stock specific relationships. The Group recommends that SKJ length-weight relationships should be sampled and analysed more regularly ideally from scientific observer programs, to provide more data to support length-weight parameters required for stock assessment.

The Group recommends that baitboat indices of relative abundance are developed that represent recent catches in the E-SKJ stock. The existing historical indices for the Azores, Canary Islands and Dakar stop at the time where several fishing strategies changed in these fisheries (e.g. change in target species, "pesca a la mancha", FAD use), but it would be beneficial to include an index in the stock assessment that represents this significant proportion of the E-SKJ catches. Analysts should attempt to incorporate changes in fishing strategy in the standardization models.

9. Responses to the Commission

The Group reviewed the requests from the Commission that were not addressed or not fully addressed by the SCRS in 2021 (*Report for Biennial Period 2020-2021, Part I (2020), Vol. 2*). The intention was to review the requests and the responses provided so far and discuss how the remaining questions are going to be addressed from now to the SCRS meeting in September:

- *21.1 Discards in purse seine fisheries, Rec. 17-01, paragraph 4.* The Group noted that this can be addressed using information from observers. However, it was noted that this information was already available at the ICCAT Secretariat and could be used by the SCRS to inform the Commission. The Secretariat will provide a summary of the available information at the next meeting.

- *21.4 Fishing prohibited with FADs, Rec. 21-01, para 28.* The Group was informed that the analysis proposed by the SCRS in 2021 is in progress and results will be presented to the Group by September 2022. It was suggested to incorporate 2021 in the analysis if data are available in time. The idea is to have a projection matrix to evaluate the impact of the moratoria on FADs.

  The Group also noted that in order to evaluate the efficacy of historical closures, appropriate indicators of fishing mortality for one-year old for the major surface fleets would be evaluated based on recent stock assessment results from BET and YFT.

- *SCRS to inform on CPCs that have provided by 31 July 2022 the required historical FAD set data. Rec. 21-01, para 31.* It was noted that reporting this information is mandatory.

- *21.8 The SCRS shall refine the MSE process in line with the SCRS roadmap and continue testing the candidate management procedures. Rec. 21-01, para 62.* It was noted that the roadmap will be discussed in the Meeting of the Tropical Tunas MSE Technical SubGroup (19-20 May, 2022).

- *21.9 Efficacy that full fishery closures along the lines of those proposed in PA1_505A/2019, Rec. 21-01, para 66a.* The Group noted that a tool to evaluate the impact of the closure was presented in the past (Herrera *et al.*, 2020) but that the SCRS could not address this question. However, this question is linked to Rec. 21-01 paragraph 28 and will be at least partially addressed in the response to the request.

- *21.11 The SCRS and the Secretariat shall prepare TORs to carry out an evaluation of the monitoring, control and surveillance mechanisms in place in ICCAT CPCs. Rec. 21-01, para 66c.* No action was agreed by the Group.

- *One Commission request missing (paragraph 66 b) in Rec. 21-01.* In 2021 the SCRS provided a table with the annual evolution of only large-scale PS vessels operating in ICCAT. The information was incomplete and should be updated including also the capacity and number of other fleet components (e.g. support vessels, BB, LL). The Group emphasized the importance of providing this information by September 2022 and requested national scientists to collaborate with this task.

10. Other matters

The Secretariat reminded the Group that in 2021 the SCRS requested an independent expert to review the 2022 skipjack stock assessment process. For a number of reasons, it was not possible to contract the independent expert before the data preparatory meeting. However, the Group agreed that it still would be important to have such review. Accordingly, it was agreed that the Secretariat would work with the Tropical Tunas Coordinator and Species Group Rapporteurs on the Terms of Reference and seek for an independent external reviewer to attend the stock assessment session and the September 2022 Species Groupmeeting.

11. Adoption of the report and closure

The Report of the 2022 Skipjack Tuna Data Preparatory Meeting was adopted. Dr David Die and the SCRS Chair thanked the participants and the Secretariat for their hard work and collaboration to finalize the report on time. The meeting was adjourned.

References

Anonymous. 2009. Report of the 2008 Yellowfin and Skipjack stock assessments *(Florianópolis, Brazil, July 21 to 29, 2008).* Collect. Vol. Sci. Pap. ICCAT, 64(3): 669-927.

Anonymous. 2015. Report of the 2014 ICCAT East and West Atlantic Skipjack Stock Assessment Meeting *(Dakar, Senegal, 23 June - 1 July 2014).* Collect. Vol. Sci. Pap. ICCAT, 71(1): 1-172.

Batts B. S., (1972) Sexual maturity, fecundity and sex ratios of: the skipjack tuna, Katsuwonus pelamis, in North Carolina waters. Chesapeake Sci. 13, 193-200.

Brooks E., and Deroba J.J. 2015. When "data" are not data: The pitfalls of post hoc analyses that use stock assessment model output. Canadian Journal of Fisheries and Aquatic Sciences 72:1-8.

Carneiro V., Fialho E. and Andrade H.A. 2015. Updated standardized catch rates for skipjack tuna (*Katsuwonus pelamis*) caught in the southwest of South Atlantic Ocean. Collect. Vol. Sci. Pap. ICCAT, 71(1): 306-316.

Carvalho F., Winker H., Courtney D., Kapur M., Kell L., Cardinale M., Schirripa M., Kitakado M., 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, Vol (240).

Cayré,P. and Laloë F. 1986. Relation Poids - Longueur de Listao (*Katsuwonus pelamis*) de l'Océan Atlantique. Proc. ICCAT Intl. Skipjack Yr. Prog. 1: 335-340.

Eveson. 2011. Preliminary application of the Brownie-Petersen method to skipjack tag-recapture data. Prepared for the 13th Session of the IOTC Working Party on Tropical Tuna, 16-23 October 2011, Maldives. IOTC–2011–WPTT13–30.

Fabens A.J. 1965. Properties and fitting of the von Bertalanffy growth curve. Growth, 29, pp.265-289.

Fu D. 2020. Preliminary Indian Ocean skipjack tuna stock assessment 1950-2019 (Stock Synthesis). IOTC–2020–WPTT22–10.

Gaertner D. 2015. Indirect estimates of natural mortality rates for Atlantic skipjack (*Katsuwonus pelamis*) using life history parameters. Collect. Vol. Sci. Pap. ICCAT, 71(1): 189-204.

Hallier J.P., Gaertner D. 2006. Estimated growth rate of the skipjack tuna (*Katsuwonus pelamis*) from tagging surveys conducted in the Senegalese area (1996-1999) within a meta-analysis framework Collect. Vol. Sci. Pap. ICCAT 59(2): 411-420.

Hamel A. 2015. A method for calculating a meta-analytical prior for the natural mortality rate using multiple life history correlates, ICES Journal of Marine Science, 72(1): 62–69.

Hampton J. 2000. Natural mortality rates in tropical tunas: size really does matter. Canadian Journal of Fisheries and Aquatic Sciences, 57(5), pp.1002-1010.

Herrera M., Sharma R., Calay S., Coelho R., Die D., Melvin G., Ortiz M., Restrepo V. and Neves dos Santos M. 2020. Progress report of the group evaluating the Decision Support Tool presented in Sharma & Herrera (2019) and proposal for further review and discussion by the SCRS. Collect. Vol. Sci. Pap. ICCAT, 77(8): 18-25.

Leroy B. 2013. Preliminary results on skipjack (Katsuwonus pelamis) growth. SCTB13 Working Paper, 13p.

Luque *et al*. 2021. A comparison of direct age estimates from otolith and fin spine sections of skipjack tuna (*Katsuwonus pelamis*) in the Indian Ocean. IOTC-2021-SC24-INF04.

Martell S., Froese R., 2013. A simple method for estimating MSY from catch and resilience 504–514. https://doi.org/10.1111/j.1467-2979.2012.00485.x

Pedersen M.W., Berg C.W. 2017. A stochastic surplus production model in continuous time. Fish and Fisheries 18(2): 226-243. https://doi.org/10.1111/faf.12174

Precioso D., Navarro-Garcia M., Gavira-O'Neill K., Torres-Barran A., Gordo D., Gallego V., and Gomez-Ullate D. 2021. TUN-AI: Tuna biomass estimation with Machine Learning models trained on oceanography and echosounder FAD data. Fisheries Research. https://arxiv.org/abs/2109.06732v3

Saber S., Macías D., Gómez-Vives M.J., García-Barcelona S., Ortiz de Urbina J. 2020. Standardized catch rates of skipjack from the Mediterrarrean Spanish recreational fishery (2006-2018). Collect. Vol. Sci. Pap. ICCAT, 76(6): 867-873.

Saber S., Macías D., Gómez-Vives M.J., García-Barcelona S., de Urbina J.O. 2019. Collect. Vol. Sci. Pap. ICCAT, 76(6): 867-873.

Tanabe T., Kayama S., Ogura M. 2003. An outline of the growth study on skipjack tuna (*Katsuwonus pelamis*) in the Western Pacific. Doc. IOTC WPTT-03-17, 14 p.

Then A.Y., Hoenig J.M., Hall N.G., Hewitt D.A. and Handling editor: Ernesto Jardim. 2015. Evaluating the predictive performance of empirical estimators of natural mortality rate using information on over 200 fish species. ICES Journal of Marine Science, 72(1), pp.82-92.

Vincent M.T., Pilling G.M., Hampton J. 2019. Stock assessment of skipjack tuna in the western and central Pacific Ocean. WCPFC-SC15-2019/SA-WP-05-Rev2.

Winker H., Mourato B., Parker D., Sant'Ana R., Kimoto A., Ortiz, M. 2020. Preliminary stock assessment of South Atlantic albacore tuna (*Thunnus alalunga*) using the Bayesian state-space surplus production model JABBA. Collect. Vol. Sci. Pap. ICCAT, 77(7): 352-376.

Uchiyama J.H. and Struhsaker P. 1981. Age and growth of skipjack and yellowfin tuna as indicated by daily increments of the sagittae. Fish. Bull. 79:151-62.

Table 1. Available growth parameter estimates for skipjack tuna.

Area	Linf	K	t0	Method	Reference	Source
E. Atlantic G. of Guinea	80	0.322		Tagging	Bard and Antoine 1986	Gaertner 2015 Table 3
E. Atlantic N. trop	80	0.601		Tagging	Bard and Antoine 1986	Gaertner 2015 Table 3
E. Atlantic G. of Guinea	86.7	0.307	-0.317	Spines	Chur and Zharov 1983	Gaertner 2015 Table 3
E. Atlantic Senegal	62	2.08		Tagging	Cayré *et al*. 1986	Gaertner 2015 Table 3
E. Atlantic Cap Vert	60	1.537		Tagging	Cayré *et al*. 1986	Gaertner 2015 Table 3
E. Atlantic Senegal	97.26	0.25	0.368	Tagging	Hallier and Gaertner 2006	Gaertner 2015 Table 3
W. Atlantic Caribbean	94.9	0.34		Tagging	Pagavino and Gaertner 1995	Gaertner 2015 Table 3
W. Atlantic Brazil	87.12	0.22	-2.09	Spines	Vilela and Costello 1991	Gaertner 2015 Table 3
Indian Ocean	60.6	0.93		Length-freq	Marcille and Stequert 1976	Gaertner 2015 Table 3
Indian Ocean Maldives	64.3	0.55		Tagging	Adams 1999	Gaertner 2015 Table 3
Indian Ocean Maldives	82	0.45		Length-freq	Hafiz 1987	Gaertner 2015 Table 3
Indian Ocean Sri Lanka	85	0.62		Length-freq	Amarasiri and 1987	Gaertner 2015 Table 3
Indian Ocean Sri Lanka	77	0.52		Length-freq	Sivasubramanium 1985; in Adam 1999	Gaertner 2015 Table 3
Indian Ocean Minicoy	90	0.49		Length-freq	Mohan and Kunhikoya 1985; in Adam 1999	Gaertner 2015 Table 3
Indian Ocean	82.91	0.24		Tagging	De Bruyn and Murua 2008	Gaertner 2015 Table 3
Indian Ocean	76.88	0.28		Tagging	Gaertner *et al*. 2011	Gaertner 2015 Table 3
E. Pacific	85	0.7		Tagging	Rothschild 1966	Gaertner 2015 Table 3
E. Pacific	79	0.64		Tagging	Josse *et al*. 1979	Gaertner 2015 Table 3
E. Pacific N	96.3	0.52		Tagging	Bayliff 1988	Gaertner 2015 Table 3
E. Pacific S	66.5	1.81		Tagging	Bayliff 1988	Gaertner 2015 Table 3
E. Pacific	73	0.82		Tagging	Joseph and Calkins 1969	Gaertner 2015 Table 3
E. Pacific	107	0.42		Length-freq	Joseph and Calkins 1969	Gaertner 2015 Table 3
E. Pacific	75.5	0.772		Tagging	Sibert *et al*. 1983	Gaertner 2015 Table 3
W. Pacific	61.3	1.25		Tagging	Sibert *et al*. 1983	Gaertner 2015 Table 3
W. Pacific	65.5	0.945		Tagging	Josse *et al*. 1979	Gaertner 2015 Table 3
W. Pacific Vanuatu	60	0.75		Length-freq	Brouard *et al*. 1984	Gaertner 2015 Table 3
W. Pacific Trop. and Jap.	93.6	0.43	-0.49	Otolith (daily)	Tanabe *et al*. 2003	Gaertner 2015 Table 3

Table 1. Continued.

Area	Linf	K	t0	Method	Reference	Source
W. Pacific Japan	76.6	0.6	-0.31	Length-freq	Yao 1981; in Wild and Hampton 1994	Gaertner 2015 Table 3
W. Pacific Taiwan	103.6	0.302	-0.016	Vertebrae	Chi and Yang 1973; in Wild and Hampton 1994	Gaertner 2015 Table 3
Central Pacific	102.2	0.55	-0.02	Otolith (daily)	Uchiyama and Struhsaker 1981	Gaertner 2015 Table 3
Central Pacific	80	0.95		Length-freq	Brock 1954; in Adams 1999	Gaertner 2015 Table 3
Central Pacific West	74.8	0.52		Length-freq	Wankowski 1981	Gaertner 2015 Table 3
Central Pacific West	62.17	2.373	-0.04	Otolith (daily)	Leroy 2013	Gaertner 2015 Table 3
Hawaii	82.3	0.77		Tagging	Rothschild 1984	Gaertner 2015 Table 3
South China Sea	77.67	0.299		Length-freq	Chu Tien Vinh 2000	Gaertner 2015 Table 3
Philippines	74	0.77		Length-freq	Tandog-Edralin *et al*. 1990	Gaertner 2015 Table 3
West Atl. South Brazil	66.85	0.241	-3.8	Spines	Garbin & Castello 2014	
West Atl. South Brazil	85.42	0.151	-3.9	Spines	Garbin & Castello 2014	
West Atl. South Brazil	72.51	0.333	-1.2	Spines	Garbin & Castello 2014	
West Atl. South Brazil	92.46	0.161	-2.9	Spines	Garbin & Castello 2014	
West Atl. South Brazil	90.1	0.24	-0.54	Length-freq	Soares *et al*. 2019	
West Atl. South Brazil	94.3	0.14	-1.95	Spines (backcalculated)	SCRS/2022/024	
West Atl. South Brazil	76.67	0.14	-3	Spines (backcalculated)	SCRS/2022/024	
West Atl. South Brazil	94.8	0.15	-2.1	Spines	SCRS/2022/024	
West Atl. South Brazil	72.83	0.17	-3.07	Spines	SCRS/2022/024	

Table 2. Skipjack length-weight relationship parameters listed by year with location, reference, and the SCRS paper they were extracted from. Minimum and maximum lengths and sample size are noted where possible. The current l-w relationship used by the SCRS and those relationships provided in the current meeting are highlighted.

id	reference	year	alpha	beta	location	min	max	n	source
1	Rodriguez *et al.*	2022	4.00E-06	3.4217	SW Atlantic	37	83	1031	SCRS/2022/025
2	Rodriguez *et al.*	2022	1.28E-05	3.1363	SW Atlantic	37	70	465	SCRS/2022/025
3	Rodriguez *et al.*	2022	2.80E-06	3.5075	SW Atlantic	38	83	566	SCRS/2022/025
4	Bell *et al.*	2022	5.04E-06	3.358	St. Helena	36	68	1108	SCRS/2022/021
5	Saber *et al.*	2020	1.37E-05	3.122	Mediterranean	53	77		Saber *et al*. 2020
6	Smallwood *et al.*	2017	1.13E-05	3.0538	Pacific			38	SCRS/2022/021
7	Smallwood *et al.*	2017	1.49E-05	2.9981	Pacific			59	SCRS/2022/021
8	Gumanao *et al.*	2016	7.70E-06	3.304	Pacific	19	66.5	24	SCRS/2022/021
9	Menezes *et al.*	2010	3.82E-06	3.377	SW Atlantic	40.1	85.6		Gaertner 2015
10	Thapanand-Chaidee	2010	7.81E-06	3.226	Indian				Gaertner 2015
11	Andrade *et al.*	2002	6.54E-06	3.293	SW Atlantic	35	85		Gaertner 2015
12	Chu *et al.*	2000	5.80E-06	3.3471	Pacific				Gaertner 2015
13	Claro and García-Arteaga	1994	4.81E-06	3.35	West Atlantic	23	76	664	SCRS/2022/021
14	Claro and García-Arteaga	1994	5.72E-06	3.34	Caribbean				SCRS/2022/021
15	Claro and García-Arteaga	1994	6.79E-06	3.28	West Atlantic				SCRS/2022/021
16	Claro and García-Arteaga	1994	8.78E-06	3.22	Caribbean	42	60	1612	SCRS/2022/021
17	Claro and García-Arteaga	1994	1.12E-05	3.15	Caribbean	30	57	367	SCRS/2022/021
18	Wild and Hampton	1994	1.13E-05	3.16	Indian	41	62	848	SCRS/2022/021
19	Wild and Hampton	1994	3.42E-06	3.456	East Atlantic	40	73	520	SCRS/2022/021
20	Wild and Hampton	1994	4.03E-06	3.413	Pacific	39	71	924	SCRS/2022/021
21	Wild and Hampton	1994	4.81E-06	3.368	Pacific	33	88	1298	SCRS/2022/021
22	Wild and Hampton	1994	5.77E-06	3.353	West Atlantic	26	76	644	SCRS/2022/021
23	Wild and Hampton	1994	8.52E-06	3.216	Indian	39	83	268	SCRS/2022/021
24	Wild and Hampton	1994	9.61E-06	3.19	Pacific	35	54	100	SCRS/2022/021
25	Wild and Hampton	1994	1.13E-05	3.16	Pacific	30	60	20	SCRS/2022/021
26	Vilela and Castelo	1993	6.87E-06	3.287	SW Atlantic				Gaertner 2015
27	Valle *et al.*	1986	4.68E-06	3.39	Caribbean				Gaertner 2015
28	Valle *et al.*	1986	1.07E-05	3.175	Caribbean				Gaertner 2015
29	Cayré and Laloë	1986	7.48E-06	3.253	All Atlantic				Gaertner 2015
30	Vooren	1984	6.21E-06	3.19	Pacific				Gaertner 2015
31	Habib	1984	3.48E-06	3.29	Pacific				Gaertner 2015
32	Amorim	1981	6.79E-06	3.28	SW Atlantic				Gaertner 2015
33	Marcille and Stequert	1976	1.13E-05	3.158	Indian				Gaertner 2015
34	Lenarz	1974	5.61E-06	3.315	East Atlantic	36	64	2554	Gaertner 2015
35	Pianet	1974	4.12E-06	3.409	East Atlantic				Gaertner 2015
36	Batts	1972	2.16E-06	3.353	West Atlantic				Gaertner 2015
37	Nakamura and Uchiyama	1966	4.81E-06	3.368	Pacific				Gaertner 2015
38	Hennemuth	1959	5.53E-06	3.336	Pacific				Gaertner 2015

Table 3. Estimated catches t of “faux-poisson” for EU-FRA and EU-ESP PS FAD tropical fleets between 2015 and 2020 adopted by the Group (SCRS/2022/038).

Gear	Flag	Fleet code	Species	Stock	2015	2016	2017	2018	2019	2020
PS	EU-España	EU.ESP-ES-ETRO	FRI	A+M	1532.9	1753.4	1350.8	1068.9	1191.8	899.6
			BET	BET-A	334.4	397.8	323	215.7	265.1	200.1
			LTA	A+M	1968.1	1885.4	1243.7	781	1101.5	831.4
			SKJ	SKJ-E	3028.1	3658.4	2788.1	1943.2	2395.9	1809
				SKJ-W	7.8	67.3	34.6	7.5	12.9	9.2
			YFT	YFT-E	510.7	547	418.3	275.9	342.4	269.1
				YFT-W	6.8	24.2	21.2	9.5	23.8	7.3
	EU-France	EU.FRA-FR-ETRO	FRI	A+M	854.9	1046.1	467.7	886.4	863.8	731.2
			BET	BET-A	191	233.2	108.3	213	200.8	232.9
			LTA	A+M	870	731.7	296.5	469.9	493.4	273.3
			SKJ	SKJ-E	1715.7	1919.7	892.9	2169	1615.6	1681
			YFT	YFT-E	332.4	349.5	158.4	292.8	290.2	290.6
				YFT-W	0.7	2.2	3.1	3.4	2.7	
TOTAL					**11353.5**	**12615.9**	**8106.9**	**8336.3**	**8800**	**7234.7**

Table 4. Estimated catches (t) of “faux-poisson” for non-EU PS tropical fleets fishing with FADs between 2015 and 2020, using the method adopted by the Group (preliminary estimates to be confirmed by each CPC).

Gear	FlagName	FleetCode	Species	2015	2016	2017	2018	2019	2020
PS	Belize	BLZ-BZ-ETRO	FRI	200.0	450.5	238.6			
			BET	44.2	101.2	56.2			
			LTA	228.2	384.5	186.3			
			SKJ	398.9	880.3	477.6			
			YFT	73.1	149.5	80.0			
	Cape Verde	CPV-CV-ETRO	FRI	745.2	536.8	163.5	237.8	183.4	190.5
			BET	164.6	120.5	38.5	53.4	41.9	54.1
			LTA	850.4	458.1	127.7	145.7	132.2	109.1
			SKJ	1486.3	1048.8	327.3	521.1	354.8	418.8
			YFT	272.4	178.2	54.8	72.9	59.7	69.5
	Curaçao	CUW-CW-ETRO	FRI	826.2	1180.7	567.3	801.7	647.4	588.0
			BET	182.5	265.1	133.6	180.0	147.8	166.8
			LTA	942.8	1007.6	443.0	491.1	466.5	336.8
			SKJ	1647.9	2306.8	1135.5	1756.7	1252.2	1292.7
			YFT	302.0	391.9	190.1	245.7	210.8	214.5
	El Salvador	SLV-SV-ETRO	FRI	344.9	989.4	386.0	621.3	665.1	731.5
			BET	76.2	222.1	90.9	139.5	151.8	207.6
			LTA	393.6	844.4	301.4	380.6	479.3	419.0
			SKJ	687.9	1933.1	772.6	1361.5	1286.4	1608.1
			YFT	126.1	328.4	129.4	190.5	216.6	266.9
	Guatemala	GTM-GT-ETRO	FRI	368.5	339.9	252.5	327.6	299.1	298.1
			BET	81.4	76.3	59.5	73.5	68.3	84.6
			LTA	420.6	290.1	197.2	200.7	215.6	170.7
			SKJ	735.1	664.1	505.5	717.9	578.5	655.2
			YFT	134.7	112.8	84.6	100.4	97.4	108.7
	Panama	PAN-PA-ETRO	FRI	382.2	658.4	262.2	295.4		377.8
			BET	84.4	147.8	61.7	66.3		107.2
			LTA	436.2	561.9	204.7	181.0		216.4
			SKJ	762.4	1286.4	524.8	647.4		830.7
			YFT	139.7	218.5	87.9	90.6		137.9
	Senegal	SEN-SN-ETRO	FRI	155.1	803.1	610.8	933.0	1181.4	1064.6
			BET	34.3	180.3	143.8	209.5	269.6	302.1
			LTA	177.0	685.4	477.0	571.5	851.4	609.8
			SKJ	309.4	1569.1	1222.6	2044.5	2285.0	2340.5
			YFT	56.7	266.6	204.7	286.0	384.7	388.4
TOTAL				14271.0	21638.7	10799.7	13944.7	12526.8	14366.7

Table 5. SKJ total T1NC catches (t, landings and dead discards) by stock and gear group between 1950 and 2020.

	SKJ-E													SKJ-W													
YearC	BB	GN	HL	HS	LL	PS	RR	TN	TP	TR	TW	UN	Total	BB	GN	HL	HP	HS	LL	PS	RR	TL	TP	TR	TW	UN	Total
1950	704												704	0													0
1951	459												459	0													0
1952	581												581	1229													1229
1953	786												786	1281													1281
1954	720												720	1370													1370
1955	1192												1192	1396													1396
1956	1151											1	1152	1503													1503
1957	170				3							3	176	1955													1955
1958	458												458	1650													1650
1959	426												426	1830													1830
1960	1148				23								1171	3263													3263
1961	2572				4							1	2577	3295													3295
1962	9264								1			7	9272	1549						463							2012
1963	15683					384			1			1	16069	968						2995							3963
1964	11864				19	1346			31			489	13749	1071					0	3980							5051
1965	19118				22	3316			55			25	22536	1481					0	64							1545
1966	14862				32	6148							21042	1651					0	40						100	1791
1967	13600				14	7941						14	21569	2655					3	32						100	2790
1968	21532				35	24157			1			6	45731	2407					2	135						100	2644
1969	13087				9	14434			64			25	27619	1655					1	102						100	1858
1970	17768				12	29978						252	48010	2200					6							271	2477
1971	27340				39	49080			56			274	76789	1700					19							271	1990
1972	25327				52	50045			140			143	75706	1400					24	365						271	2060
1973	25092				32	50400			9			509	76042	1921					65	29				276		276	2567
1974	38961				108	74417			53			472	114011	2972					80	28				41		310	3431
1975	16425				116	35706			11			503	52761	2836					98	299						254	3487
1976	28711				23	33201						3777	65712	2883					25	700						166	3774
1977	42400				93	57571	4					7055	107123	2588					8	600						160	3356
1978	42354				25	58863	3		1			836	102082	2464					31	3461						268	6224
1979	45031	2		6	7	37030	2		1			1497	83576	4225					6	1489						464	6184
1980	38157	2		28	7	56767			11			3832	98804	9351	0		1		6	2887			0			147	12392
1981	38890	30	4	30	49	69077			6			2368	110454	17999	0	78			32	4654	180		0			149	23092
1982	44488	5	52	63	16	76400						2856	123881	22402		72			30	9705	22					296	32527
1983	34873	8	62	30	417	67754			1			2031	105175	20057	41	39			209	11121	108					440	32015
1984	28146	6	342	10	22	62336			1			951	91814	16810		48			55	17958	36					689	35596
1985	29856	4	69	20	6	49176	8		10			88	79237	28506	34	36			72	11191	28					405	40272
1986	30036	1	17	11	19	59181	2					1589	90856	25885	7	33			19	5208	136					863	32151
1987	38836		9	5	6	55265	1					1005	95127	18805	0	22		1	19	4964	94			1		257	24164
1988	48041	3	106	3	4	71174	1					1198	120530	21146	1	3	0		19	2315	45		0	27	0	180	23736
1989	41028		37	7	9	52537	1		2	10		1390	95021	23492	4	12		0	39	2466	19		0	16		334	26382
1990	37113	43	26	2	0	80842	1			133		777	118937	22350	2	12		0	27	3241	66		0	58	0	353	26110
1991	41670	50	56	2	5	146924	0			19		1715	190441	24096	21	16		0	42	8527	86		0	57	0	557	33404
1992	35669	282	76	2	3	103963	1			23		1024	141043	21112	10	6			37	8509	49		0	53		378	30155
1993	31735	14	74	2	2	143870	1		2			855	176555	19902	1	7		0	21	12794	81		4	93	0	318	33221
1994	37822	87	203	2	10	123312	1					18	161456	22855	5	10			16	5712	66		1	68	0	1216	29949
1995	33955	103	99	2	3	118718						104	152984	17744		6			36	2059	21			62		1932	21860
1996	35947	122	175	2	7	93313						24	129590	23741	4	6			21	3349	82			49		310	27562
1997	37287	60	56	7	47	79764			1			7	117229	27045	16	5			7	4347	64		0	65		163	31712
1998	46804	621	54	3	85	84507			8			244	132325	24727	18	163			21	3826	86			81	2	163	29087
1999	44914	126	16	2	42	109696			17			127	154940	23881	29	7			58	2936	99		17	60	1	268	27356
2000	33770	2212	19	2	48	90141			4			98	126294	25641	2	226			22	3063	30		0	91	1	116	29193
2001	56698	529	50		53	74496			2			81	131909	25142	5	162			60	5297	49		0	112	0	622	31451
2002	31229	452	32		59	68763			2		6	42	100585	18737	2	13			334	2116	70		1	272	0	55	21600
2003	34606	256	111		83	95119			1			17	130192	21990	1	13			95	2296	61		2	238	1	51	24749
2004	54510	641	283		67	98420	0		4		14	66	154006	24082	17	10			206	2769	74	0	0	272	30	1	27461
2005	48600	1679	607		83	92948	0		1		14	50	143982	26028	2	12			207	1967	15		0	286		1	28517
2006	44788	1743	3341		204	61750			1		14	83	111923	23766	1	15			286	2045	49		0	289	1	1	26453
2007	44426	1881	1406		428	72043	0		4			32	120219	23898	0	20			53	1209	52			207	4	1	25443
2008	31908	2381	1324		199	87226	3		0	0		40	123082	20702	0	45			49	901	49			266	9	1	22022
2009	35120	2886	1975		59	97529		0	30	58	20	153	137829	23518	5	23	0		20	2035	103			69	0	2	25774
2010	38632	2854	1542		46	120275		1	470	29	16	161	164026	22803	11	11			854	1943	86			197	0	0	25907
2011	38456	3928	1119		35	143091		2	22	29	49	341	187073	29468	234	178			353	1859	98			198	23	1	32411
2012	44843	4946	1239		58	166790		0	88	20	7	440	218431	30693	46	252			62	1814	91			109	0	1	33067
2013	30677	5494	1436		79	186052		0	115	49	0	105	224007	32187	33	226			642	975	323			209		1	34596
2014	25708	1142	737		54	177396		1	81	33	97	68	205316	24817	74	376			464	1238	172			210		5	27356
2015	23849	1574	748		21	194685			41	9	3	146	221076	17538	0	472			209	2592	92			162	0	1	21066
2016	29002	890	1579		540	205357		1	19		7	1	237395	16810	1	1176			806	3216	176			174	0	8	22367
2017	25785	1553	1045	1928	498	210985		0	10		131	23	241957	14648	0	5302			292	3403	195			204	0	1	24045
2018	33444	72	3604	1154	113	244532		0	17	0	182	50	283169	14926	0	4468			322	3227	76			172	0	82	23273
2019	24443	3276	1416	663	350	228329		0	7	0	26	15	258526	15410	0	2203			416	1900	44			146	0	2	20121
2020	15627	301	3077	926	360	196862	30	2	2	0	7	4	217199	14593	0	2279			193	1685	67			41	0	0	18859

Table 6. SKJ-E standard SCRS catalogue on statistics (Task 1 and Task 2) by stock, major fishery (flag/gear combinations ranked by order of importance) and year (1991 to 2020). Only the most important fisheries (representing ±97.5% of Task-1 total catch) are shown. For each data series, Task 1 (DSet= "t1", in t) is visualised against its equivalent Task 2 availability (DSet= "t2") scheme. The Task 2 colour scheme, has a concatenation of characters ("a"= T2CE exists; "b"= T2SZ exists; "c"= T2CS exists) that represents the Task 2 data availability in the ICCAT-DB.

Species	Stock	Status	FlagName	GearGrp	DSet	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	%	%cum
				T1 Total		190441	141043	176555	161456	152984	129590	117229	132325	154940	126294	131909	100585	130192	154006	143982	111923	120219	123082	137829	164026	187073	218431	224007	205316	221324	234953	244527	283693	248764	206589			
SKJ	ATE	CP	EU-España	PS	t1	78877	50579	66402	49987	48733	33947	33428	29976	42714	37145	27798	21596	39396	33421	18718	14975	17675	27918	30041	34175	46823	48185	57594	43139	38754	41085	46867	39807	37626	25541	1	22.9%	23%
SKJ	ATE	CP	EU-España	PS	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	a	1		
SKJ	ATE	CP	Ghana	PS	t1						4090	6065	17717	22954	13598	13076	21677	16341	13595	28167	11337	12574	24755	24179	31773	28157	37296	36794	39878	49480	41304	48048	57050	54441	52823	2	13.9%	37%
SKJ	ATE	CP	Ghana	PS	t2						abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	ab	2		
SKJ	ATE	CP	Ghana	BB	t1	24464	18379	19637	21258	18607	20115	20315	25895	31134	22919	44464	18516	18094	34151	26042	20597	22845	13893	19743	13731	16012	16736	11269	10108	12369	13420	9449	11097	8414	6799	3	11.2%	48%
SKJ	ATE	CP	Ghana	BB	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	ab	3		
SKJ	ATE	CP	EU-France	PS	t1	36908	25738	39592	37824	28110	23818	16749	17791	23774	21381	15560	15407	20802	23078	13524	5769	4633	3948	7722	14733	13569	13395	16022	17351	20649	18071	15392	21983	19357	12182	4	11.1%	59%
SKJ	ATE	CP	EU-France	PS	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	4		
SKJ	ATE	CP	Curaçao	PS	t1						7096	8444	8553	9932	10008	13370	5427	10092	8708	88	3213	1703	6541	10060	9594	12380	13324	18312	18437	19621	22180	20660	24539	17360	10841	5	5.7%	65%
SKJ	ATE	CP	Curaçao	PS	t2						ab	ab	ab	a	ab	ab	ab	ab	ab	b	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	abc	abc	5		
SKJ	ATE	CP	Panama	PS	t1	8247	8719	12939	12845	14853	5855	1300	572	1117	1374	281	342		7126	12286	14016	19798	8946	9199	9944	13119	11211	15520	14565	8372	11510	8815	9089	10926	10626	6	5.2%	70%
SKJ	ATE	CP	Panama	PS	t2	ab	a	ab	ab	ab	ab	ab	ab	a	ab	ab	ab		ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	ab	abc	6		
SKJ	ATE	CP	EU-España	BB	t1	5907	7195	3217	5270	5760	5044	7075	8593	5607	3780	3156	3836	7174	7207	10119	7633	6378	8345	8647	8405	11674	19445	10185	9951	7269	10994	10560	13085	10734	6249	7	4.7%	75%
SKJ	ATE	CP	EU-España	BB	t2	ac	ac	ac	ac	ac	ac	abc	ac	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	abc	abc	abc	abc	a	7		
SKJ	ATE	CP	EU-Portugal	BB	t1	7987	7412	5598	7510	4986	8276	4395	4519	1800	1285	2135	2940	4276	8459	4687	11001	8604	5734	904	12859	4078	2758	4039	1703	1296	695	1752	6985	2558	1020	8	2.8%	78%
SKJ	ATE	CP	EU-Portugal	BB	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	8		
SKJ	ATE	CP	Belize	PS	t1								720		229	278								1488	3109	7797	15733	6854	11080	12599	7730	9958	20748	17063	19180	9	2.7%	80%
SKJ	ATE	CP	Belize	PS	t2								a		ab	ab		b						abc	ab	ab	ab	ab	ab	ab	ab	abc	a	a	a	9		
SKJ	ATE	CP	Cape Verde	PS	t1						8	18	21	1		300	366	54	1040	7498	4862	5434	4872	5387	5823	8277	5680	16135	16307	17292	9425	5895	6698	5067	5016	10	2.6%	83%
SKJ	ATE	CP	Cape Verde	PS	t2			a			a	a	a	a		a	a	a	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	abc	ab	a	10		
SKJ	ATE	CP	Senegal	PS	t1								284	152																2705	14092	21852	26712	28735	20931	11	2.3%	85%
SKJ	ATE	CP	Senegal	PS	t2								-1	-1																abc	abc	ac	ac	ac	ac	11		
SKJ	ATE	CP	Guatemala	PS	t1													2120	4808	6649	5028	5612	6481	4095	3087	2880	3732	4979	5904	7078	7386	9800	8648	7626	6503	12	2.0%	87%
SKJ	ATE	CP	Guatemala	PS	t2													ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ac	abc	abc	12		
SKJ	ATE	NCO	Mixed flags (EU tropical)	PS	t1	5176	2959	3858	3568	4543	1316	2345	1508	1119	2194	218	65	1547	2953	1708	1478	3003	2998	2624	3427	2372				10960	12785	11196	11647			13	1.9%	89%
SKJ	ATE	NCO	Mixed flags (EU tropical)	PS	t2	-1	-1	-1	-1	-1	-1	-1	b	b	-1	-1	-1	-1	-1	-1	-1	b	b	b	b	b	b	b	b	-1	-1	-1	-1			13		
SKJ	ATE	CP	El Salvador	PS	t1																									6970	16949	14577	17045	16729	14806	14	1.7%	91%
SKJ	ATE	CP	El Salvador	PS	t2																									abc	abc	abc	ac	abc	abc	14		
SKJ	ATE	CP	Senegal	BB	t1	343		55	64	282	238	429	1699	1632	1357	1284	1178	639	1446	5033	3858	4552	3045	4506	2707	5383	4414	4490	3092	1895	2495	2740	1085	1419	925	15	1.2%	92%
SKJ	ATE	CP	Senegal	BB	t2	a		a	a	a	ac	a	a	ab	a	ab	ab	ab	ab	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	15		
SKJ	ATE	CP	Maroc	PS	t1	1745	598	3637	3596	6740	2728	5468	4116	4033	3072	1568	1148	3289	3476	3660	536	131	108	654	892	1061	1076	1121	583	92	20	150	1076	378	953	16	1.1%	93%
SKJ	ATE	CP	Maroc	PS	t2	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	16		
SKJ	ATE	CP	EU-France	BB	t1	1490	1500	2154	2547	2697	1698	3700	4179	2342	1507	2546	2340	2018	1344	2239	1610	1769	778	1187	904	932	1382	613	752	940	1270	1275	1183	1287	634	17	1.0%	94%
SKJ	ATE	CP	EU-France	BB	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	17		
SKJ	ATE	NCO	Vanuatu	PS	t1	5281	5468	10808	10896	8477	5992	1233		1192																						18	1.0%	95%
SKJ	ATE	NCO	Vanuatu	PS	t2	a	a	a	a	a	a	a		a																						18		

Table 7. SKJ-W standard SCRS catalogue on statistics (Task 1 and Task 2) by stock, major fishery (flag/gear combinations ranked by order of importance) and year (1991 to 2020). Only the most important fisheries (representing ±97.5% of Task-1 total catch) are shown. For each data series, Task 1 (DSet= “t1”, in t) is visualised against its equivalent Task 2 availability (DSet= “t2”) scheme. The Task 2I colour scheme, has a concatenation of characters (“a”= T2CE exists; “b”= T2SZ exists; “c”= T2CS exists) that represents the Task 2 data availability in the ICCAT-DB.

Species	Stock	Status	FlagName	GearGrp	DSet	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	%	%cum
				T1 Total		33404	30155	33221	29949	21860	27562	31712	29087	27356	29193	31451	21600	24749	27461	28517	26453	25443	22022	25774	25907	32411	33067	34596	27356	21066	22367	24045	23273	20121	18859			
SKJ	ATW	CP	Brazil	BB	t1	20548	18533	17762	20582	16530	22517	25821	23570	22948	24691	24038	18185	20416	23036	25269	23029	23783	20632	23077	22627	29322	30569	32127	24787	17499	16418	14577	14886	15355	14590	1	80.0%	80%
SKJ	ATW	CP	Brazil	BB	t2	ab	ab	ab	ab	ab	a	ab	a	a	-1	a	a	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	a	a	a	ab	a	a	a	1		
SKJ	ATW	CP	Venezuela	PS	t1	6186	6893	10049	5692	2059	3348	3604	3607	2696	2590	5189	2000	2296	2769	848	1806	806	688	1808	1931	1308	1573	908	1081	1974	1912	2150	1226	868	603	2	9.9%	90%
SKJ	ATW	CP	Venezuela	PS	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	2		
SKJ	ATW	CP	Brazil	HL	t1						0											5		4	4	159	244	222	369	465	1169	5293	4461	2195	2277	3	2.1%	92%
SKJ	ATW	CP	Brazil	HL	t2						-1											-1		-1	a	-1	-1	-1	a	-1	-1	ab	ab	a	ab	3		
SKJ	ATW	NCO	Cuba	BB	t1	1596	1638	1017	1268	886	1000	1000	651	651	651			624	545	514	536															4	1.6%	94%
SKJ	ATW	NCO	Cuba	BB	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1		b	-1	-1	-1	-1															4		
SKJ	ATW	CP	Venezuela	BB	t1	1952	941	1123	1005	328	224	224	506	282	299	1104	552	950	501	245	201	115	69	441	177	146	124	60	27	39	393	70	41	55	4	5	1.5%	95%
SKJ	ATW	CP	Venezuela	BB	t2	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	5		
SKJ	ATW	CP	Brazil	PS	t1							743	219	240	473	108	116			1119	239	403	213	223		552	9								406	6	0.6%	96%
SKJ	ATW	CP	Brazil	PS	t2							-1	-1	a	-1	-1	-1			a	a	a	a	a	a	-1	-1								a	6		
SKJ	ATW	CP	EU-España	PS	t1	1592	1120	397																						8	709	257	116	205	133	7	0.6%	96%
SKJ	ATW	CP	EU-España	PS	t2	-1	ac	-1	c		ac	ac	a	a	c	abc	abc		bc	a			a	abc	abc	abc	abc	abc	abc	ac	bc	abc	ab	ab	a	7		
SKJ	ATW	CP	Ghana	PS	t1																						232	67	157	265	160	410	1234	700	283	8	0.4%	97%
SKJ	ATW	CP	Ghana	PS	t2						ac	ac	ac	ac	ac	ac	ac	ac	ac	ac	c	c	c	ac	c	bc	bc	ab	a	ab	ab	a	ab	ab	b	8		
SKJ	ATW	CP	Brazil	LL	t1	0	2	9	6	30	9						38		1		2			3	825	323	41	88	39	170	645	199	260	374	160	9	0.4%	97%
SKJ	ATW	CP	Brazil	LL	t2	-1	b	a	-1	-1	-1						-1	a	a		a			-1	a	b	a	-1	-1	-1	-1	a	-1	-1	-1	9		
SKJ	ATW	CP	USA	RR	t1	86	49	81	66	21	82	64	86	99	30	49	70	61	74	15	49	52	49	102	86	98	91	323	172	92	176	195	76	44	67	10	0.3%	97%
SKJ	ATW	CP	USA	RR	t2	ab	ab	ab	ab	ab	b	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	ab	abc	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	10		

Table 8. Summary of SKJ conventional tagging data available in ICCAT including the AOTTP data. The number of SKJ releases by year and associated recoveries by year. Also shown, the number of releases with unknown status (pending), recoveries without release information (?), and recoveries without recovery date (?).

Releases		Recoveries	Recoveries (year)																																	
Year	Total	Total	1964	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2013	2016	2017	2018	2019	2020	2021	?
?	116	116						115																	1											
1959	1																																			
1961	24																																			
1962	26																																			
1963	8																																			
1964	586		1																																	
1965	393																																			
1966	780																																			
1967	41																																			
1968	22																																			
1969	53																																			
1970	111																																			
1971	40																																			
1972	36																																			
1973	53																																			
1974	17																																			
1975	62																																			
1976	28																																			
1977	60																																			
1978	119	2		2																																
1979	113	12			12																															
1980	6454	438				255	165	3	1																											14
1981	7975	1121					813	233	11																											64
1982	2172	1928						1895	8																											25
1983	120	28							28																											
1984	242	94								82	1	1																								10
1985	242	29									29																									
1986	225	44										38	2																							4
1987	15	3											1																							2
1988	43	1												1																						
1989	155	21												21																						
1990	2231	229													225	1																				3
1991	821	68														68																				
1992	1352	158															155	2																		1
1993	8																																			
1994	959	140																	140																	
1995	76	9																		9																
1996	546	71																			63	5														3
1997	3094	676																				587	88													1
1998	418	5																					3	2												
1999	3041	558																						504	50											4
2000	1495	68																							62	4										2
2001	3648	137																								127	3	1								6
2002	4556	891																									874	3								14
2003	3																																			
2004	22																																			
2005	4																																			
2006	21																																			
2007	3																																			
2009	1																																			
2010	45																																			
2011	8																																			
2012	59	1																											1							
2013	1																																			
2015	7																																			
2016	12085	1829																												1584	212	9	2			22
2017	13374	763																													626	90	14	1		32
2018	16313	412																														302	70	14	1	25
2019	4796	616																															591			25
2020	507	3																																3		
Total	89826	10471	1	2	12	255	978	2246	48	82	30	39	3	22	225	69	155	2	140	9	63	592	91	506	113	131	877	4	1	1584	838	401	677	18	1	257

Table 9. Summary of SKJ 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 Skipjack Tuna (*Katsuwonus pelamis*)

			Years at liberty					
Year	Releases	Recaptures	< 1	1 - 2	2 - 3	3-4	Unk	% recapt*
1959	1							
1961	24							
1962	26							
1963	8							
1964	586		1					
1965	393							
1966	780							
1967	41							
1968	22							
1969	53							
1970	111							
1971	40							
1972	36							
1973	53							
1974	17							
1975	62							
1976	28							
1977	60	0						
1978	119	2	2					1.7%
1979	113	12	12					10.6%
1980	6454	438	392	31	1		14	6.8%
1981	7975	1121	998	57	2		64	14.1%
1982	2172	1928	1899	4			25	88.8%
1983	120	28	28					23.3%
1984	242	94	82	1	1		10	38.8%
1985	242	29	29					12.0%
1986	225	44	39	1			4	19.6%
1987	15	3	1				2	20.0%
1988	43	1	1					2.3%
1989	155	21	21					13.5%
1990	2231	229	226				3	10.3%
1991	821	68	68					8.3%
1992	1352	158	156	1			1	11.7%
1993	8	0						
1994	959	140	140					14.6%
1995	76	9	9					11.8%
1996	546	71	67	1			3	13.0%
1997	3094	676	670	5			1	21.8%
1998	418	5	5					1.2%
1999	3041	558	549	5			4	18.3%
2000	1495	68	66				2	4.5%
2001	3648	137	129	2			6	3.8%
2002	4556	891	876	1			14	19.6%
2003	3							
2004	22							
2005	4							
2006	21							
2007	3							
2009	1							
2010	45							
2011	8							
2012	59	1		1				1.7%
2013	1							
2015	7							
2016	12085	1829	1789	14	4		22	15.1%
2017	13374	763	704	25	2		32	5.7%
2018	16313	412	353	25	8	1	25	2.5%
2019	4796	616	591				25	12.8%
2020	507	3	3					0.6%
?	116	116					116	100.0%
Grand Total	89826	10471	9906	174	18	1	373	11.7%

Table 10. Summary of the evaluation CPUE table for the East and West skipjack stock assessment.

Index Name:	**BRA BB**	**BRA HL schools**	**US GOM Larvae**	**US LL Observer**	**VEN PS**	**EU Echosounder**	**Catch ratio YFT/SKJ**	**EU PS VAST**	**W-Med RR**
SCRS Document	**SCRS/2022/029**	**SCRS/2022/036**	**SCRS/2022/040**	**SCRS/2022/039**	**SCRS/2022/039**	**SCRS/2022/026**	**SCRS/2022/031**	**SCRS/2022/028**	**SCRS/2019/169**
SKJ stock unit	**West**	**West/East**	**West**	**West**	**West**	**East**	**East**	**East**	**East**
Data Source (state if based on logbooks, observer data etc)	logbooks, landings interviews and observer data	logbooks	larval survey	Observer Program	logbooks	echosounder buoys	Port sampling/stock assessment results	logbooks (T3 corrected)	Tournaments
Do the authors indicate the percentage of total effort of the fleet the CPUE data represents?	Yes	No	N/A	Yes	No	NA	No	Yes	no
If the answer to 1 is yes, what is the percentage?	51-60%	NA	N/A	0-10%	NA	NA	-	91-100%	
Are sufficient diagnostics provided to assess model performance??	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	no
How does the model perform relative to the diagnostics ?	Well	Well	Fair	Well	Well	Well	Some residual patterns	Well	n/a
Documented data exclusions and classifications?	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	yes
Data exclusions appropriate?	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	yes
Data classifications appropriate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	yes
Geographical Area	Atl SW	Tropical	Gulf of Mexico	Atl NW	Atl NW	Tropical	30W-10E; 10S-10N	Tropical	Mediterranean
Data resolution level	trip	trip	Station	Set	Set	Acoustic record	Well; <100 km	Set	set
Ranking of Catch of fleet in TINC database (use data catalogue)			N/A	11 or more		NA	Not applicable	1-5	lowest
Length of Time Series	longer than 20 years	6-10 years	32 years	longer than 20 years	33 years	11 years	29 years	6-10 years	12
Are other indices available for the same time period?	Few	Few	Few	Few	No	Few	Few	Few	no
Are other indices available for the same geographic range?	None	None	Few	None	No	Few	Few	Few	no
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	Yes	Yes	no
Estimated annual CV of the CPUE series	Low	Low	Fairly low	Low	Low	Yes	Yes	Low	lowest
Annual variation in the estimated CPUE exceeds biological plausibility	Possible	Likely	yes	Possible	Possible	Unlikely	Unlikely	Unlikely	unlikely
Is data adequate for standardization purposes	Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	yes
Is this standardised CPUE time series continuous?	Yes	Yes	yes	Yes	Yes	Yes	Yes	Yes	no
For fisheries independent surveys: what is the survey type?			larval survey			Acoustic	Not applicable		n/a
For 19: Is the survey design clearly described?			yes			Yes	Not applicable		n/a
Other Comments							Diagnostics not provided in current version of MS, but shown in the presentation. MS can be revised as advised.		Probably at the limit of the distribution of the stock in an area where the species is expanding its distribution

Table 11. E-SKJ available abundance indices for the 2022 stock assessment.

Name		EU Echosounder		Catch Ratio YFT/SKJ	
SCRS Doc		SCRS/2022/026		SCRS/2022/031	
Use in 2022 Assessment		Yes		only sensitivity	
Year	Quarter	Scaled index	SE	Scaled index	SE
1990	1				
1990	2			0.314	0.347
1990	3			0.229	0.358
1990	4			0.404	0.344
1991	1			0.552	0.298
1991	2			0.713	0.344
1991	3			0.155	0.327
1991	4			0.193	0.301
1992	1			0.408	0.301
1992	2			0.248	0.314
1992	3			0.040	0.331
1992	4			0.073	0.321
1993	1			0.195	0.300
1993	2			0.148	0.305
1993	3			0.077	0.344
1993	4			0.133	0.303
1994	1			0.134	0.319
1994	2			0.182	0.305
1994	3			0.040	0.321
1994	4			0.055	0.294
1995	1			0.131	0.297
1995	2			0.112	0.297
1995	3			0.090	0.331
1995	4			0.107	0.284
1996	1			0.143	0.296
1996	2			0.090	0.308
1996	3			0.059	0.312
1996	4			0.142	0.293
1997	1			0.266	0.294
1997	2			0.092	0.311
1997	3			0.072	0.343
1997	4			0.115	0.345
1998	1			0.446	0.564
1998	2			0.109	0.540
1998	3			0.413	0.487
1998	4			0.118	0.447
1999	1			1.039	0.486
1999	2			0.388	0.399
1999	3			0.241	0.378
1999	4			0.225	0.583
2000	1			0.436	0.377
2000	2			0.280	0.353
2000	3			0.213	0.411
2000	4			0.322	0.331
2001	1			0.469	0.363
2001	2			0.181	0.385
2001	3			0.493	0.377
2001	4			0.399	0.396
2002	1			0.940	0.368
2002	2			0.421	0.358
2002	3			0.230	0.371
2002	4			0.402	0.350
2003	1			0.507	0.354
2003	2			0.589	0.359
2003	3			0.299	0.371
2003	4			0.468	0.387
2004	1			0.398	0.369
2004	2			0.251	0.342
2004	3			0.452	0.372
2004	4			0.528	0.339
2005	1			0.279	0.368
2005	2			0.423	0.371
2005	3			0.329	0.320
2005	4			0.484	0.328
2006	1			0.3865	0.3218
2006	2			0.3617	0.3381
2006	3			0.7208	0.3466
2006	4			0.4665	0.315
2007	1			0.6143	0.3697
2007	2			0.3334	0.3408
2007	3			0.5454	0.3532
2007	4			0.5654	0.3285
2008	1			0.4799	0.3289
2008	2			0.2163	0.3728
2008	3			0.2173	0.3643
2008	4			0.2233	0.3594
2009	1			0.2189	0.3751
2009	2			0.2831	0.3754
2009	3			0.4846	0.3342
2009	4			0.6264	0.3314
2010	1	1.624	0.249	0.5983	0.3523
2010	2	1.377	0.208	0.4617	0.3462
2010	3	1.033	0.161	0.337	0.3397
2010	4	1.952	0.304	0.5075	0.3392
2011	1	1.357	0.218	0.7778	0.4255
2011	2	1.446	0.223	0.7168	0.3324
2011	3	0.663	0.103	0.9154	0.3224
2011	4	0.825	0.125	0.6885	0.3226
2012	1	0.631	0.098	0.663	0.3504
2012	2	1.082	0.167	0.8068	0.3616
2012	3	0.561	0.087	0.7687	0.3688
2012	4	0.517	0.078	0.3507	0.3908
2013	1	0.669	0.1	0.7045	0.3743
2013	2	0.737	0.103	0.6877	0.3791
2013	3	0.57	0.072	0.7993	0.374
2013	4	0.954	0.115	0.6679	0.3235
2014	1	0.828	0.108	0.3253	0.4103
2014	2	0.745	0.093	0.3799	0.3765
2014	3	0.79	0.091	0.4798	0.3395
2014	4	0.86	0.089	0.3794	0.3425
2015	1	0.758	0.089	0.4911	0.4038
2015	2	0.762	0.091	0.3392	0.3535
2015	3	0.81	0.081	0.4627	0.3215
2015	4	0.944	0.083	0.3772	0.3363
2016	1	0.761	0.084	0.5161	0.4521
2016	2	0.863	0.118	0.2837	0.3675
2016	3	0.846	0.097	0.4267	0.3825
2016	4	0.903	0.09	0.2724	0.3481
2017	1	0.768	0.088	0.1954	0.4519
2017	2	0.996	0.123	0.6455	0.4036
2017	3	1.097	0.135	0.5454	0.3747
2017	4	1.493	0.151	0.4403	0.3574
2018	1	1.434	0.161	0.4936	0.3882
2018	2	1.979	0.244	0.8801	0.4113
2018	3	1.485	0.175	0.4466	0.4381
2018	4	1.585	0.174	0.8618	0.3742
2019	1	1.749	0.232		
2019	2	1.524	0.202		
2019	3	1.418	0.196		
2019	4	1.577	0.2		
2020	1	1.341	0.196		
2020	2	1.838	0.235		
2020	3	1.122	0.148		
2020	4	0.81	0.081		

Table 11. Continued.

Name	EU PS VAST		W-Med RR		Azores BB		Canary BB		Dakar BB	
SCRS Doc	SCRS/2022/028		SCRS/2019/169		Assessment 2014		Assessment 2014		Assessment 2014	
Use in 2022 Assessment	Yes		No		Continuity runs		Continuity runs		Continuity runs	
Year	Scaled index	SE	Scaled index	SE	index	SE	index	SE	index	SE
1960										
1961										
1962										
1963					0.135	0.391				
1964					0.983	1.342				
1965					0.321	0.544				
1966					1.436	1.215				
1967					0.215	0.403				
1968					0.553	1.079				
1969					0.051	0.133			0.743	0.595
1970					0.007	0.021			0.788	1.039
1971					1.171	1.728			0.808	1.043
1972					0.466	0.910			0.792	1.043
1973					0.091	0.205			0.790	1.039
1974					0.035	0.086			0.831	1.039
1975					0.010	0.030			0.755	1.038
1976					0.294	0.645			0.792	1.040
1977					1.612	1.306			0.752	1.038
1978					1.328	1.511			0.930	1.099
1979					0.733	1.048			0.909	1.100
1980					0.715	0.717	0.959	0.729	0.667	1.038
1981					1.079	0.970	1.225	1.161	1.009	1.038
1982					1.549	1.254	1.443	1.369	0.954	1.039
1983					0.386	0.586	0.677	0.692	0.876	1.037
1984					1.480	1.507	0.901	0.898	1.023	1.100
1985					0.222	0.399	1.839	1.796	0.791	1.040
1986					0.721	0.999	0.867	0.869	0.897	1.039
1987					1.181	1.386	0.938	0.953	1.051	1.039
1988					2.682	1.853	1.146	1.150	1.075	1.037
1989					1.844	1.661	1.483	1.416	1.143	1.100
1990					0.068	0.131	1.558	1.515	1.142	1.037
1991					1.818	1.745	1.192	1.163	0.953	0.972
1992					0.864	1.317	1.137	1.136	0.975	1.007
1993					0.760	1.006	0.707	0.739	1.166	0.984
1994					1.377	1.487	1.169	1.138	1.047	0.974
1995					0.279	0.439	1.042	1.000	0.954	0.977
1996					0.808	1.078	1.026	1.051	1.066	0.974
1997					0.424	0.709	1.046	1.096	1.008	0.965
1998					0.586	0.734	2.241	2.229	1.207	0.966
1999					1.047	0.835	0.702	0.721	1.172	0.961
2000					0.838	0.785	0.705	0.746	0.994	0.961
2001					1.019	0.818	0.641	0.678	1.104	0.963
2002					1.303	1.324	0.226	0.242	1.128	0.964
2003					2.069	1.475	0.745	0.792	1.087	0.964
2004					1.490	1.105	0.750	0.794	1.044	0.965
2005					1.266	1.028	0.855	0.907	1.158	0.968
2006			0.160	0.072	2.062	1.737	0.893	0.928	1.088	0.967
2007			0.253	0.060	2.651	1.876	0.565	0.593	1.178	0.969
2008			0.220	0.068	2.779	1.850	0.946	0.969	1.072	0.973
2009					0.232	0.389	0.751	0.798	1.156	0.968
2010	0.838	0.325	0.320	0.227	3.604	2.544	0.771	0.811	1.192	0.966
2011	0.991	0.328	0.224	0.130	1.572	1.350	0.669	0.723	1.344	0.968
2012	1.016	0.336	0.228	0.042	0.243	0.396	1.381	1.361	1.391	0.972
2013	1.006	0.346	0.339	0.073	0.538	0.913	0.801	0.839		
2014	0.987	0.353	0.443	0.043						
2015	1.030	0.365	0.371	0.043						
2016	1.208	0.371	0.248	0.030						
2017	0.693	0.383	0.237	0.033						
2018	0.747	0.392	0.209	0.032						
2019	0.859	0.403								

Table 12. W-SKJ available abundance indices for the 2022 stock assessment.

Name	BRA BB		BRA HL schools		USA GOM		USA LL observer		VEN PS	
SCRS Doc	SCRS/2022/029		SCRS/2022/036		SCRS/2022/040		SCRS/2022/037		SCRS/2022/039	
Use in 2022 Assessment	Yes + use early period of BRA BB 1981 1999 (2014 SA)		Yes for West up to 2016 only, re-estimate w/o 2017-2020		only sensitivity		Yes		Yes	
Year	Scaled index	SE	Scaled index	SE	Scaled index	CV	Scaled index	CV	Scaled index	CV
1981										
1982					1.795	0.164				
1983					0.512	0.279				
1984					0.524	0.230				
1985					0.031	1.449				
1986					0.337	0.356				
1987					0.142	0.368			0.906	0.300
1988					0.176	0.361			0.780	0.280
1989					0.833	0.209			0.887	0.280
1990					0.663	0.148			0.925	0.390
1991					0.664	0.273			1.132	0.270
1992					0.464	0.280			0.992	0.230
1993					0.997	0.150	0.390	0.230	1.059	0.300
1994					0.838	0.193	0.650	0.230	0.944	0.320
1995					0.644	0.132	0.350	0.220	0.720	0.340
1996					0.503	0.255	1.360	0.260	1.003	0.500
1997					0.451	0.193	0.510	0.260	1.409	0.240
1998					0.748	0.194	2.170	0.230	1.454	0.310
1999					0.637	0.192	0.820	0.210	0.866	0.320
2000	1.214	0.124			0.815	0.173	0.870	0.240	1.172	0.220
2001	1.073	0.101			0.976	0.203	1.250	0.230	1.108	0.300
2002	1.020	0.100			0.755	0.172	0.300	0.410	1.325	0.220
2003	0.768	0.101			1.179	0.223	1.120	0.220	0.957	0.270
2004	0.935	0.100			1.618	0.277	1.430	0.180	0.914	0.190
2005	1.029	0.105			0.687	0.197	1.370	0.170	0.855	0.180
2006	1.310	0.107			0.886	0.176	1.980	0.180	0.653	0.250
2007	1.355	0.101			0.947	0.178	1.080	0.170	0.438	0.200
2008	1.300	0.101			0.958	0.127	0.940	0.160	0.610	0.190
2009	1.303	0.104			1.195	0.220	1.110	0.150	0.731	0.230
2010	1.076	0.102	0.095	0.296	1.618	0.246	0.660	0.170	0.903	0.280
2011	1.525	0.098	0.290	0.113	1.803	0.151	2.050	0.160	0.780	0.360
2012	1.854	0.098	0.239	0.115	0.985	0.167	1.460	0.160	0.796	0.220
2013	1.167	0.105	0.403	0.211	2.249	0.138	0.610	0.160	1.059	0.220
2014	0.917	0.110	1.063	0.370	1.648	0.129	0.580	0.160	1.078	0.180
2015	0.819	0.124	0.645	0.027	1.900	0.098	0.830	0.170	1.613	0.340
2016	0.620	0.197	0.456	0.065	1.927	0.114	1.340	0.160	1.390	0.290
2017	0.442	0.108	2.112	0.086	2.369	0.127	0.870	0.180	1.210	0.250
2018	0.488	0.109	1.842	0.023	1.344	0.148	0.620	0.190	1.065	0.290
2019	0.520	0.112	2.148	0.042	1.183	0.120	0.840	0.210	1.210	0.210
2020	0.679	0.103	1.707	0.077			0.430	0.280	1.057	0.820
2021	0.585	0.108								

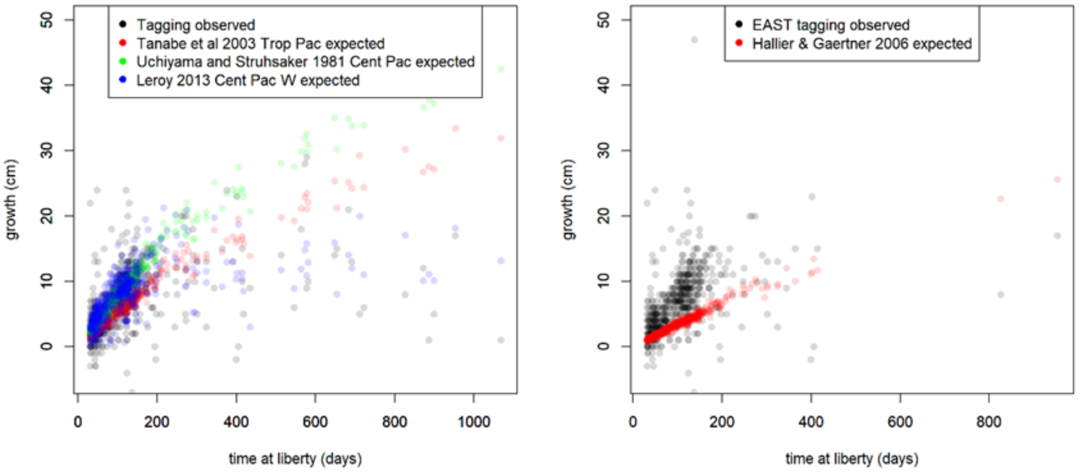


Figure 1. Comparative analysis of observed growth (from AOTTP tagging data) and growth predicted by various von Bertalanffy growth functions for skipjack tuna based on observed length at release and time at liberty pairs. The growth parameter *k* for each growth curve is 0.25 in Hallier and Gaertner (2006) and 0.43, 0.55, 2.4, respectively for Tanabe *et al*. (2003), Uchiyama and Struhsaker (1981) and Leroy (2013).

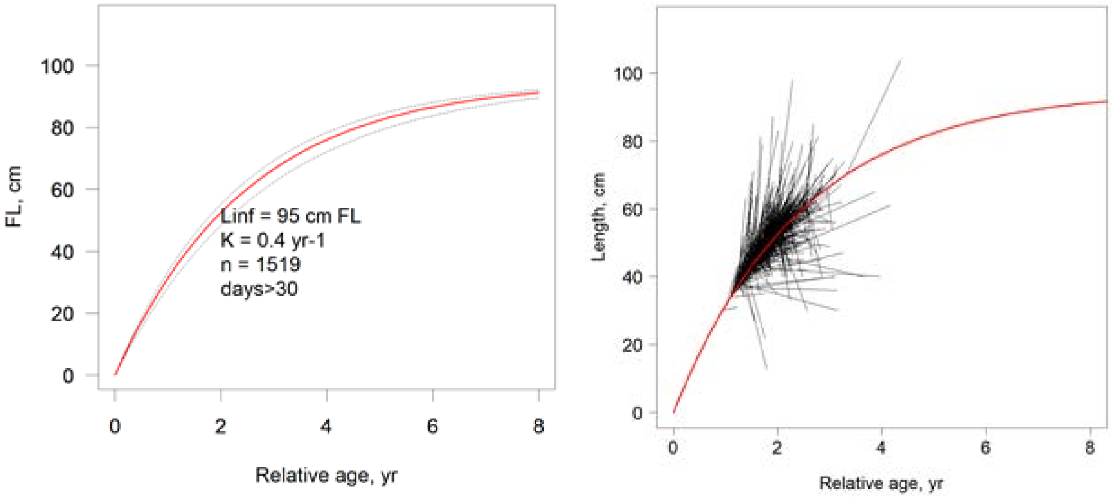


Figure 2. Von Bertalanffy growth curve (red line) and 95% bootstrap confidence intervals (dotted lines, left panel) estimated using skipjack tuna (species recorded as SKJ at release and recovery) released in the East (time at liberty > 30 days) with L_{INF} fixed at 95cm FL. This dataset includes recovery lengths recorded as measured, estimated, and unknown. An alternative run restricting the dataset to measured fish resulted in the same estimate of *k*. Black lines in the right panel show growth trajectories of individual fish. The relative age of each fish at the time of tagging is estimated from the length at tagging by inverting the von Bertalanffy growth equation. The age at recapture is then taken to be the age at tagging plus the time at liberty. Each growth trajectory starts on the fitted von Bertalanffy growth curve (shown in red).

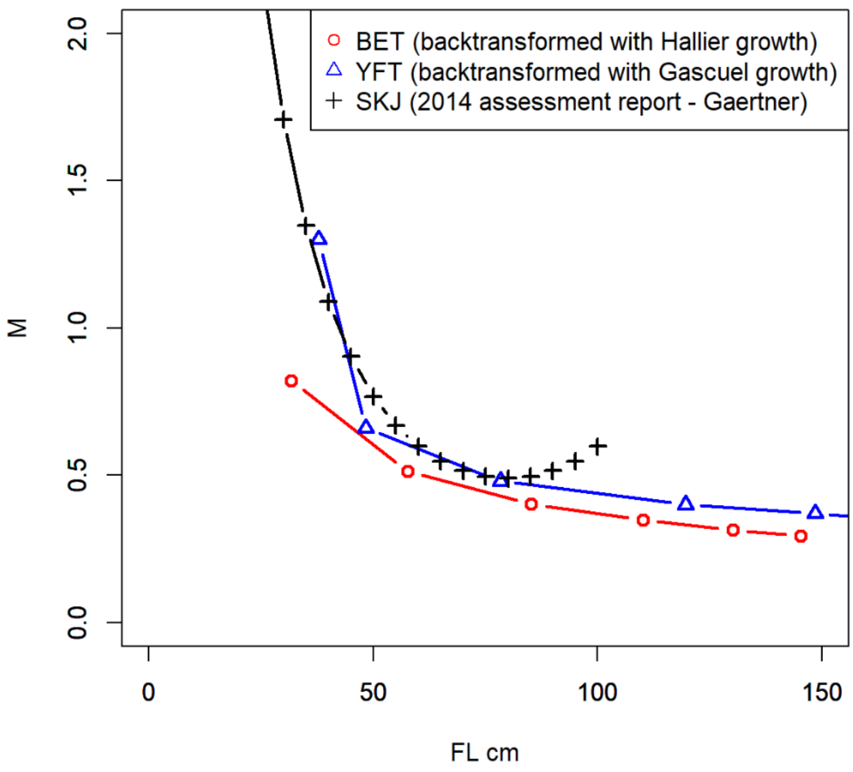


Figure 3. Comparison of M-at-length vectors assumed for BET and YFT compared with the M-at-length vector presented in the 2014 assessment report (from Gaertner, 2015, Figure 5).

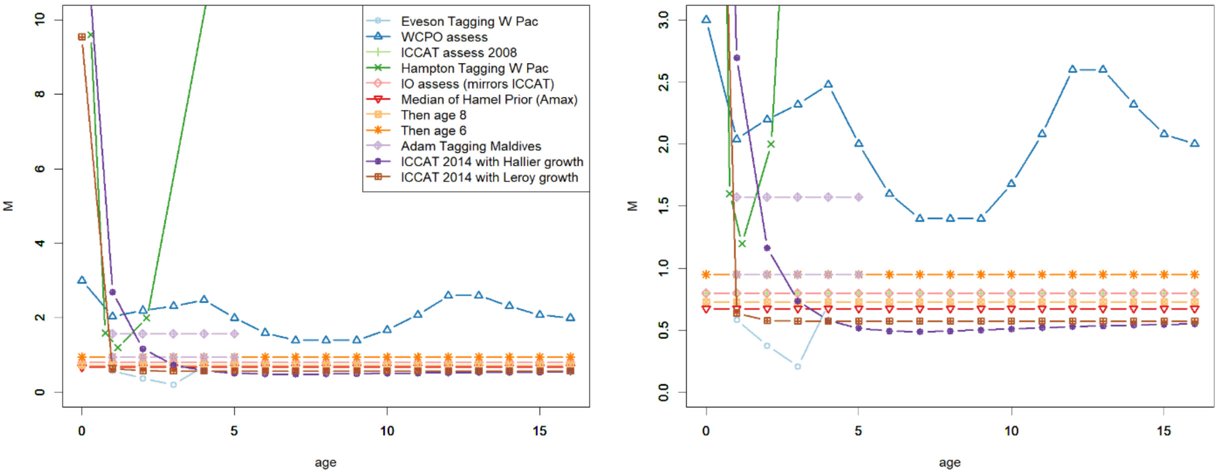


Figure 4. Comparison of M-at-age vectors developed for skipjack across various studies and oceans. References in order are as follows: Eveson (2011), Vincent *et al.* (2019), Anon. (2009), Hampton (2000), Fu (2020), Hamel (2015), Then *et al.* (2015), Anon. (2015), and Gaertner (2015).

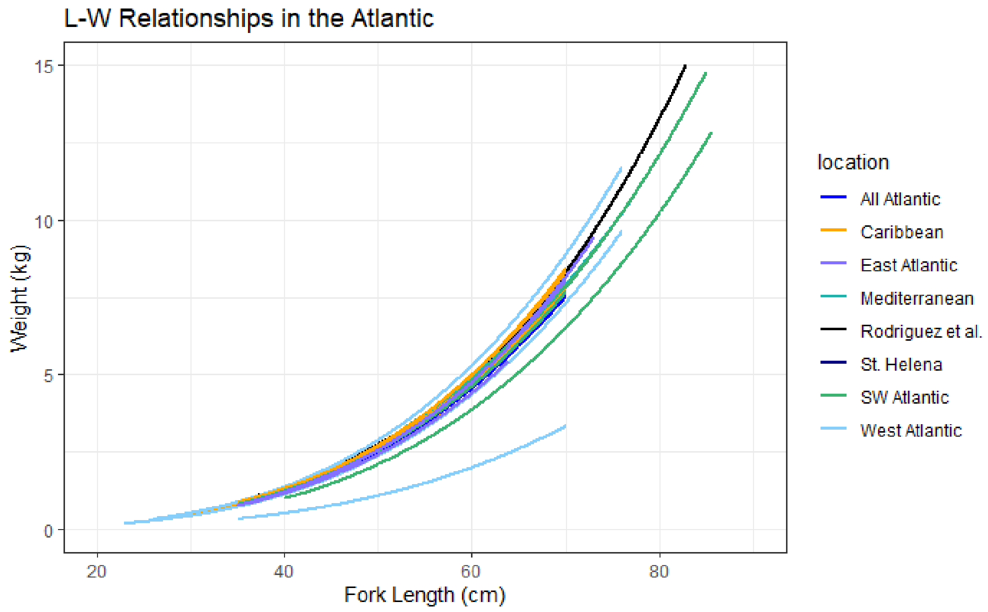


Figure 5. Plotted length-weight relationships from the literature listed in **Table 2** by region in the Atlantic Ocean. Weight predictions are only shown for the size range of samples (line with lowest predictions of weight correspond to the Batts 1972 reference).

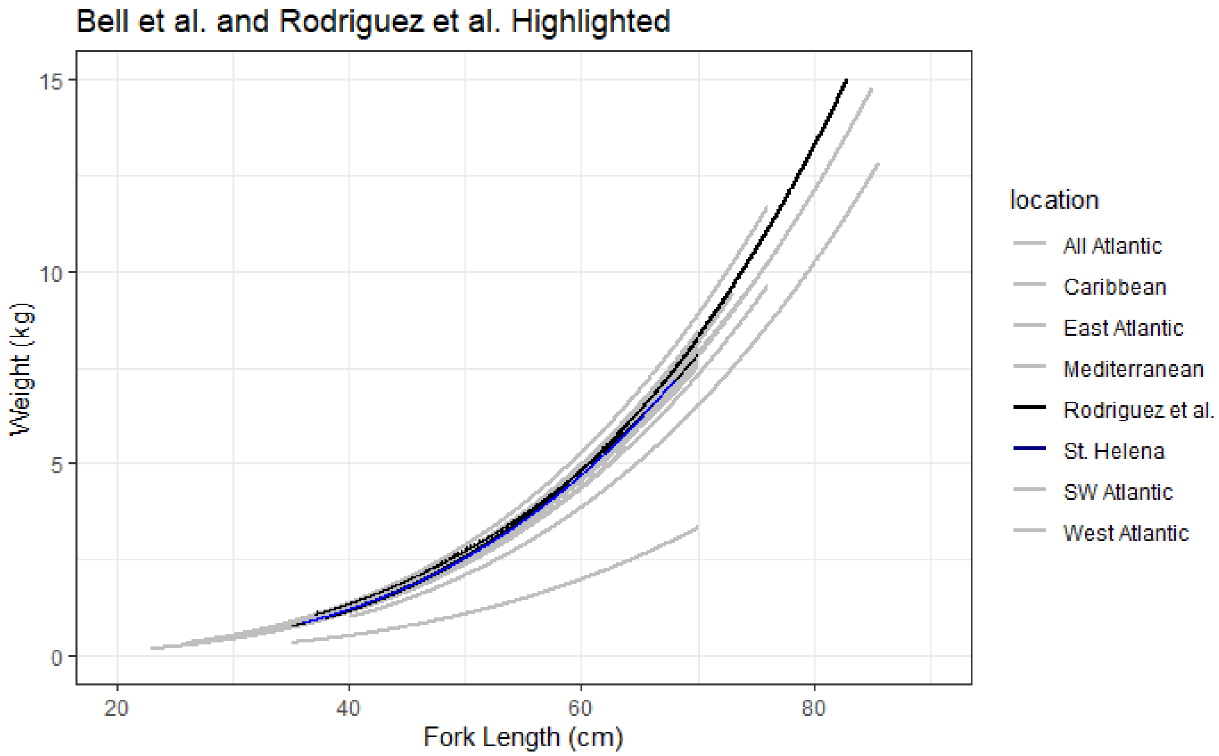


Figure 6. Plotted length-weight relationships in the Atlantic Ocean with SCRS/2022/025 highlighted in black and SCRS/2022/021 highlighted in blue to demonstrate their fits to the historical data. Weight predictions are only shown for the size range of samples.

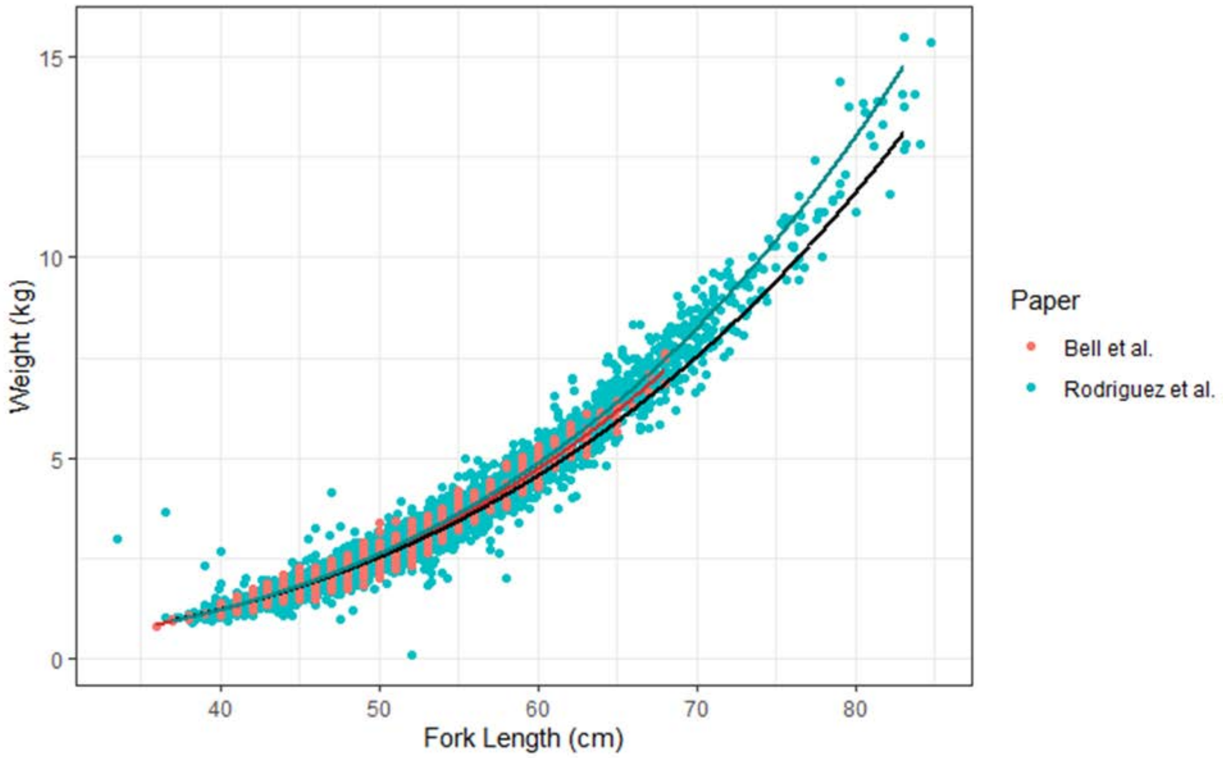


Figure 7. All sampled lengths and widths from SCRS/2022/025 and SCRS/2022/021 with trend lines in grey and the 2014 skipjack stock assessment length-weight relationship (Cayré and Laloë, 1986) in black. Weight predictions are only shown for the size range of samples.

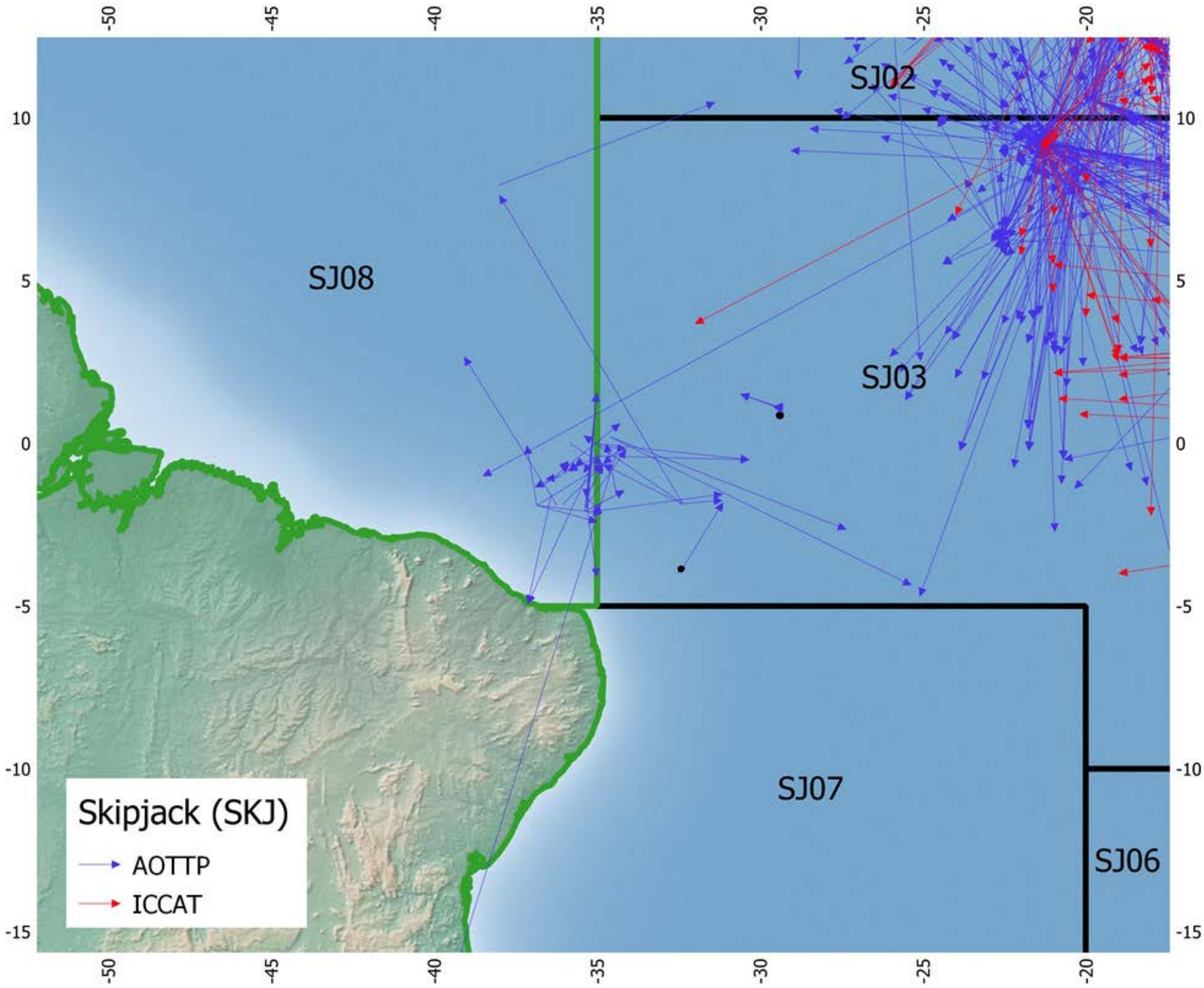
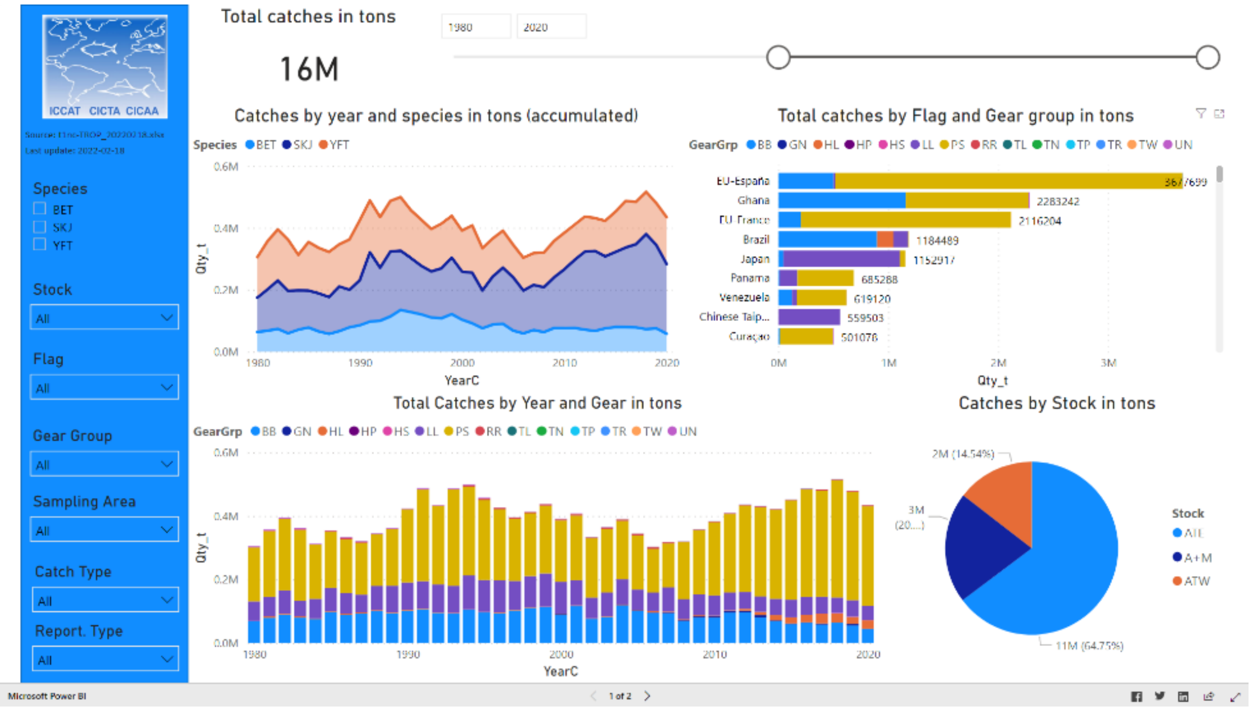


Figure 8. A map of the AOTTP and ICCAT tags demonstrating a collection of tags caught along the eastern-western stock boundary.



Start year: 1980
End year: 2020

Species
☐ BET
☐ SKJ
☐ YFT

Stock: All

Flag: All

Gear Group: All

Sampling Area: All

Catch Type: All

Report. Type: All

Figure 9. Screenshot of the dashboard developed for T1NC with the three major tropical tuna species (BET, SKJ, and YFT).

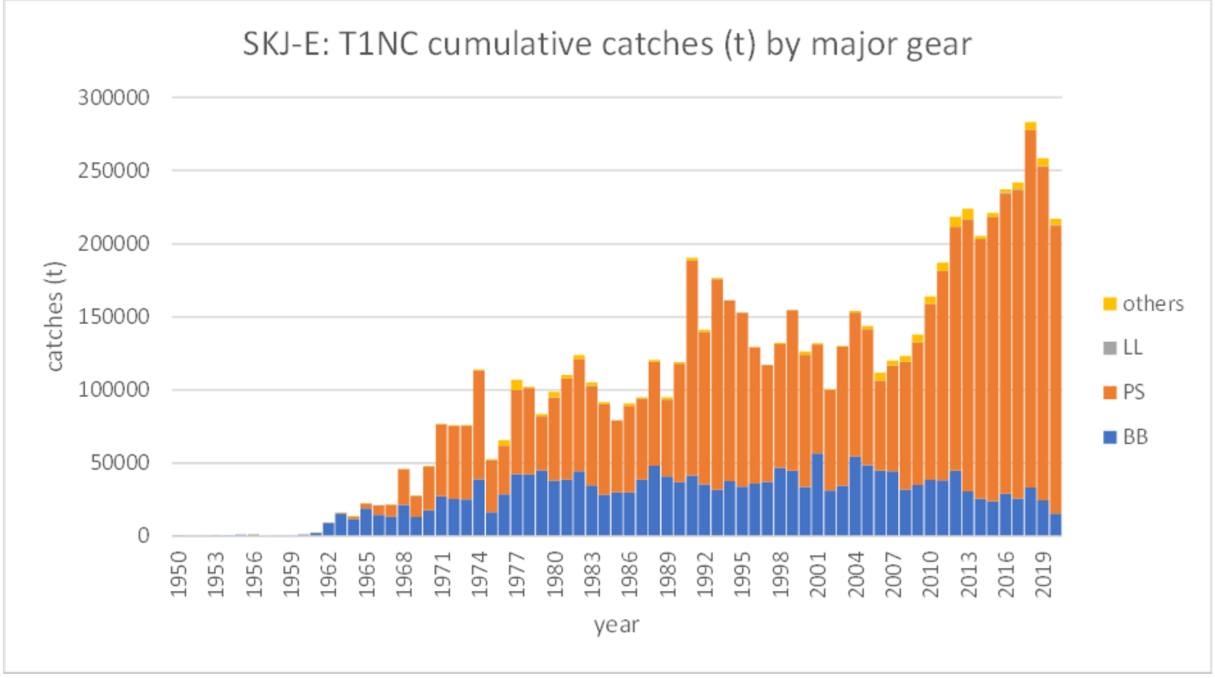


Figure 10. SKJ-E cumulative T1NC catches (t) by major gear between 1950 and 2020.

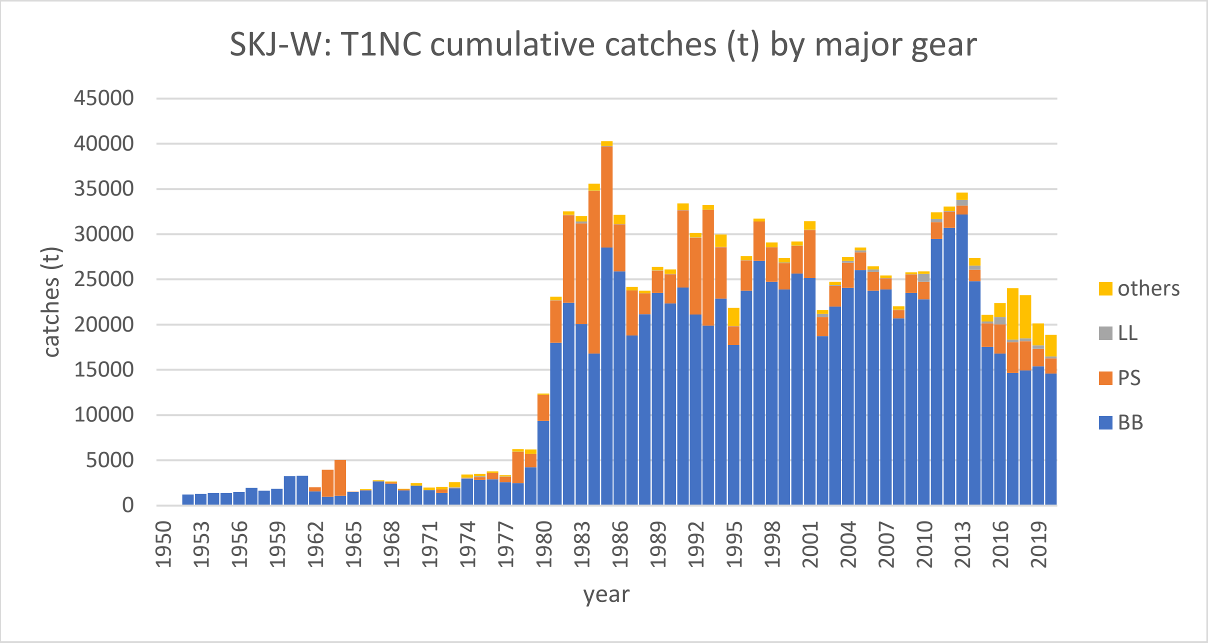


Figure 11. SKJ-W cumulative T1NC catches (t) by major gear between 1950 and 2020.

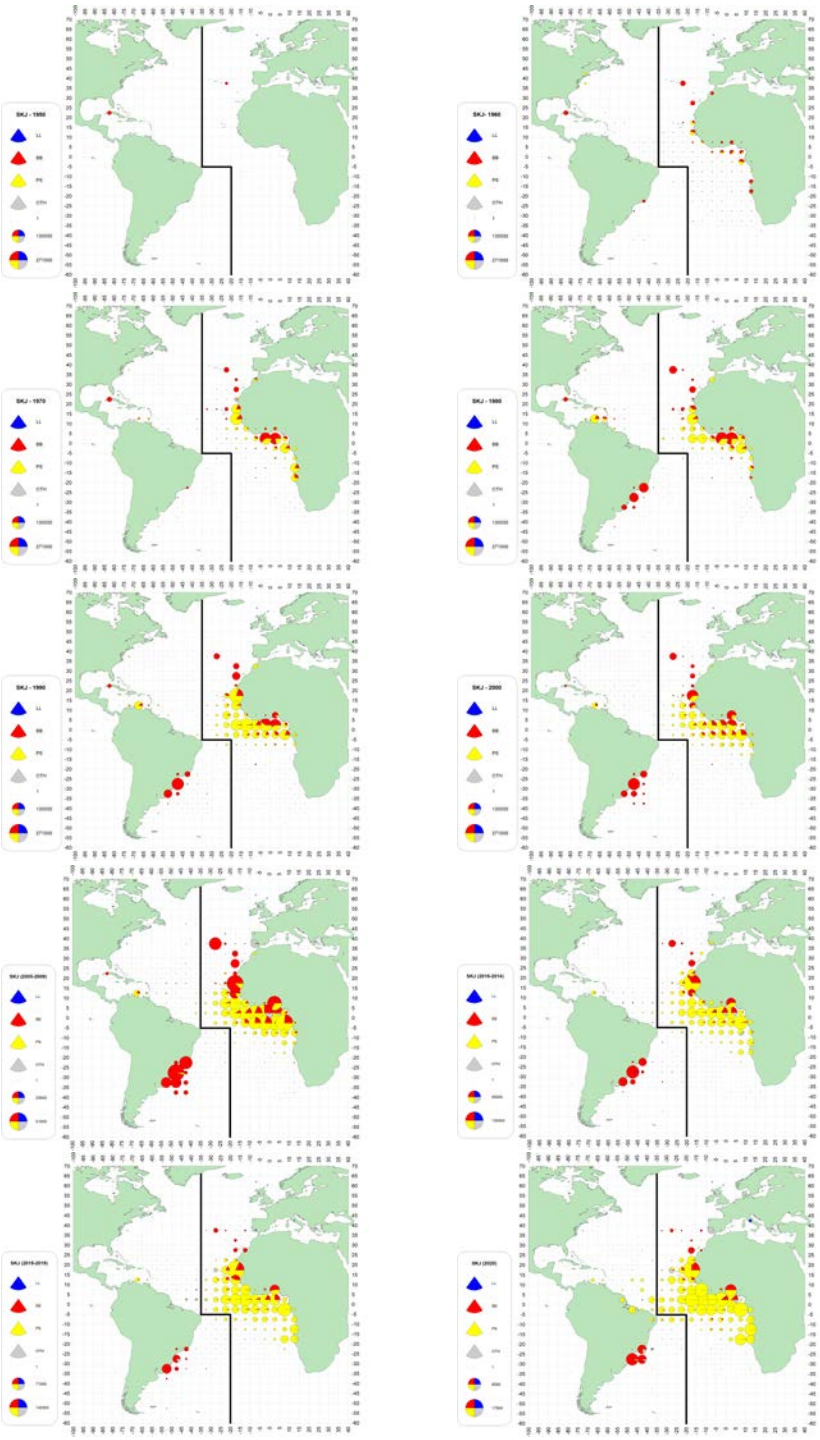


Figure 12. SKJ CATDIS maps by decade 1950-2000, 6 top maps, and by lustrum 2005-2020, 4 bottom maps.

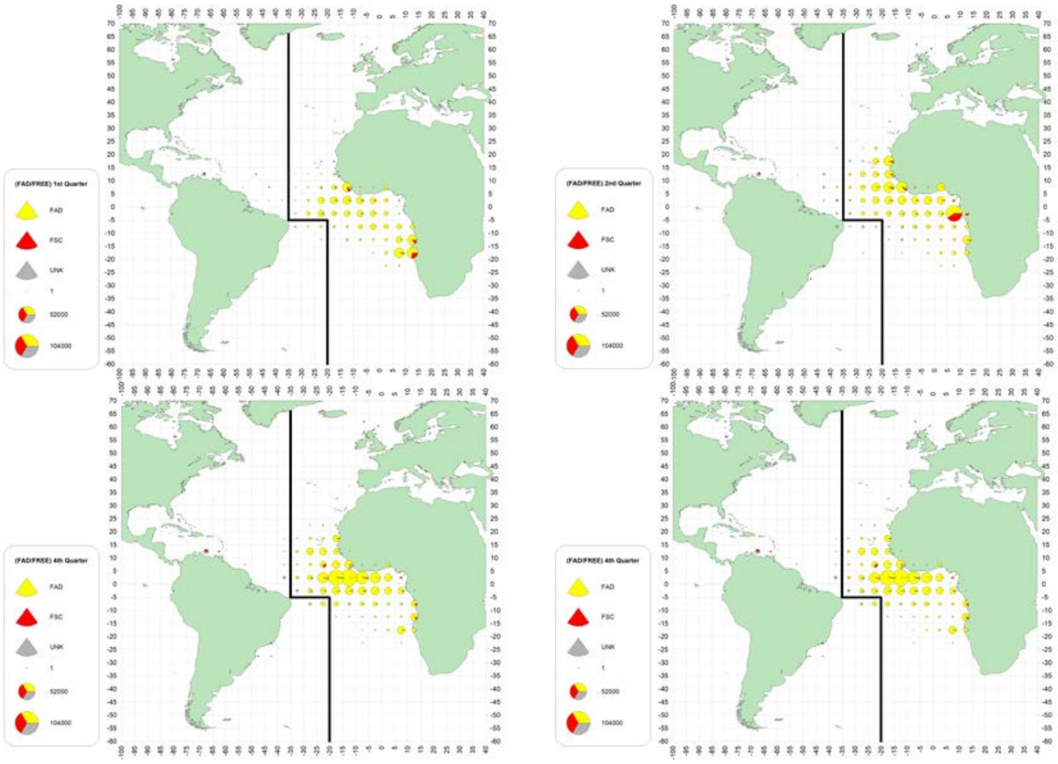


Figure 13. SKJ CATDIS PS catches (t, cumulative) by fishing mode in the period 2015-2020 (1 map per trimester).

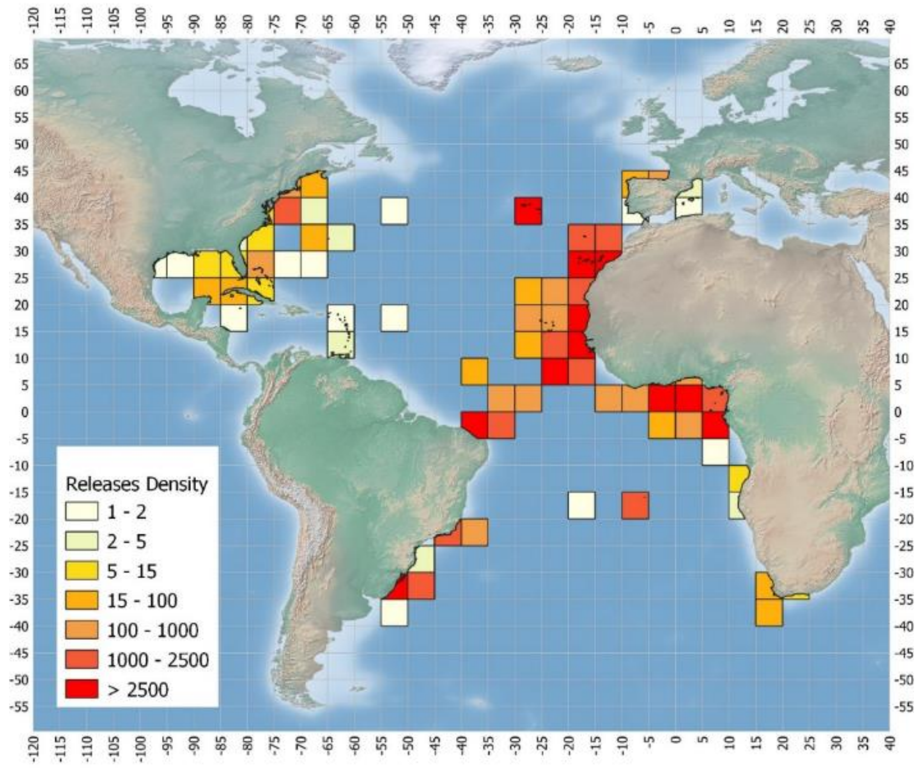


Figure 14. Density of the release positions at 5x5 lat lon grids (A) in ICCAT conventional tagging on SKJ.

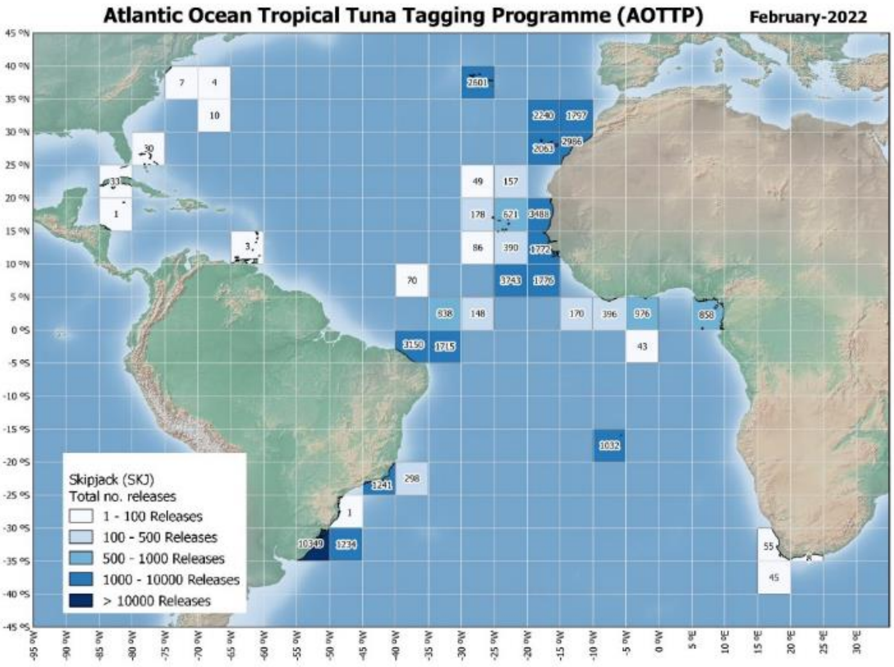


Figure 15. Density of the release positions at 5x5 lat lon grids (A) in AOTTP conventional tagging on SKJ.

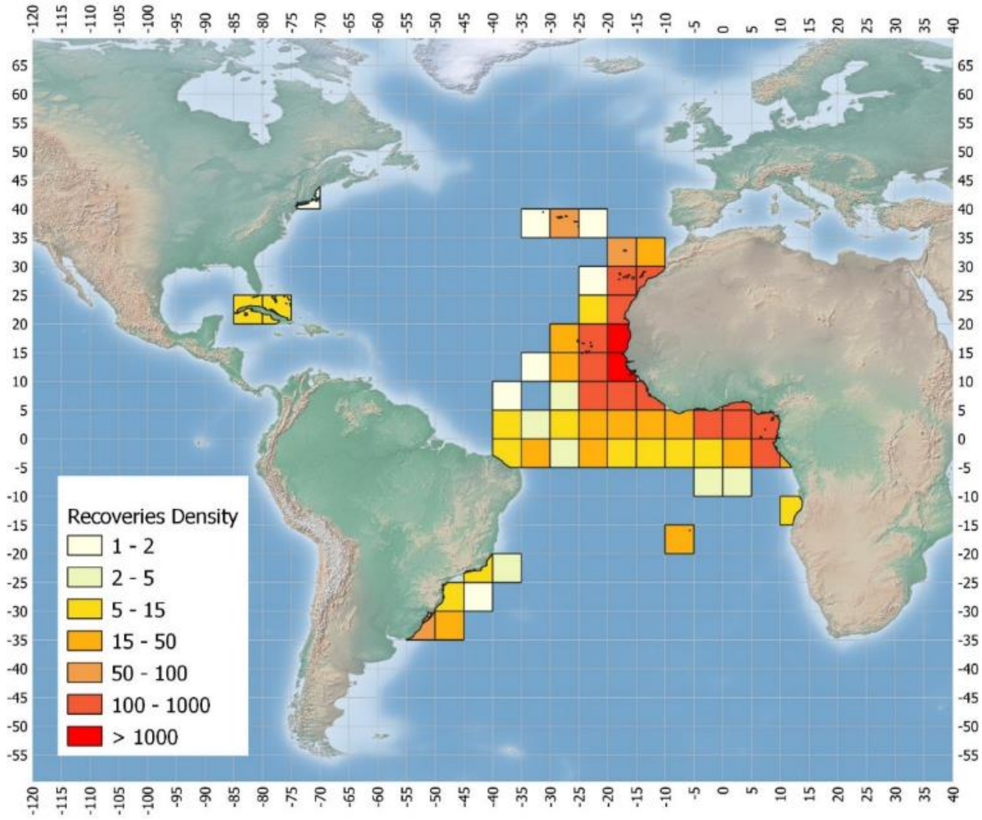


Figure 16. Density of the recovery positions at 5x5 lat lon grids (A) in ICCAT conventional tagging on SKJ.

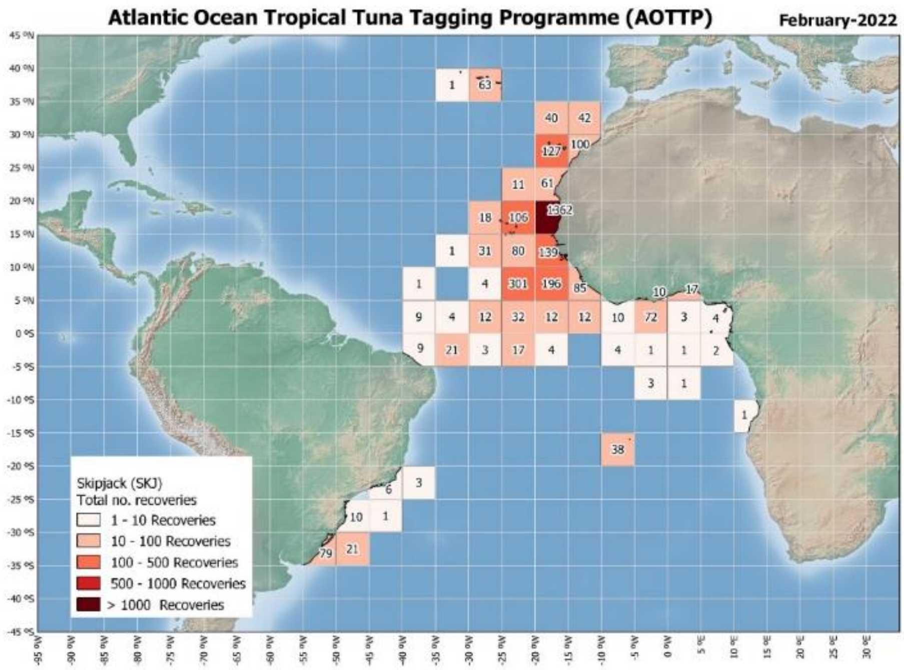


Figure 17. Density of the recovery positions at 5x5 lat lon grids (A) in AOTTP conventional tagging on SKJ.

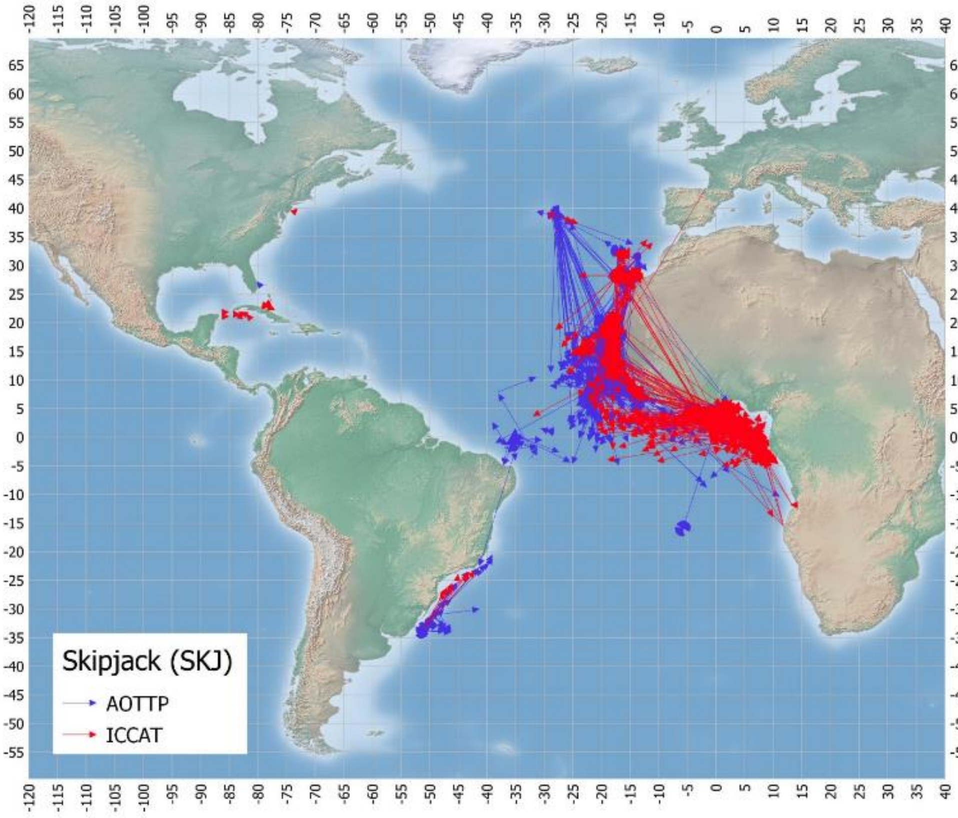


Figure 18. Straight displacement from the release to the recovery position of the recaptured specimens in ICCAT and AOTTP conventional tagging on SKJ.

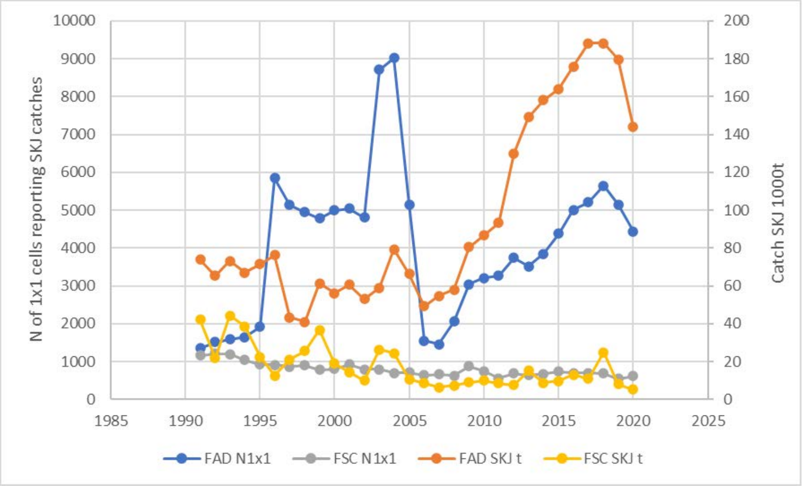
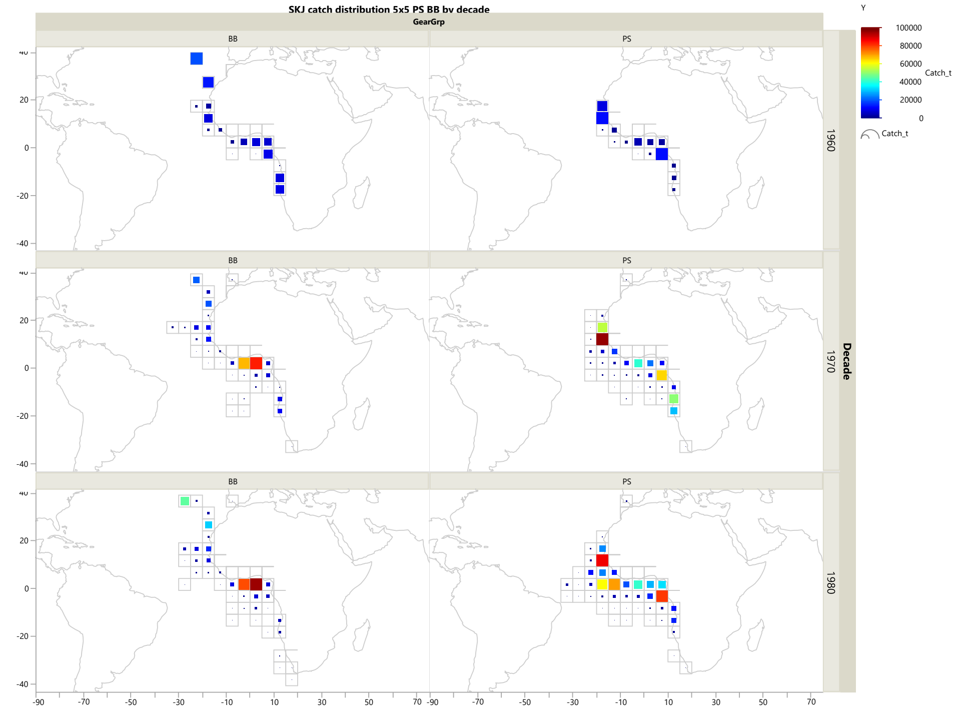
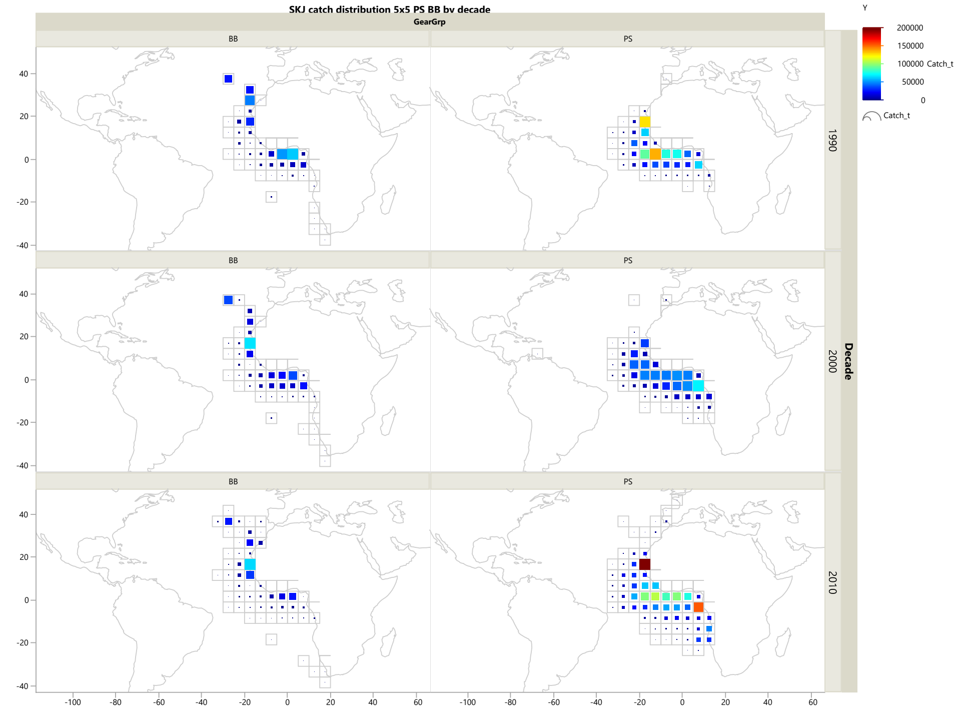


Figure 19. Number of 1x1° lat-lon cells (N1x1) with E-SKJ catch (left y-axis) and the E-SKJ catch (SKJ-t, right y-axis) from purse seine fisheries by fishing mode FAD and FSC and year.

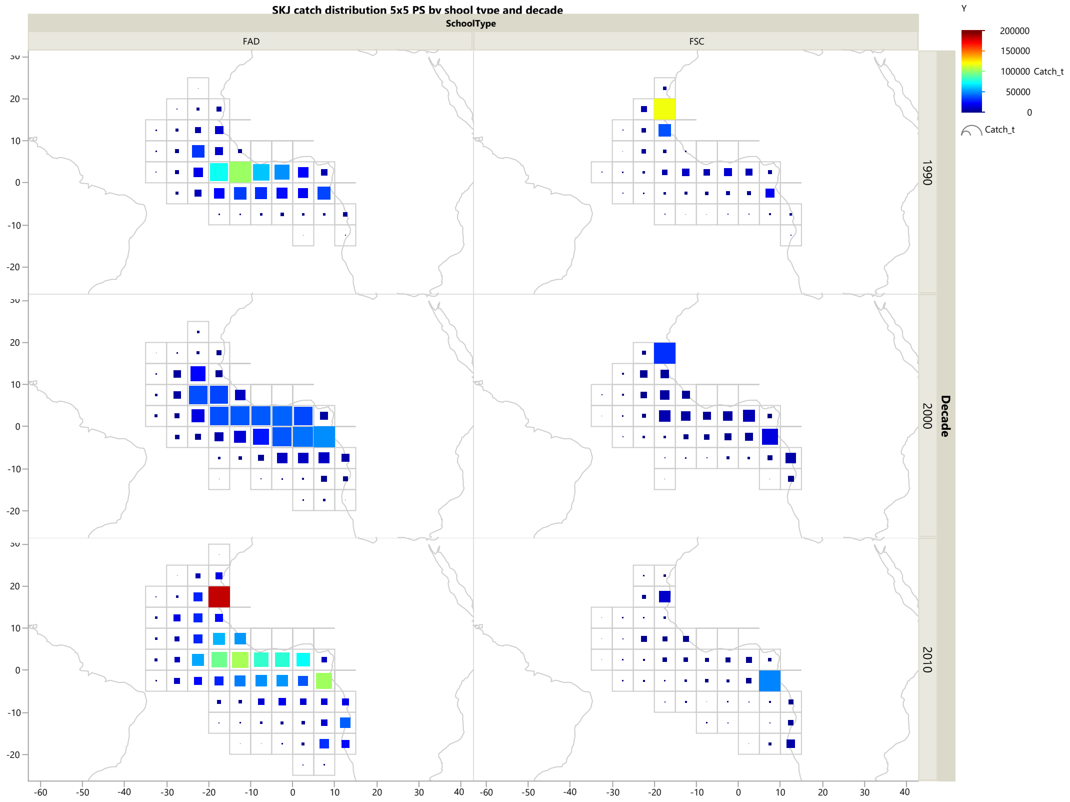


Where((Stock = ATE) and (Decade = 1960, 1970, 1980) and (GearGrp = BB, PS))



Where((Stock = ATE) and (Decade = 1990, 2000, 2010) and (GearGrp = BB, PS))

Figure 20. E-SKJ spatial distribution (5x5) of the catch by decade (1960-2010) for the BB and PS fisheries.



Where((Stock = ATE) and (Decade = 1990, 2000, 2010) and (GearGrp = PS) and (SchoolType = FAD, FSC) and (FishName = PS EU FAD 91+, PS EU FSC 91+, PSBB Ghana))

Figure 21. Comparison of the E-SKJ catch spatial distribution by decade from the PS fisheries on floating objects (FAD) or free-schools (FSC).

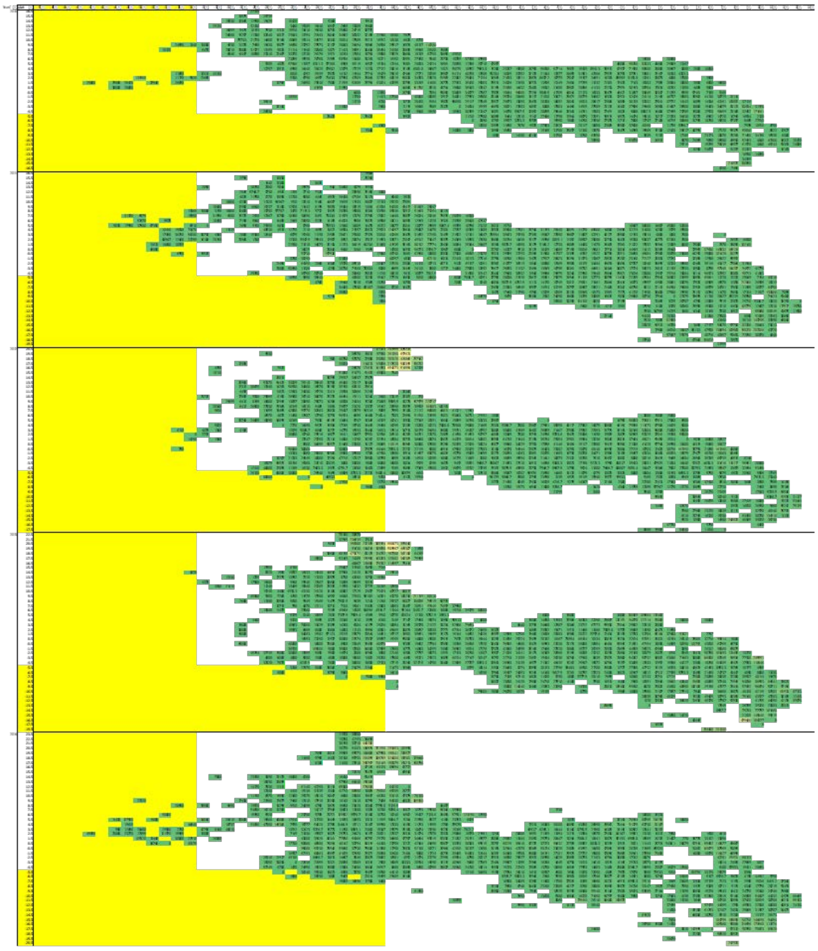


Figure 22. Spatial distribution of the SKJ catch from PS-FAD fisheries by 1° degree latitude (y-axis) and longitude (x-axis) and by year (each rectangle box) 2010-2020. Green cells indicate catches of SKJ, the yellow background indicates the W-SKJ area.

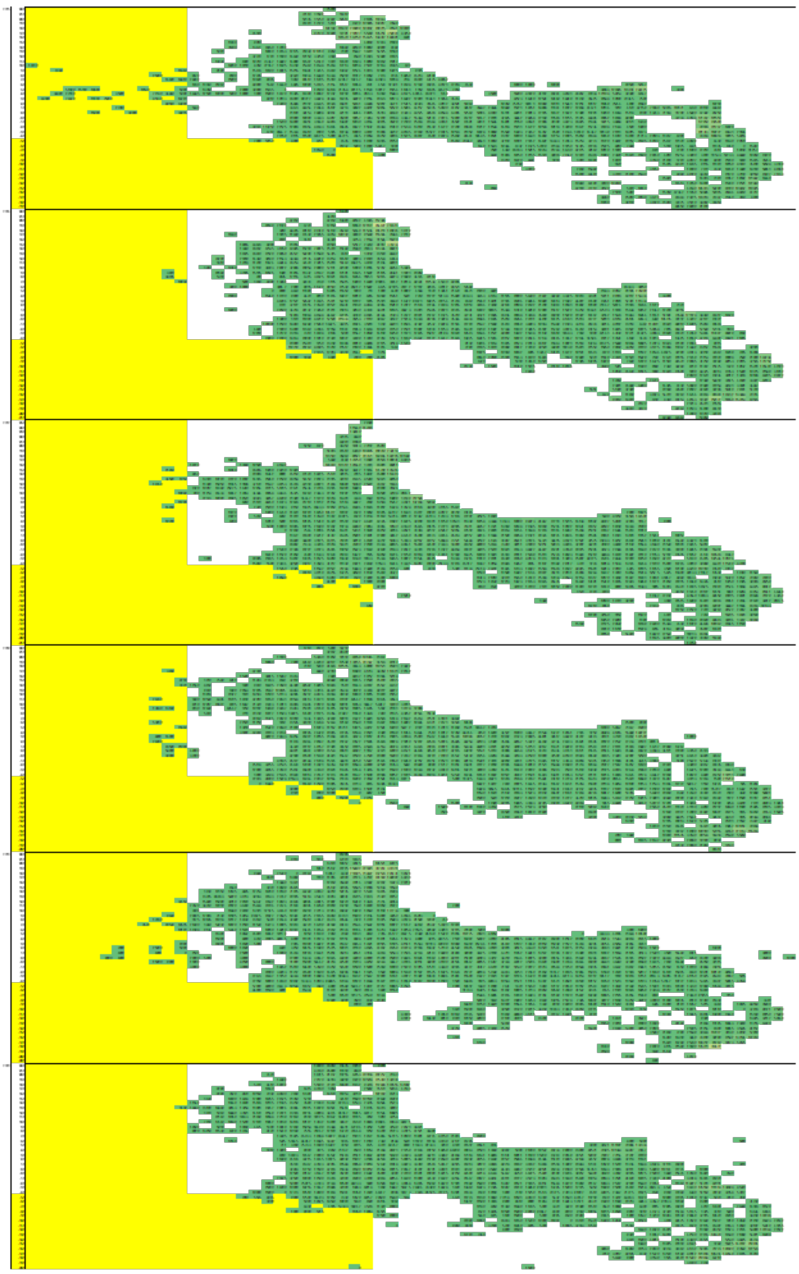


Figure 22. Continued.

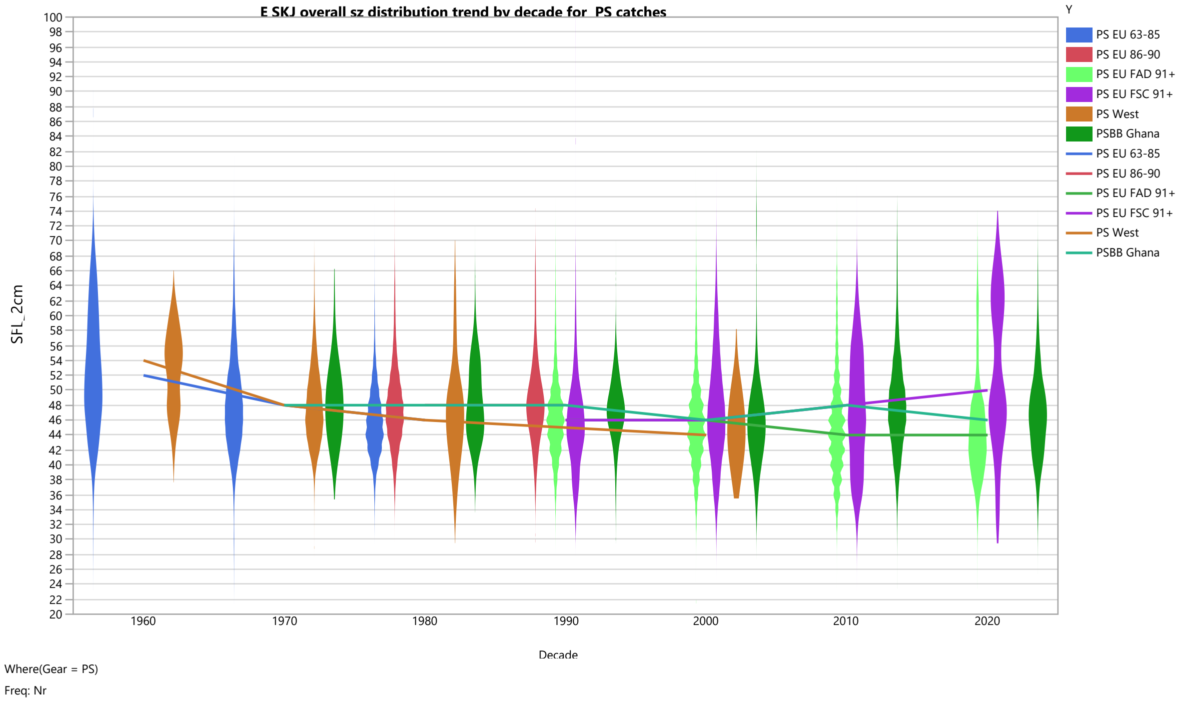


Figure 23. E-SKJ overall size distribution of catch by decade for the PS fisheries by Fleet ID, lines indicate the median of the distributions.

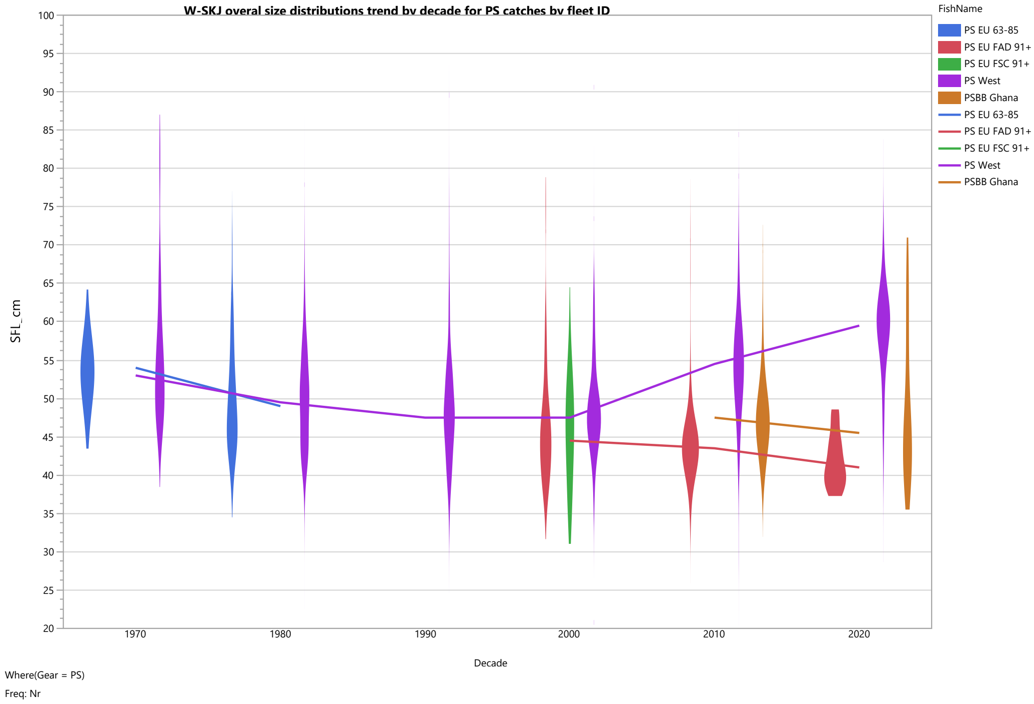


Figure 24. W-SKJ size distributions by Fleet ID from the PS fisheries.

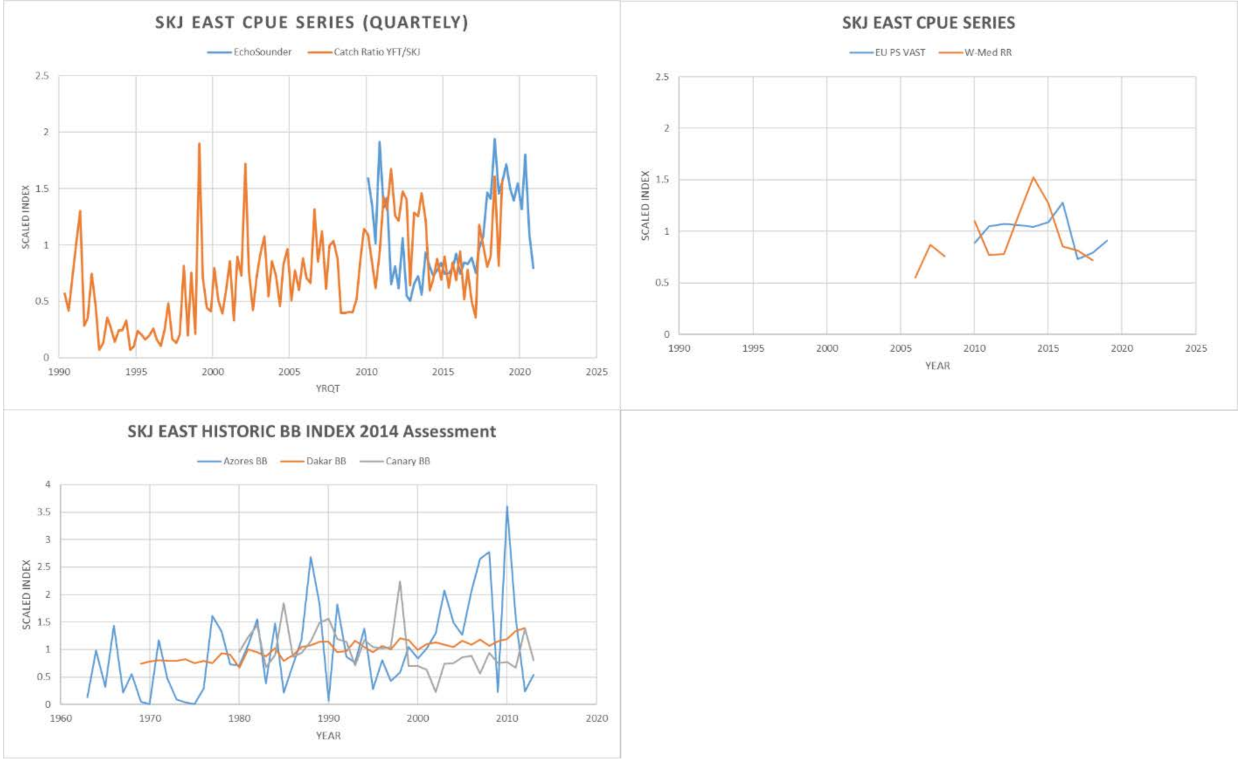


Figure 25. E-SKJ available abundance indices for the 2022 stock assessment.

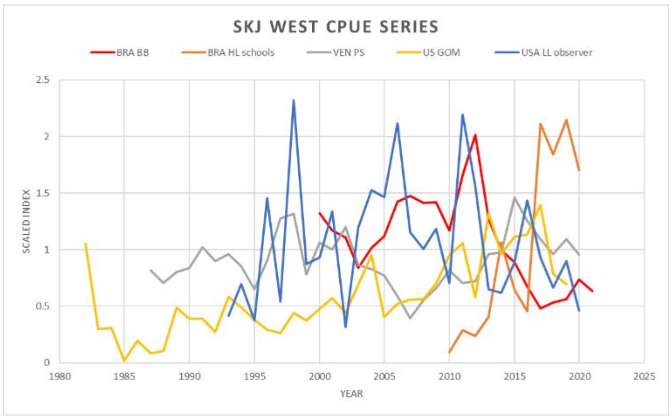


Figure 26. W-SKJ available abundance indices for the 2022 stock assessment.

Appendix 1

Agenda

1. Opening, adoption of Agenda, and meeting arrangements

2. Review of historical and new data on skipjack biology (including analysis of AOTTP data)

   2.1 Age and growth
   2.2 Natural mortality
   2.3 Reproduction and sex-ratio
   2.4 Length-weight relationship and its variability
   2.5 Movement and stock structure

3. Review of fishery statistics and tagging

   3.1 Task 1 (catches) data
   3.2 Task 2 (catch-effort and size samples) data
   3.3 Tagging data

4. Fishery indicators

5. Size samples and estimation of catch at size and catch at age

6. Indices of relative abundance

   6.1 Detailed descriptions of individual fleets
   6.2 Combined indices

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

8. Research recommendations

9. Responses to the Commission

10. Other matters

11. Adoption of the report and closure

Appendix 2

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Appendix 3

List of SCRS Papers and Presentations

Reference	Title	Authors
SCRS/2022/021	Life History of Skipjack caught around the UK Overseas Territory of St Helena, South Atlantic: Report for the 2022 ICCAT Skipjack Tuna Data Preparatory Meeting	Bell J. B., Wright S.R., Naulaerts J., and Henry L.
SCRS/2022/024	Growth and mortality rates of skipjack tuna *Katsuwonus pelamis* in the Southwest Atlantic Ocean	Benevenuti Soares J., Correa G.M., Monteiro-Neto C., Tubino R.A., and Rodrigues da Costa M.
SCRS/2022/025	Life history trades of the skipjack tuna in the Southwest Atlantic	Rodriguez da Costa M., Tubino R.A, Castello J.P., Mello V.S., Benevenuti Soares J., Marcel G., Camponez de Almeida P.R., Coletto J.L., Pastous Madureira L.S., and Monteiro-Neto C.
SCRS/2022/026	Index of abundance of skipjack tuna in the Atlantic Ocean derived from echosounder bouys (2010-2020).	Santiago J., Uranga J., Quincoces I., Grande M., Murua H., Merino G., Zudaire I., Urtizberea A., and Boyra G.
SCRS/2022/027	Review and preliminary analyses of size samples of East and West Atlantic skipjack tuna stocks (*Katsuwonus pelamis*)	Ortiz M. and Kimoto A.
SCRS/2022/028	European purse seiners CPUE standardization of Eastern Atlantic skipjack caught under non-owned dFADs using the VAST methodology	Akia S., Guery L., Grande M., Kaplan D., Pascual P., Ramos M.L., Uranga J., Abascal F., Santiago J., Merino G., and Gaertner D.
SCRS/2022/029	CPUE standardization of skipjack tuna (*Katsuwonus pelamis*) caught by Brazilian baiboat fleet in the southwestern Atlantic Ocean	Sant'Ana R., Mourato B.L., Cardoso L. G., and Travassos P.
SCRS/2022/030	What can the size data tell us about the western Atlantic skipjack tuna stock?	Cardoso L.G., Mourato B.L., Sant’Ana R., Silva G., Castello J.P., Monteiro-Neto C., Rodrigues M.R., and Tubino R.
SCRS/2022/031	An alternative index of abundance for Atlantic skipjack tuna (*Katsuwonus pelamis*) based on catch ratio and abundance of a reference species	Abascal F.J., Gaertner D., Báez J.C., Kaplan D., Pascual P., and Ortiz de Urbina J.
SCRS/2022/032	What does genetics reveal about the population connectivity and exploitation of the skipjack tuna (*Katsuwonus pelamis*)?	Queiroz-Brito M.C.G, Silva D.L., Mendonça F.F., Robalo J., Travassos P., Adam M.L., and Torres R.A.
SCRS/2022/034	A systematic review of tropical tuna preferences for tropical tuna movement models.	Norelli A.P., Die D., and Moffat B.T.
SCRS/2022/035	The skipjack fishery in the Canary Islands for the period 1926 to 2020.	Pascual-Alayón P.J., Deniz S., and Abascal F.J.

SCRS/2022/036	Bayesian generalized linear models for standardization of skipjack catch rates based on Brazilian handline associated school fishing (2010-2020) in the western equatorial Atlantic	Mourato B.
SCRS/2022/037	Standardized catch indices of skipjack tuna, *Katsuwonus pelamis*, from the United States pelagic longline observer program	Lauretta M.
SCRS/2022/038	The faux poisson estimates for the EU-FR and EU-SP purse seine fleet over the period 2015 - 2020	Duparc A., Pascual-Alayon P.J., and Rojo Mendez V.
SCRS/2022/039	Standardized catch rates for skipjack tuna (*Katsuwonus pelamis*) from the Venezuelan purse seine fishery in the Caribbean Sea and adjacent waters of the Western Central Atlantic for the period of 1987 - 2020	Narváez M., Evaristo E., Marcano J.H., Gutiérrez X, and Arocha F.
SCRS/2022/040	Annual indices of skipjack tuna (*Katsuwonus pelamis*) larvae in the Gulf of Mexico (1982-2019)	Ingram G.W.

Number	Title	Authors
SCRS/P/2022/001	A brief overview of AOTTP results for skipjack tuna	Ailloud L.
SCRS/P/2022/002	Tuna catch estimate in faux poisson for the purse seine fishery	Duparc A.
SCRS/P/2022/003	Contributions to the knowledge of skipjack tuna, Katsuwonus pelamis, vertical and horizontal movements in the southwest Atlantic ocean from tagging and catch data	Pastous L.S., Monteiro-Neto C., Rodrigues M., Tubino R.A., Coletto J.L., Marques C., and Peres M.

Appendix 4

SCRS Documents and Presentation Abstracts as provided by the authors

SCRS/2022/021 - Skipjack Tuna (SKJ) are intermittently caught by rod and reel vessels around the island margin and seamounts of St Helena. Catch, tagging, and biological data have been collected since 2015 and is here reported to assist with the development of the new assessment protocol for Atlantic SKJ by the ICCAT SCRS in 2022. The agenda for the data preparatory meeting (21-25 Feb 2022) lists a number of areas for consideration, of which we provide the following information provided by observers and fishers from around St Helena: catch-at-size; length-weight relationships; growth rates; maturity; and a preliminary index of relative abundance based on catch rates by inshore vessels fishing around St Helena.

SCRS/2022/024 - The skipjack tuna supports an important pole-and-line fishery in the Southwest Atlantic. Dorsal fin spines from 452 specimens collected between January 2014 and May 2016 (Period I) and January 2017 and August 2018 (Period II) were used for age determination. Age validation was carried out by analyzing the percentage variation of the edge type and the seasonal average of marginal increment. The formation of a translucent band occurred in late autumn and early winter for both periods. The growth parameters did not show differences between sexes in each period. Nevertheless, the mortality rates indicated differences in the exploitation rates between periods. For the Period I the exploitation rate was 0.35, while in Period II it ranged from 0.50 - 0.52. Our results show an increase in fishing effort on the species between the periods evaluated, indicating that the stock is at the 50% limit of its exploited biomass. Given the risks and uncertainties surrounding the assessment of stocks, we recommend further studies on the species and factors that may affect its production in biomass.

SCRS/2022/025 - We investigated skipjack tuna (SKJ) population parameters in the southwestern Atlantic Ocean (SWA), off the Brazilian coast. Between January 2017 and August 2018, samples from pole and line commercial catch landings were taken at the ports of Rio Grande and Niterói. On each occasion, 100 to 300 individuals were randomly sampled for fork-length measurement. For each sample, a subsample of 15 to 30 individuals was randomly drawn to evaluate the size-structure of the catches, patterns of reproductive dynamics, and feeding ecology. Our results show that a single SKJ stock uses shelf break and slope waters off the Brazilian coast. This unique stock unit in the SWA has bioecological peculiarities that corroborate behavioral patterns described in the literature for the region, but share similarities with studies from other oceanic areas, influenced by different environmental conditions and fishing effort. Such results provide updated information on the SKJ population attributes in the SWA and allow integrated analyzes in different current and historical perspectives, supporting management measures aimed at the sustainability of the SKJ stocks.

SCRS/2022/026 - The collaboration with the Spanish vessel-owners associations and the buoy-providers companies, has made it possible the recovery of the information recorded by the satellite linked GPS tracking echosounder buoys used by the Spanish tropical tuna purse seiners and associated fleet in the Atlantic since 2010. These instrumental buoys inform fishers remotely in real-time about the accurate geolocation of the FAD and the presence and abundance of fish aggregations underneath them. Echosounder buoys have the potential of being a privileged observation platform to evaluate abundances of tunas and accompanying species using catch-independent data. Current echosounder buoys provide a single acoustic value without discriminating species or size composition of the fish underneath the FAD. Therefore, it has been necessary to combine the echosounder buoys data with fishery data, species composition and average size, to obtain a specific indicator. This paper presents a novel index of abundance of skipjack tuna in the Atlantic Ocean derived from echosounder buoys for the period 2010-2020.

SCRS/2022/027 - Size sampling data of east and west Atlantic skipjack stocks were reviewed, and preliminary analyses were performed for its use within the stock evaluation models. The size samples data was revised, standardized, and aggregated to size frequencies samples by main fleet/gear type, year, and quarter. For the east and west Atlantic stock, the size sampling proportion among the major fishing gears is not consistent with the proportion of the catch since 1980, most of the size samples come from the purse seine fisheries, but proportionally the baitboat provide more size samples per weight of the catch. The number of fish measured has decreased substantially in the last decades from both the east and west Atlantic fisheries. Size frequency data was consolidated by year, quarter, and FleetID for 1 cm bin size.

SCRS/2022/028 - Abundance index for Eastern Atlantic skipjack was derived from the European purse seiner CPUEs series (2010-2019) for fishing operations made on drifting FADs non-owned by the vessel. By selecting non-owned dFADs only, i.e., dFADs for which the purse seiner has no previous information for detecting the object and on the corresponding aggregated biomass, we relaxed as possible the assumptions on the non-random detection process as well as on the effort creep over the years. The CPUE standardization is based on a multicomponent model applied to the VAST methodology.

SCRS/2022/029 - Catch and effort data from the Brazilian baitboat fishery in the southwestern Atlantic Ocean, from 2000 to 2021, were analyzed in this working paper. The effort was distributed between 19º S and 35º S. Bayesian Spatial-Temporal Hierarchical models using Integrated Nested Laplace Approximations with a Lognormal distribution were used to standardise CPUE series for the stock assessment of the West Skipjack Stock. The covariates used in the models were: year, quarter, vessels and lat-lon squares of 0.5º x 0.5º. The estimated Bayesian Spatial-Temporal lognormal model showed interesting movements of the abundance of the stock. The lognormal index showed two distinct periods. The first one between 2000 and 2012, in general, marked by a stable trend over the years, with a pike in the last year of this period. And the second period, between 2012 and 2021, was marked by a steep one-way downward trend with a small stabilization trend in the last four years of the period.

SCRS/2022/030 - More than 75% of the total catches of the western Atlantic skipjack tuna stock are performed by the baitboat fishery along the south and southeastern Brazil. This fishery has been well sampled but occurs in a restricted area concerning the entire stock distribution preventing a comprehensive analysis of the fish size's spatial distribution. However, a vast dataset on spatially distributed size samples (> 7 million measured fish) provided an opportunity to analyze the spatial distribution of skipjack sizes across the Western Atlantic. Overall, the larger mean sizes occurred inside and a little further north and south of the tropical latitudes, from 30ºN to 30ºS. The smaller mean sizes were observed in areas closer to the coast and at higher latitudes in the southern and northern hemispheres. The different fishing gears seem to present different selectivities since the length composition from the purse seine showed the smaller individuals than the baitboat fishery, while the longline catches the larger ones.

SCRS/2022/031 - Indices of abundance, frequently based on catch rates per unit effort (CPUE), are one of the main inputs to tropical tuna stock assessments. While standardized longline CPUE series are routinely obtained and used in the stock assessments of yellowfin and bigeye tunas, the standardization of the effort in fisheries targeting skipjack tuna is more problematic, due to several factors that are known to affect the efficiency of the fleets but are difficult to quantify. In this scenario, alternative approaches need to be tested. In this document, we propose an alternative approach based on the ratio in the catch of skipjack vs yellowfin tuna, using the abundance of the reference species as an offset in the standardization.

SCRS/2022/032 - This study assesses the genetic structure of Atlantic populations of Katsuwonus pelamis using mitochondrial (control region d-loop – CR) and nuclear (intron S7) data. In addition, we investigate the species composition of canned tuna marketed in Brazil, using Cytochrome Oxidase I (COI). The canned tuna DNA was successfully extracted for all four samples used in this initial experiment, and the fragments of COI indicate the presence of K. pelamis in these products. For CR and S7 data, high genetic diversity was found, agreeing with the "Least Concern" status by the IUCN. None of these data showed a clear geographic structure, which may be related to life strategies of the species. However, some signals of genetic differentiation were observed by pairwise FST, especially in the Azores (SK01 ICCAT area) by CR data. Furthermore, S7 recovered a weak to moderate genetic differentiation between and within West and East Atlantic stocks. Despite being preliminary, these results can be used to improve the ICCAT management strategy, and collaboration between the West and East Atlantic and a deeper investigation into the Azores population may be necessary.

SCRS/2022/034 - The objective of this study was to extract parameter information from multiple sources and quantify parameter uncertainty for model application. Following PRISMA methods, we searched Scopus, reviewed titles, and abstracts in AbstrackR, and extracted tropical tuna movement parameters from relevant articles. We quantified parameters and uncertainty for four drivers affecting tuna movement: speed, temperature preferences, oxygen preferences, and associations of tuna with Fish Aggregation Devices (FADs). Bigeye, Yellowfin, and Skipjack, move at about 1 m/s. Bigeye prefer a wider and colder range of temperatures (14.7°C-23.2°C) than Yellowfin (20.3°C-25.5°C) and Skipjack (19.3°C-27.9°C). Bigeye dives into less oxygenated waters than Yellowfin (1.4 ml/L, 3.1 ml/L), but oxygen information on Skipjack is lacking (n=1). The continuous residence time of Bigeye and Yellowfin on FADs (7.7 days, 6.8 days) is double the residence times of Skipjack (2.6 days). All species sense a FAD from 5.4 nautical miles away and take 23.8 days to colonize it. We hope that this systematic review can inform movement models and encourage others to fill gaps in the literature to improve tropical tuna management.

SCRS/2022/035 - This document presents a detailed study of the skipjack (*Katsuwonus pelamis*) fishery in the Canary Islands during the period from 1926 to 2020. There is clear evidence of the existence of this fishery since the beginning of the 19th century on the island of La Gomera. The fishing effort for the different fleet segments is analyzed for the period analyzed. Total catches of skipjack have oscillated in saw tooth pattern, with good years and bad years. The skipjack catches are directly related to bigeye catches, representing in many years more than 40% of the total catches in the islands. The seasonality of catches of the species has not changed in the last 25 years, with the second and third quarters being the most important in terms of catch volume. Catch sizes are smaller in the second and third quarters. And the largest sizes are captured in the free school mode and mainly in the winter months such as December, January and February. Skipjack catches are made mainly in coastal areas and inter-island channels by vessels of less than 50 GRT.

SCRS/2022/036 - In the present analysis, port sampling and logbook records from the Brazilian handline tuna fishery in associated schools in the western tropical Atlantic, from 2010 to 2020, were used to generate a standardized CPUE series, by a Bayesian generalized linear model, using Integrated Nested Laplace Approximation (INLA) approach. The data set included 876 fishing trips, comprising 15314 days at sea and records of catch in kilograms by species. Two main parametric covariates (i.e. factors) were considered. The factor "year" included data from 2010 to 2020 and "month", with two 12 levels, while "fishing boat" was included as a random effect. The standardized catch rate series shows a stable trend until 2016 followed by an increase in 2017 and remaining relatively stable up to 2020. The apparent rise in catch rates in recent years, i.e. after 2017, might be related to unaccounted factors (i.e. explanatory variables) that potentially could increase the catchability, such as the increasing of landings due to the demand for this species in the Brazilian canning company. Also, it was observed the entrance of larger fishing boats with more fishing capacity in this fleet in 2017. These changes directly might influence catchability and consequently the estimation of the relative abundance of skipjack tuna caught by this fleet. Although the results might be speculative because the data seems to be not the ideal, they might be considered when discussing the assessment of the western Atlantic skipjack tuna.

SCRS/2022/037 - Catch and effort data from the United States pelagic longline observer program in the Atlantic Ocean and Gulf of Mexico were analyzed to estimate indices of relative abundance for Skipjack for the period 1993 to 2020. A negative binomial generalized linear model was used to incorporate multiple factors that may influence gear catchability, including year, season, fishing area, target species, hook type, and number of light sticks. Standardized abundance indices are provided, along with estimates of 95% confidence intervals of the predicted means.

SCRS/2022/038 - This short note presents the details of the methodology used to assess crude estimates of the faux poisson catch of the EU PS fleet over the period 2015-2020 for the major and small tuna species: yellowfin (YFT), bigeye (BET), skipjack (SKJ), frigate tuna (FRI) and little tuna (LTA).

SCRS/2022/039 - Standardized index of relative abundance for skipjack tuna (*Katsuwonus pelamis*) was estimated using Generalized Linear Models approach assuming a delta lognormal model distribution. For this, logbooks registers were used (1987-2020), considering as categorical variables year, season/quarter, area, association with whales, association with whale shark, seiner capacity and help (help by bait boat, without help) during the fishing set. As indicators of overall model fitting, diagnostic plots were evaluated. The standardized skipjack tuna catch rate index shows a declining trend since 2015, which stabilizes for the last three years of the time series.

SCRS/2022/040 - Fishery independent indices of larval skipjack tuna in the western North Atlantic Ocean are presented utilizing NOAA Fisheries ichthyoplankton survey data collected from 1982 through 2019 in the Gulf of Mexico. Indices were developed using standardized data (i.e. abundance of 2 mm larvae under 100 m2 sea surface sampled with bongo gear). Due to the large frequency of zero catches during ichthyoplankton surveys, indices of larval abundance were developed using zero-inflated delta-lognormal models, including the following covariates: time of day, month, area sampled, and year.