REPORT OF THE 2022 ICCAT ATLANTIC SWORDFISH DATA PREPARATORY SESSION

(Online, March 21 to 1 April 2022)

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

1. Opening, adoption of agenda and meeting arrangements

The meeting was held online, 21 March to 1 April 2022. The northern swordfish rapporteur Kyle Gilespie (Canada) opened the meeting with the Species Group (the Group) coordinator Dr. Rui Coelho (EU-Portugal) and the southern rapporteur, Denham Parker (South Africa). The ICCAT Executive Secretary, welcomed and thanked the participants, highlighting the difficulties of working online during the COVID-19 pandemic. The Chairman proceeded to review the Agenda which was adopted without changes (**Appendix 1**).

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

Sections	*Rapporteur*
Items 1, 11	Taylor, N.G.
Item 2	Rosa, D.
Item 3	Palma C., Mayor C., Garcia, J., Rosa, D.
Item 4	Coelho, R., Lauretta, M. Parker, D., Mourato, B., Kimoto, A., Coelho, R., Gillespie, K., Parker, R., Hanke, A.
Item 5	Schirripa, M., Ortiz, M. Parker, D.
Item 6	Gillespie K., Hordyk, A., Rosa, D. Miller, S.
Item 7	Taylor, N.G., Kimoto, A., Ortiz, M.
Item 8	Brown, C., Hanke, A. Duprey, N.
Item 9	Taylor, N.G.

2. Review of historical and new information on biology

Presentation SCRS/P/2022/008 provided an update on the ICCAT swordfish biology programme. The programme is a collaborative project between institutes from 15 ICCAT CPCs and its goal is to address life history uncertainties important in the ICCAT swordfish assessments and MSE. A brief review was given on the number of swordfish sampled, sampling coverage, and the sampling materials obtained from fish in each of the stocks. The programme, now entering its fifth year, is now focusing on filling spatial-temporal gaps and analyzing samples for age and growth, reproduction, and stock differentiation.

The Secretariat informed the Group on a possible extension of phase 4, to allow for better use of the available funds and to fill additional gaps related to the collection of samples under the current phase. It was noted that for this phase most of the funds are already allocated to processing while a smaller portion is available for sampling, however this extension would be considered by the Group.

Presentation SCRS/P/2022/005 showed an update on the age and growth component of the biology programme for swordfish. For this component, both spines and otoliths are being collected and processed for comparison of age readings between both structures. Readings have started for the North Atlantic stock, and growth modelling will be conducted after the readings are finalized. The Group acknowledged and thanked the authors for the presentation. Document SCRS/2022/061 presented information with regards to conversion factors between Straight Lower Jaw Fork Length (S-LJFL) and Curved Lower Jaw Fork Length (C-LJFL) for swordfish in the North Atlantic. Sex and Month had a large effect on the predictions while Area had less of an effect. The differences between C-LJFL and S-LJFL increase as specimens grow to larger sizes.

The Group considered this work to be extremely important and useful. It was noted that the conversion between curved and straight LJFL would be most impacted in the spawning season. The authors noted that a difference was found particularly in the northwest in the months from July to September, with the fish being in a better condition (more curve), however this would only translate in around 1 cm difference. It was further noted that this would probably be due to feeding, as that area is not a spawning ground. This work is ongoing and further sampling and analysis will be conducted.

A question was asked if the Group would decide to use the curved or straight fork length. It was noted that both have been used to report Task 2 data. Moreover, with the standardization of the analysis on the size data (SCRS/2022/060), the Secretariat has converted all sizes to straight LJFL, as this should be the standard measurement type to be used in the assessment.

It was noted that the current paper only presented equations to estimate curved LJFL from straight LJFL. The authors provided an updated version before the end of the meeting (aiming at publication of the document in the ICCAT Col. Vol. Sci. Pap.) that includes conversions for both measurements (i.e., straight LJFL to curve LJFL, and vice-versa). It was also agreed that the Secretariat would update the size revisions to be used in the stock assessment based on those new equations.

3. Review of fishery statistics and tagging data

The Secretariat presented to the Group the most up to date (as of 20 March 2022) fishery statistics information available in the ICCAT database system (ICCAT-DB) in relation to swordfish (*Xiphias gladius*, SWO) for both Atlantic stocks (SWO-N: North Atlantic; SWO-S: South Atlantic). The datasets revised by the Group includes, Task 1 nominal catches (T1NC), Task 2 catch and effort (T2CE), Task 2 size frequencies (T2SZ), Task 2 catch-at-size estimated/reported by CPCs (T2CS), and the most recent CATDIS estimations (T1NC catches distributed by trimester and 5x5 squares, between 1950 and 2020). The CATDIS, published in the ICCAT Statistical Bulletin Vol. 47, reflects the SWO T1NC information received until January 2022. The existing swordfish conventional tagging (and electronic tagging at a minor extent) information was also presented and revised by the Group.

3.1 Task 1 (catches) Data

After the large and comprehensive revision made by this Group in 2017 (detailed in Appendix 5 of Anon. 2017a), where the entire catch series (1950-2015) of both SWO Atlantic stocks (SWO-N and SWO-S) were fully revised and updated (reduced unclassified gears, gap completion, reclassified erroneous gears, corrections to sampling areas and stocks, etc.), no major corrections were made to T1NC for that period. Only the catches for the period 2015-2020 were addressed in detail at this meeting.

The T1NC gaps identified on both SWO Atlantic stocks (catch series period: 2015-2020) for the most important flag/gear combinations, were completed with carry overs (average of the previous three years). The gap completion table is summarised in **Table 1**. By default, all the T1NC gaps completed with this approach are considered preliminary and must be replaced by CPC official statistics in the future.

In addition, some preliminary catches were obtained during the meeting for the Venezuela artisanal drift gillnet fleet (2015-2020), the Senegal longline, handline and gillnet fleets (2020). An historical recovery on SWO-N catches was presented by Costa Rica for National mid-scale longline fleet fishing on Costa Rica EEZ waters and covering the period 1999 to 2020 (SCRS/2022/047).

Finally, the Group adopted all the T1NC updates described above, noting that some catches of Marrocco and Senegal still have to be finalized by the end of March 2022. The revised T1NC catches are presented in **Table 2** (total catches by stock and major gear, between 1950 and 2020) and **Table 2a** (total landings and dead discards by major gear and flag, between 1990 and 2020)**.** Graphically, the total SWO catches for the Atlantic stocks are presented in **Figure 1** (SWO-N) and **Figure 2** (SWO-S). A dashboard to dynamically navigate through T1NC was also prepared by the Secretariat (**Figure3**)

In relation to the progress made on reporting SWO discards (DD: discarded dead; DL: discarded live; DM: mortality estimates obtained from DL) in T1NC by ICCAT CPCs, the Secretariat informed that, very little progress has been made. Very few CPCs have reported discards (DD and DL shown in **Table 3**). The Group reiterated the need to improve the reporting of both dead and alive discards.

Only one document with historical revisions of T1NC was presented at the meeting. Document SCRS/2022/047 presented a historical revision of the swordfish (*Xiphias gladius*) landings of the Costa Rican mid-scale longline fleet (in recent years about three vessels with length overall ranging from 15 to 20 meters) fishing in the Caribbean Sea for the period 1999 to 2020. The swordfish catches in their majority are bycatch. The basic information (number of longline vessels and corresponding catches) is recorded and managed by the Costa Rica Institute of Fisheries and Aquaculture.

The Group congratulated Costa Rica for the work in providing this totally new catch series with 17 years to ICCAT. The catch series covers a much larger period then the last five years in which Costa Rica is a Cooperating party to ICCAT. The Group also encouraged Costa Rica to expand its work in understanding the seasonality of the SWO catches in this poorly known area of the Caribbean Sea.

The Group mentioned the importance of having scientific documents involving T1NC revisions to validate and improve the current T1NC held in ICCAT.

The Secretariat also presented to the Group the most recent update to CATDIS with SWO estimates (derived T1NC information with catches distributed by trimester and in 5x5 squares, reflecting the catch and effort space-time available in ICCAT). The SWO maps with catches by decade (1950-2020) and gear are presented in **Figure 4**. The overall SWO catches (all years) by gear are presented in **Figure 5**.

The CATDIS is the main source of catch information entering into SS3 modelling approaches when working with quarterly catch series. This update reflects the T1NC information received until 31 January 2022. In order to have both T1NC and CATDIS synchronised, additional changes to T1NC since that date need to be incorporated into CATDIS. The Group adopted 1 April 2022 as the deadline to have completed this for both T1NC and CATDIS.

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

The SWO standard SCRS catalogues (T1NC and T2CE/SZ/CS availability, ranked by importance in the total SWO stock production within the period 1991 to 2020) were updated and presented to the Group (SWO-N in **Table 4**, and SWO-S in **Table 5**). The SCRS catalogue is an instrument that allows to see a combined view of Task 1 and Task 2 datasets by major fishery.

Task 2 catch and effort (T2CE)

T2CE datasets are identified in the SCRS catalogues with the character “a”. The Secretariat reminded the Group that these catalogues no longer show (since 2015, as recommended by the SC-STAT) T2CE datasets with poor time-area resolution (e.g.: datasets aggregated by year and/or datasets with 10x20/20x20 geographical grids aggregation levels) available in the ICCAT-DB but usually not used in any scientific work. The rationale behind this is to encourage CPCs to report improved datasets to ICCAT to replace those identified as “poor” in terms of time-area resolution.

The Secretariat informed the Group that very minor improvements were made to T2CE (when compared with T2CE data available in the 2017 Stock Assessment session, Anon. 2017b) in both SWO Atlantic stocks. There are however, several incomplete T2CE longline series (Belize, Korea Rep., Namibia and Vanuatu) affecting both SWO Atlantic stocks, which would require full revisions. The Group recommended that CPC scientists use standard SCRS catalogues as a tool to identify any missing data.

Task 2 size frequencies

Task 2 size samples and catch at size, respectively, must be reported to ICCAT in two different electronic forms:

- ST04-T2SZ: observed size frequencies (T2SZ)
- ST05-T2CS: CPC estimations of the size composition of the catches (T2CS). Also known as reported CAS.

The SWO standard SCRS catalogues show the availability of both T2SZ (character "b") and T2CS (character "c"). As for T2CE, these catalogues do not show T2SZ/CS datasets with poor quality (poor time-area detail, size/weight bins larger than 5 cm/kg) available in ICCAT-DB but usually not used in scientific work (like overall CAS matrix estimations). Overall, the tendency to report higher resolution T2SZ/CS datasets has been maintained in the last decade. For both stocks there is a lack of some important datasets in various years.

The Group considers that the Secretariat's ongoing (since 2010) Task 2 data recovery/improvement work should continue with active participation of the CPC scientists.

In the preparation of the current SWO data preparatory, USA recovered and provided to ICCAT the SWO dead discard size samples (T2SZ) for the period 1992-2009, a missing series unavailable in the ICCAT-DB (data recovery requested by this Group in 2017). This information was made available to the Group which approved it.

Other CPCs including Belize, Brazil, China PR, Côte d'Ivoire, Korea Rep., Panama, St. Vincent and Grenadines, and UK-Bermuda, should provide updates of Task 2 size data with higher resolution due to incomplete series or highly aggregated time are data. The Secretariat will provide support in those revisions.

No new SCRS documents that included Task 2 revisions or recoveries were presented to the Group by ICCAT CPCs. The Secretariat presented, however, a detailed analysis of all the T2SZ information available in the ICCAT-DB.

Document SCRS/2022/060 presented the size sampling data of North and South Atlantic swordfish stocks. Size data were reviewed, and preliminary analyses were performed for its use within the stock assessment models. The size samples data were standardized to straight-lower jaw fork length units and aggregated to size frequencies samples by main fleet/gear type, year, and quarter. For the North and South Atlantic stocks, the size sampling proportion among the major fishing gears is consistent with the proportion of the catch since 1990, and most of the size samples come from the longline fisheries. The number of fish measured has decreased substantially in the last decades from both the North and South Atlantic fisheries. A review of the size-frequency data by fleets indicated no unusual shift of size data around 1992/93, which had previously been noted, for the main longline fleets. Size frequency data were aggregated by year, quarter, and fleetID for 5 cm lower limit size-class bin.

The Secretariat informed the Group that the detailed analysis presented reflects the T2SZ information available in December 2021. The document should be updated with the most recent T2SZ presented to the Group, which contains new size data recently added (e.g.: USA discard T2SZ series, Spanish longline T2SZ series obtained from T2CS) and the new curved/lower jaw straight fork length relationships (SCRS/2022/061). While some CPCs report size samples from all sources in ST04, the Group noted that some CPCs reported SWO size samples recorded by Domestic Observer Programmes only using the ST09 form (i.e., not reported on ST04 at all). Size samples reported this way are not being included by the Secretariat in the preparation of Task 2 size samples (form ST04) to be used as input for the stock assessment models, as there is no information to determine if information is doubly reported. The Group agreed that all size samples (including dead and live discards), regardless of how they were collected, should be reported using the ST04 form.

3.3 Catch-at-size, Catch-at-age, Weight at Age

No updates of the overall catch-at-size (CAS) matrix estimates were made for this assessment. Thus, no catch-at-age/weight-at-age derived estimates were made.

3.4 Tagging data

The Secretariat presented a summary of swordfish conventional tagging updated. **Table 6** shows releases and recoveries per year and **Table 7** shows the number of recoveries grouped by number of years at liberty. Three additional figures summarise geographically the SWO conventional tagging available in ICCAT: the density of releases in 5x5 squares (**Figure 6**), the density of recoveries in 5x5 squares (**Figure 7**) and the SWO apparent movement (arrows from release to recovery locations) (**Figure 8)**. In addition, the Secretariat also presented a swordfish dashboard to visualize tagging data dynamically and interactively (Snapshot in **Figure 9**).

The Group acknowledged the work of the Secretariat to develop the tagging dashboard and its usefulness. It was noted that under "Releases" the field "fleet" does not always match with the fleet that tagged the fish, but with a tagging programme, for example, tags reported as USA are sometimes tags distributed to other fleets to tag swordfish. The Group was informed by the Secretariat that the conventional tagging database is being revised aiming to recover (from the original files reported to ICCAT) and include the sex information. This was a request made by the Sharks Species Group.

The Secretariat has informed the Group that it has faced difficulties in incorporating the conventional tagging data reported by the USA between 2009 and 2016 (all species including SWO), and that the ICCAT-USA 2008 data exchange protocol on conventional tagging (Anon., 2009) may need a revision. The proposed solution by the Group to solve this problem is that the Secretariat works directly with USA scientists to (a) revise the existing data exchange protocol and (b) work on a complete submission by USA of all the conventional tagging datasets (which incorporates all the revisions to historical records).

In addition, the Group recommended that additional effort be devoted to recovering all SWO tagging data (conventional and electronic) from other projects outside ICCAT (see current ICCAT electronic tagging inventory at: https://www.iccat.int/Data/Tag/ElecTags_consolidation.7z).

Document SCRS/2022/052 presented results for tagging funded through ICCAT (16 tags) and NOAA (10 tags). Of the 26 tagged individuals, data for eight was analysed for horizontal and vertical movements. In both the North and South Atlantic swordfish moved in several directions and travelled considerable distances. Vertically, swordfish spent the night-time close to the surface and the daytime in deeper/cooler waters. Additional tags are available, and tagging will continue through 2022.

The author was asked about the tagging process. In the longline commercial vessels, swordfish are kept in the water as much as possible and tagged with a pole on the dorsal side below the dorsal fin base, the tags had a single tether. In the case of the harpoon fishery tagging, a harpoon was modified to tag, with one tag having a Domeier's dart and the other three being equipped with small titanium darts.

The Group was informed that tags from a batch with battery issues were replaced by Wildlife Computers and additional three goodwill tags were also provided.

Regarding future tagging events, it was noted that the areas close to the current stock boundaries are a priority, however tagging in other areas could also be possible. Canadian and Brazilian scientists showed interest in deploying the tags that have not yet been distributed. Additionally, USA and Canadian scientists have expressed interest in contributing with further tag data for the analysis with tags deployed in their domestic tagging programmes. The Group was informed of a tag deployed off Florida that was recovered by the EU-Spain fleet and will be returned through the assistance of IEO (*Instituto Español de Oceanografia*); this will allow for detailed data recovery (data recorded by the tag every 5 seconds).

The Group was also informed that one of the tags deployed in the Mediterranean has pop-up and is stranded in the beach. Attempts to recover it were made but it has not yet been possible to do so, therefore the Group considers to be important to have hand-held Argos receivers that could be used to recover tags (see Recommendations section).

The high post-release mortality rate and the high percentage of premature releases was noted, resulting in few analysed tag data despite the tagging effort. It was noted that tagging in commercial longline vessels could lead to these mortality rates, as swordfish, despite being in good condition could have been hooked for varying times, decreasing the chance of survival. Tagging in harpoon or sports fishing is expected to have a higher survivorship. Regarding premature releases, this happens in several species and few solutions have been put forward to mitigate this aspect. Double tethers can be considered, but those also present some logistical complications, especially when tagging in larger commercial vessels.

The Secretariat informed the Group that a new electronic database is being developed and the tagging data should be made available in the next 1-2 years. Some tagging data is already available in an OwnCloud for sharing data between those that are contributing data. This will be continued as more data becomes available.

4. Indices of abundance (individual and combined indices)

The Group reviewed 17 fleet specific indices of relative abundance: 10 indices for the North Atlantic stock, and 7 indices for the South Atlantic stock. North Atlantic indices included nine pelagic longline standardized catch-per-unit-effort (CPUE) indices, and a larval survey index from the northern Gulf of Mexico. All seven indices for the South Atlantic were pelagic longline standardized CPUE indices. Discussions highlighted the need to 1) distinguish between retained catches only versus indices that record kept and discarded fish, 2) indices metrics in weight versus numbers of fish, 3) spatiotemporal properties, 4) standardization model assumptions and diagnostics, and 5) age or size classes referenced by the index. These were noted as particularly important for determining use in Stock Synthesis versus production models, as well as the joint longline analyses. The Group discussed the CPUE evaluation table recommended by the Working Group on Stock Assessment Methods (WGSAM) for both stocks (**Table 8** and **10** for North and South Atlantic stocks, respectively). **Table 9** lists the index values for the North Atlantic, and **Table 11** lists the index values for the South Atlantic. **Figures 10** and **11** plot the indices by stock.

The following list provides a summary of the different indices recommended for use in the stock assessment, followed by a detailed section on each index considered and the Group discussions.

North Atlantic indices of relative abundance:

- Canada longlines (1962-2021): retained numbers of fish/(an effort offset) logbooks.
- EU-Portugal longlines (1999-2020: retained and discarded weight/effort, observer/self-reported
- EU-Spain longlines (1986-2019): retained weight of fish/effort, landing and voluntary trip records provided by the fleet, production models only.
- EU-Spain longlines Age-specific (1982-2019): retained numbers of fish/effort, ages 1-5, landing and voluntary trip records provided by the fleet, for Stock Synthesis only excluding the age-1 index for 2016-2019.
- Japan longlines (1976-1993, 1994-2020 except 2000-2005): retained numbers of fish/(an effort offset), logbooks.
- U.S. longlines (1993-2020): retained and discarded numbers of fish/effort, observers.
- Chinese Taipei longlines (1968-1989, 1997-2020): retained numbers of fish/effort, logbooks.
- Morocco longlines (2005-2020): retained weight/effort, landing reports, revision recommended (completed and accepted by the Group before the conclusion of the meeting).

South Atlantic indices of relative abundance:

- Brazil longlines (1994-2020): retained numbers of fish/effort, logbooks.
- EU-Spain longlines (1989-2019): retained weight of fish/effort, landings/ landing and voluntary trip records provided by the fleet.
- Japan longlines (1976-1993, 1994-2020): retained numbers of fish/(an effort offset), logbooks.
- Uruguay longlines (2001-2012): retained numbers of fish/effort, observers.
- Chinese Taipei longlines (1968-1990, 1998-2020): retained numbers of fish/effort, logbooks.
- South Africa longlines (2004-2020): retained weight of fish/effort, logbooks.

4.1 North Atlantic Indices

Japan longline CPUE (SCRS/2022/046): JPN LL

Japanese longline operational data were standardized by two separate regions (North and South of the 5°N latitude stock boundary) and split into two time periods (Early: 1976-1993, and Late: 1994-2020). Multiple GLMMs were tested, including alternative factor treatments and error distribution assumptions. A Bayesian spatiotemporal GLMM was applied for the base index assuming 1x1 spatial and quarterly strata. The index values for the period 2000-2005 were recommended to be excluded from the stock assessment models due to changes in the collected data structure. It was recommended to the author that the standardization of CPUE evaluate the effect of including the input data for 2000-2005 years within the spatiotemporal model of standardization used so that this might be reviewed for the 2022 Stock Assessment meeting (20-29 June 2022).

The Group noted that the 2017 CPUE showed a steep decline plus that 1974-1975, and 2020 CPUE were not used. The author answered that before 1975, there were no data about the hooks between floats and vessel name.

The Group noted the change in model structure from previous analyses that focused on a core fishery area to the wider data spatial coverage and application of the spatial mixed effects model. The model can be considered more robust to uncertainty in swordfish distribution relative to the core area assumptions. The final indices were the summarized posterior distributions of the least squared (LS) means (R-INLA), and it was noted that model uncertainty estimates, and credible intervals are not directly comparable to the estimates of CV and confidence intervals from maximum likelihood estimators used in the fixed effects GLMs.

The Group had some concerns in the trends and heterogeneity of the model residuals and suggested looking at plots of the residuals by predictor variable. The author agreed that there are some nonrandom residual patterns with regards to the predicted zero catch values, likely due to the occurrence of swordfish as a bycatch species and a considerable number of zero observations in the data. The author also noted that multiple model constructs were tested, and the final model was chosen based on goodness of fit and information criteria statistics.

The Group requested additional summary plots for the index, including:

1. A plot comparing the new index with the prior one used in the 2017 Stock Assessment.
2. Additional residual plots requested (Q-Q plots, residuals by factor).
3. Recalculate the standardization of the late period indices, excluding the 2000-2005 data.
4. Rescaling on the nominal series separately for the two periods as well as the two standardized CPUE series to better see the yearly effect.

The Group reviewed the requested summary plots. Morocco scientists presented the updated CPUEs using a random effect for the year: month interaction, including diagnostics. The Group noted that the diagnostics were in general acceptable, even though the QQ plot showed some extreme outliers. The Group asked for several additional plots, namely the residuals against the month and year predictors; these were shown during the meeting. There were also issues related with the calculation of the CVs, and those were to be corrected in the final version. The author agreed to update the paper with those new analysis. The Group agreed that the final index was accepted to be used in the assessment models.

The Group recommended the spatiotemporal mixed model approaches be further evaluated by the WGSAM. In particular, it would be highly informative if these types of models could be tested with LLSIM data to compare performance with the other GLM and GLMM approaches that have been previously simulation tested.

Canadian longline CPUE (SCRS/2022/048), CAN LL

Two indices of swordfish relative abundance for the Canadian longline fishery were presented. The first was a strict update of the index used in the 2017 Stock Assessment and the other included a habitat covariate. The Group commented that the drop in CPUE during the 1990s seemed to correspond with the trend in the habitat index. The authors mentioned the habitat index presented covered the entire spatial area, but the trend corresponding to the area fished may be different. The authors noted that a considerable amount of habitat values assigned to the Canadian data resulted in a zero-habitat score, despite those areas being a known hotspot for swordfish in the region. This was especially the case for inshore areas. The authors of the habitat index will further explore approaches to solve the issue, noting that in the oceanographic models the edges and areas close to shore are where errors are more likely to occur.

The Group discussed the splitting of the index during the 2017 Stock Assessment but confirmed the recommendation that the updated index be modeled as a continuous series in the 2022 Stock Assessment. The analyst clarified that the methods were updated to run all samples at an aggregated trip level to produce a continuous series, while the prior analysis treated the early trip-level data for the whole time period and at the set-level for more recent data.

Chinese Taipei longline CPUE (SCRS/2022/050), CTP LL

SCRS/2022/050 presented the abundance index of swordfish for the Chinese Taipei tuna longline fishery in the North Atlantic Ocean. To address the impact of a targeting shift from albacore to bigeye tuna, catch and effort data were standardized by period using generalized linear models. The early period starts from 1968 to 1989 and the late period from 1997 to 2020 with operation type information considered in the analysis. The abundance trend showed a decreasing trend in the very early period, but suddenly increased to a higher level during the early 1990s as a result of the targeting change, and then dropped sharply in the late 1990s and stabilized until present.

The Group discussed this updated analysis and especially with regard to the earlier period. The authors clarified that there were no differences between 1968 and 1989 compared to the last 2017 Stock Assessment, and that the differences in the analysis are in the more recent periods. The recommendation was to use the two period indices, one for the period 1968 to 1989, the second for the period 1997 to 2020, and excluding 1990-1996. The Group requested the figures comparing the nominal be rescaled for the two periods separately, which were provided during the meeting. Additionally, it was suggested that alternative targeting variables could be explored that look at catch clustering.

EU-Portugal longline CPUE (SCRS/2022/054), POR LL

SCRS/2022/054 provided standardized CPUEs for swordfish captured by EU-Portugal pelagic longline fishery in the North Atlantic Ocean. The analysis was based on data collected from fishery observers and self-sampling (where measurements were taken by the crew), collected between 1995 and 2020. In general, the nominal CPUE trends increased during the period with some inter-annual variability. Various models were tested, and the final model was a GLM Tweedie, with interactions and the use of the habitat index variable. The standardized CPUEs showed similar trends with an overall increase during the period, with some oscillations.

The Group asked about the depth of the fishing operations and especially if there was some deeper swordfish fishing, such as the meso-pelagic fishery in the Mediterranean. The authors clarified that this fleet always operates in shallow depths during the night, and that there are no meso-pelagic operations taking place. The Group also asked about the size distribution and if there had been any changes. The authors clarified that for this fleet the sizes have remained mostly stable along the entire period, with some increases in mean sizes around the late 2000s.

United States longline CPUE (SCRS/2022/055), USA LL

Annual indices of swordfish relative abundance in the western Atlantic Ocean for the period 1993 to 2021 were presented, based on the United States pelagic longline observer data. A negative binomial generalized linear model evaluated multiple factors considered to affect swordfish catch rates, including year, month, fishing area, gear characteristics, and environmental conditions. Significant factors included year, month, area, target species, sea surface temperature, hook type, bait type, day/night, and light sticks. Methods followed the previous analysis and recommendations and incorporated an additional six years of data (2016 to 2021).

The Group acknowledged the detailed information and model diagnostics provided, including the influence plots as particularly helpful to understand the factor effects on model standardization, as well as the usefulness of seeing the index time series with the various fleet regulations timing overlaid. The author agreed that the influence plots are a highly informative diagnostic and offered to share model code to be considered in the best practices guide for diagnostics in CPUE standardization.

The Group asked, with regards to the various hook types and fleet-wide regulations, if there was sufficient data and overlap in the transition period. The author explained that there was a period with experimental hook sets where hook type was tested, as well as a period of overlap in the data where both types were deployed. They further noted that those experiments were conducted in particular areas, and there could be some potential confounding effects. However, the author noted that there was significant work done on the model standardization for the last Stock Assessment in 2017, including testing different data treatments, factor inclusion, model structures, and explicit evaluation of hook type effects estimated across the data series and compared to the experimental treatment with overall good agreement between the two approaches.

Moroccan longline CPUE (SCRS/2022/056), MOR LL

A lognormal GLM of Moroccan longline swordfish CPUE was used to update the standardized index of abundance. The fleet targeted swordfish south of the Moroccan Atlantic Coast during the period 2005-2020. The analysis covered a total of 1796 trips. The index showed considerable fluctuations over the time series, with a decline observed to 2018, but increased since then.

The Group noted the relatively few factors included in the standardization (i.e., only year and month), and asked for clarification on the Year-Month interaction and model performance on the large number of model parameters for available data. The authors clarified that in some of the combinations there was no data, so parameters were not estimated for all the possible combinations (as seen in the degrees of freedom).

The Group asked for clarification on the index calculations from the LSMeans, given the year-month fixed interaction. It was noted it would be useful to provide a plot with the time series of the year effect for each month, as with an interaction the trends of the years for each of the months will be different. The Group noted options for alternative factor treatments, including modeling the interaction as a random effect. It was also noted that the LSMeans package in R estimated the yearly mean incorporating the interaction automatically. The Group requested a comparison on the provided index with a model that treated the year*month interaction as a random effect to validate the index estimates.

Gulf of Mexico larval index (SCRS/2022/059), GOM larval

Fishery independent indices of swordfish spawning biomass in the Gulf of Mexico were presented utilizing NOAA Fisheries ichthyoplankton survey data collected from 1982 through 2019. Indices were developed using the occurrence of larvae sampled with neuston gear using a zero-inflated binomial model, including the following covariates: time of day, month, area sampled, year, gear and habitat score. The habitat score was based on the presence/absence of other ichthyoplankton taxa and temperature and salinity at the sampling station.

The Group commented on the results with regards to the temperature and salinity, and that it would be useful to plot not only the frequency of occurrence of the positives but for all the distribution of all the tows carried out in the entire areas. The Group asked about the correlation between larval density and density of larval predators. The author pointed out that there is a plot in the paper with the occurrence of SWO larvae in comparison with other taxa, and that in most cases the p-values for the correlations are low.

The Group discussed the low number of specimens associated with the index, which ranged between 0 and 19 total individuals detected per year. Specifically, the Group questioned the timing and location of the survey relative to swordfish spawning areas/seasons, and how representative the survey may be compared to the total swordfish spawning biomass. The author pointed out that previous work in the Gulf carried out year-round surveys and found that most of the SWO larvae were found during the period of April and May, corresponding to the survey data collected for the study.

The Group also commented on the high interannual variability, likely associated with the relatively low occurrence of a few specimens per year, and that the variability is likely outside the range of biological plausibility. This includes years with zero detections and resulting index values equal to zero, which does not likely characterize the stock spawning biomass changes over time. It was recommended that size-related mortality be considered for the next assessment. The index was excluded from the last assessment and is recommended to be excluded for this assessment.

EU-Spain longline indices (Ramos-Cartelle et al., 2022 and Mejuto et al., 2022), SPN LL

The authors provided a presentation summarizing the document presented in 2021 with updated swordfish indices from the Spanish longline fleet for the period 1986 to 2019. Ramos-Cartelle *et al.*, 2022 updated the swordfish standardized catch rates (in weight and in numbers), while Mejuto *et al.,* 2022 updated age-specific 1-5+ catch rates in number of fish also for the North Atlantic. The standardized CPUE for age 1 suggests a very positive phase of recruitments during 1997-2019, which resulted in positive effects on other ages including age 5+ and the subsequent demographic changes since mid-1990s onwards.

The indexes incorporated important changes in fishing strategy, including gear monofilament and fleet targeting. From the two alternative data treatments presented, the biomass index is recommended for use in the surplus production models, and the age-specific abundance indices for use in Stock Synthesis. The authors noted a reduction in the number of observations after 2011 fulfilling the strict sampling protocol established for the age-specific analysis, as well as a change in the current management system implemented at domestic level based on the strict annual quota per vessel that is likely causing an underestimate in the abundance index in relation to the fishing strategy of previous historical period. Additionally, the minimum size tolerance was unilaterally cancelled by the CPC at a domestic level between 2007 and 2009, but the confusion generated has been carried over to the present. Therefore, values of CPUE age 1 should be considered with caution since year 2010 but especially for the most recent periods and at least after 2015 in particular since they were probably underestimated. The authors of the paper recommend rejecting, at the very least, those values of age 1 since from 2016 (inclusive) onwards.

4.2 South Atlantic Indices

Five documents describing the standardization methods, and associated CPUE time series, were presented in the Data Preparatory meeting from the following CPCs: Brazil, EU-Spain, Japan, South Africa and Chinese Taipei. In addition, two sets of relative abundance indices from Uruguay, that had previously been presented (Pons *et al*., 2014 and Forselledo *et al.,* 2018) were made available to the Group as background documents but had not been updated. The Group noted that most of the indices that were available for the last 2017 Swordfish Stock Assessment (2017) had been updated, except for the Uruguay longline (where the fishery ended in 2012). The Group welcomed the increase in submissions of swordfish CPUE standardization papers from the South Atlantic since the previous Swordfish Data Preparatory meeting in 2017 and acknowledged the participation of the CPC scientists.

Brazilian longline indices (SCRS/2022/057), BRA LL

Standardized catch rates of swordfish from the Brazilian longline fleet were produced for the period 1994-2020. The analysis included catch and effort data distributed across a wide area of the Southern Atlantic Ocean, aggregated by 5x5 spatial squares. The standardization model was a GLM using a Delta Log-normal approach that included year, quarter, clusters, hooks per floats, number of hooks, and spatial square. The results indicate an initial decreasing trend between 1996 and 2001 that remained relatively stable thereafter to 2015. A steady decrease was observed at the end of the time series (2016-2020).

The Group acknowledged the updated methodology applied, particularly the data preparation processes, which resulted in the removal of the historical period (1978-1993) that was characterized by high variability yet flat overall trend. Under the revised data treatments, the splitting of the index in the previous assessment has now changed to a recommendation to use a continuous series from 1994 to 2020. Also, the authors explained that the American-type longline was introduced in the Brazilian fleet in 1994, when the swordfish became the target species, minimizing, at least partially, the impact of the target species change in the updated time series and used only logbook data, which differed from the used approach in the previous analysis

Spanish longline indices (Ramos-Cartelle et al., 2021), SPN LL

The authors provided a summary presentation of the updated EU-Spain longline index presented last year. Two indices (in weight and in number) were prepared for the period 1989-2019, each showing a period of stability (1993-2004) followed by a slight but sustained upward trend.

The Group noted that the recent increasing CPUE trend reported by EU-Spain for the South Atlantic was a result of an increase in the number of fish, in contrast to the North Atlantic where the observed increase in CPUE by EU-Spain was attributed to an increase in the average size of fish. The Group recommended evaluation of the targeting variable which was modeled as the fraction of SWO in the catch, particularly exploratory analyses that depict the relationship between the annual median/mean ratio and the estimated CPUE the index values. Further recommendations were made to explore alternative targeting metrics (e.g., the South African longline targeting cluster approach), but it was noted that the approach is more effective in fisheries with numerous species caught and less effective in those with a limited number of species observed.

Japan longline indices (SCRS/2022/046), JPN LL

The document is discussed in the previous section 4.1, and the recommendations are consistent with those for the North Atlantic indices. The recommendation is to use the index for the South Atlantic by two periods, 1976 to 1993, and 1994 to 2020. The additional data plots requested for the North Atlantic were also requested for the South.

Uruguay longline indices (Forselledo et al., 2017, Pons et al., 2014), URU LL

This was a historical series and remained unchanged from the previous assessment. This was from a fishery that has now ceased.

South Africa longline indices (SCRS/2022/049), ZAF LL

Standardized catch rates of swordfish from the South African longline fleet (2004-2020) were modeled using a GAMM with a Tweedie distributed error. A targeting factor was derived y clustering Principal Components Analysis (PCA) scores of the root-root transformed, normalized catch composition, and resulted in three clusters being included in the model. A definitive seasonal trend in catch rates was evident. Results indicate an initial decline (2004-2010) in CPUE followed by relative long-term stability thereafter, despite inter-annual variation.

The Group noted the variable *month* was fitted using a cyclic cubic smoothing function as opposed to the conventional method of treating seasonal parameters as factors, which resulted in a strong domed seasonality with a peak in June. The author indicated that the estimated seasonal pattern matched the observed seasonality of the fishery.

Chinese Taipei longline indices (SCRS/2022/051), CTP LL

SCRS/2022/051 presented the standardization of swordfish catch and effort data for the Chinese Taipei distant-water tuna longline fishery in the South Atlantic Ocean. The dataset was separated into three periods to consider changes in targeting, resulting in an early (1968-1990) and two late periods (1991-2020 and 1998-2020). In general, catch rates showed a decreasing trend through the 1970s, and stabilized during the 1980s. The trend started to decrease from the early 1990s, with a further drop to lower level in the late 1990s, and then stabilized over the two most recent decades (1998-2020).

The authors confirmed that catch ratios, as a proxy of targeting, were not explicitly included in the model but rather used to identify changes in targeting which were then treated as time blocks in the time series, resulting in the three various periods presented. Furthermore, the authors indicated that the periods 1968-1990 and 1998-2020 were considered most appropriate for stock assessment inclusion. Additionally, it was suggested alternative targeting variables could be explored that look at catch clustering.

4.3 Trends and correlations in the CPUE indices

The Group reviewed updated figures for trends and correlations of the CPUEs for each stock that were discussed at the 2017 Data Preparatory meeting. The aim was to identify CPUE data conflicts, understand the magnitude of correlation (both positive and negative) between CPUE indices, and capture the overall trends for the available indices. Especially the plot of the correlation matrix can identify similarities and dissimilarities of the indices. Generally, if indices represent the same stock components, then it is reasonable to expect them to be correlated. If indices are not correlated or negatively correlated, i.e., they show conflicting trends, this may result in poor fits to the data and bias in the estimates unless the models have some spatial structure. Therefore, the correlations can be used to select groups that represent a common hypothesis about the evolution of the stock. The Group also noted that the age range of catch and fishing areas for each fleet also need to be taken into account when the Group selects the indices for the stock assessment.

The Group reviewed **Figures 12** and **13** for the North and South Atlantic stocks.

North Atlantic

The following observations were made by the Group while reviewing the North Atlantic CPUE indices:

1. Indices in the NW Atlantic seem to have a general decreasing trend, while in the NE Atlantic are mostly increasing.
2. This pattern is similar to what had been observed in the last 2017 Stock Assessment. At the time the inclusion of an environmental effect in Stock Synthesis (related with AMO) allowed for the conflict to be reduced in the indices.
3. Some indices have relatively higher inter-annual variability when compared with others, especially in some years. The GOM larval survey is the index with the highest inter-annual variability.
4. The indices with the highest negative correlations indices (relative severity in brackets) were:
    a. EU-Spain LL and EU-Portugal LL (high)
    b. EU-Spain LL and Chinese Taipei LL1 (high)
    c. EU-Portugal LL and Japan LL2 (medium)
    d. EU-Portugal LL and Morocco LL (medium)
5. Positive correlations were observed between the following indices:
    a. EU-Spain LL and Japan LL1 (high)
    b. EU-Spain LL and Chinese Taipei LL2 (high)
    c. Canada LL and Chinese Taipei LL1 (medium)
    d. Gulf of Mexico larval survey and EU-Portugal LL (medium)

South Atlantic

The following observations were made by the Group while reviewing the South Atlantic CPUE indices:

1. Potential conflicting CPUE data between Japan LL2 (increasing) and Chinese Taipei LL2 (decreasing) from 2013 onwards.
2. The early period (1982-2002) of the Uruguay LL historical index has high annual variation.
3. The final point estimate (2012) of the Uruguay LL index deviates substantially from the previous years.
4. EU-Spain LL index has relatively low inter-annual variability, when compared with the other South Atlantic indices.
5. Negative correlations were observed between the following indices (relative severity in brackets):
    a. Brazil LL and Uruguay LL (high)
    b. EU-Spain LL and Brazil LL (high)
    c. EU-Spain LL and Chinese Taipei LL2 (high)
    d. Chinese Taipei LL2 and Japan LL2 (medium)
    e. Brazil LL and Japan LL2 (low)

6. Positive correlations were observed between the following indices:
    a. EU-Spain LL and Chinese Taipei LL1 (high)
    b. South Africa LL and Uruguay LL (high)
    c. Uruguay LL and Chinese Taipei LL2 (medium)
    d. EU-Spain LL and Japan LL2 (medium)

4.4 Determine indices to be used in the next assessment for the base-case and sensitivity runs CPUE table

The Group reviewed and updated the table (**Tables 8** and **9**), developed by WGSAM, describing the attributes of the CPUE indices that could be used in the modeling of the northern and southern swordfish stocks. A final decision on which indices to use was contingent on the evaluation of extra work assigned to particular index developers (Canada, Chinese Taipei, Japan, Morocco, Spain and Chinese Taipei). These extra tasks were to be completed before the conclusion of the meeting and were noted in the table.

The Group discussed whether the Canadian index should be split as in the 2017 Stock Assessment, and it was clarified that the Group in 2017 felt that it was justified because of the deviation of the nominal CPUE from the standardized CPUE. It should be noted however that other Species Groups (SKJ) encountering the same issue do not view a deviation from the nominal to be a criterion on which to evaluate the suitability of an index. It simply means the standardization is accounting for differences over time related to changes in q. The Group's final decision was to include the index as a single, continuous series in the 2022 Stock Assessment model.

Of the two Canadian CPUE series provided, the series that did not include habitat in the model was adopted due to concerns over having habitat suitability values of zero assigned to 20% of the fishing data which tended to occur in choice swordfish fishing areas.

It was agreed to drop the Japanese northern stock index values for 2000 to 2005 due to the low quality of the logbook data. It was also clarified that the CV for this index relates to Bayesian credible intervals derived from the posterior distribution of the estimates rather than by maximum likelihood estimation.

The USA indicators were based on strict updates and given that there was no support to include the larval survey in the 2017 Stock Assessment, it was recommended to exclude it from the current assessment. However, it was recognized that the larval index could be used post-assessment to compare its trend with the trend in the different components of the population.

The review of indices for the South Atlantic recognized that the updated Brazilian index is no longer split but is a continuous series from 1994 to 2020. Further, the Uruguayan indices were not updated due to the cessation of fishing.

Data inputs

The Group agreed to use Venezuela's recently submitted Task 1 and 2 data rather than catch estimates based on previous years; however, in Senegal's case it will be necessary to use an average of previous years catches to fill in missing catch.

It was noted that Canadian size composition data for the catch was submitted in form ST04 while form ST09 contains the at-sea-observer data including discards. It was recognized that the ST09 data should be submitted in form ST04 in order to be able to create the size compositions for the Canadian longline fleet. Given time constraints, a revision would not be possible in time to be included in the modeling, consequently it was agreed that Canada would provide the Secretariat with discard data in the requested format. Further, it was identified that several other fleets have provided discard size data in ST09. The most important of these was Chinese Taipei for which there is no evidence of catch below the legal limit in ST04. The Secretariat agreed to meld size composition data from forms ST09 and ST04 while attempting to avoiding duplication as much as possible.

Combined index

The Group discussed the creation of a combined index for the North that could be used in a surplus production model and to support the swordfish MSE. Many National Scientists (CAN, EU-Portugal, USA, and Chinese Taipei) have indicated that they are able to provide set level data by month and by 1x1 or 5x5 grid squares. It was noted by the USA that the resolution of the data will affect data set size because of confidentiality issues.

Morocco indicated that it could provide trip-level data for 5x5 grid cells and it was encouraged to conform with the request to the degree possible. For example, it was indicated that the depth of fishing could be a rough estimate. Japan's contribution of data by 5x5 grid square depends on receiving the necessary permissions. Spanish scientists are still to confirm data availability and co-authors of previous analyses will be consulted. It was noted that format for the additional information requested (i.e. the finer spatial-temporal resolution together with environmental data and gear features that have not already been submitted) was described in a template sent to National Scientists.

Noting that the data from National Scientists could be at different levels of aggregation, it was suggested to explore modeling techniques appropriate for this type of mixed data. It was noted that it was important to keep units consistent, most specifically, the type of catch (retained vs. retained and discarded) and units of measurement (number vs. weight).

Timeline

The Group reviewed and discussed the timeline for the delivery of assessment model inputs. The timeline was modified so that all model inputs sould be available by 15 April. Extra work related to the indices is to be completed during this meeting. Task 1 and Task 2 (including length composition for discarded lengths) related data inputs will be available by 7 April and data for the northern swordfish combined index is due on 10 April. The combined index should be available by 15 May 2022. No combined index will be developed for the South Atlantic because of time constraints.

It was proposed that a growth curve be developed from the samples from the Swordfish Sampling Programme and provided by 15 May for use in the assessment model. Concerns were expressed related to the proper vetting of the new growth information and the impact on the quality of the assessment work given the existing workload and time constraints. The Group resolved that estimating a new growth model must be given adequate time because of implications to the assessment outcomes. Accordingly, the Group agreed that establishing a new growth curve would occur in future assessment years but that time permitting and if the data are available, then a sensitivity run considering the new growth data may be considered.

It was also discussed whether to simply provide the new age information as an input to Stock Synthesis along with a prior based on the existing growth model and let Stock Synthesis estimate the growth curve, but concerns were expressed on how well the age data inputs would cooperate with the other data in the model. This approach also implies we are accepting the data. The Group discussed including the new growth information in a sensitivity analysis and it was felt that an uncertainty axis should be reserved for difficult to estimate parameters (e.g., steepness and natural mortality).

Finally, the Group recognized the importance of the combined index for advancing the work on northern swordfish MSE and the need to keep the MSE and assessment model inputs consistent.

Limit Reference Points

The Group briefly discussed the availability of new information for establishing a limit reference point (Blim) for the northern and southern Swordfish stocks. The interim Blim reference point is currently $0.4*B/B_{MSY}$ and new information is expected to be provided at the 2022 meeting of the WGSAM (31 May – 3 June 2022).

Projections

Guidance on how the projections will be conducted will be provided intersessionally.

5. Models to be used during the assessment and their assumptions

5.1 North

5.1.1 Surplus Production Models (ASPIC)

The surplus-production model incorporating covariates (ASPIC, Prager (1992)) will be used. The Group felt the continued use of this model would be educational in tracking the use of different modeling platforms over time.

Critical Model assumptions
In ASPIC catchability and selectivity of fisheries and indices are constant over the entire time period, any changes in catchability have to be modeled within the CPUE standardization process. There is an immediate response of the stock to fishing mortality, no age-delayed response.

Model Inputs
Catch and CPUEs non-age specific series. Catch should be Task 1 NC total removals (landings plus dead discards). To evaluate as sensitivity run by including mortalities estimates from the live discard reports.

Model outputs
Trajectories of F and B. Trajectories of relative F and B. Catchability q for each CPUE series. Confidence intervals. Carrying capacity K, B1/K, r. Projections

Diagnostics
Sum of Squares. Residual plots of the fits to CPUEs. Retrospective patterns. Jackknife evaluation of input CPUEs.

Key parameters
B1/K, K, r.

Uncertainties
The ASPIC model assessment model does not allow for the inclusion of uncertainty of the model inputs (e.g., CV of the CPUE series). In prior assessments, uncertainty in the CPUE series was incorporated by making separate runs using the median and upper and lower 95% confidence intervals, bootstrapping the results, and combining the bootstrap outputs. Running the model using different production functions was also deemed as being a way to assess uncertainty.

Model strengths and weaknesses
Because of the limited data requirements, this model is easier to be supported by the Secretariat. ASPIC is easy to use, and many National Scientists are familiar with its use. It is considered to be useful for data limited situations. ASPIC is fast to run and facilitates simulation testing. Because of the limited data requirements, it allows the use of longer time series where data from earlier periods are usually poor. It only estimates a few parameters, but these are typically the ones needed to provide management advice. ASPIC quickly produces diagnostics, bootstrap results, and projections. However, ASPIC as other SPMs does not necessarily reflect the true dynamics of the stock/fishery and it cannot take into consideration any variability in recruitment or changes in catchability. The model cannot accommodate changes in management regulations, like changes in minimum size, so this needs to be taken into account in the CPUE series. ASPIC often cannot resolve indices of abundance with conflicting trends.

5.1.2 Bayesian Surplus Production model - JABBA

The Bayesian Surplus Production model, Just Another Bayesian Biomass Assessment (JABBA); (Winker *et al.,* 2018) will be used. JABBA offers an implementation that models both process error and observation error. JABBA provides a user-friendly R to JAGS interface for fitting generalized Bayesian State-Space Surplus Production models with the aim to generate reproducible stock status estimates and diagnostics. JABBA is generalized in the sense that the production function can take on various forms, including conventional Fox and Schaefer production functions, and can be fit using a variety of error assumptions. Key parameters include carrying capacity (K), the maximum rate of population increase (r), and the ratio of stock biomass in the initial year to carrying capacity (Bo/K). The software enables Bayesian integration for computation of marginal posterior probability distributions for parameters and management variables and outputs for inclusion in Kobe plots.

Model assumptions
A one-year lag adequately characterizes the influence of annual stock biomass on future surplus production as in any production. Abundance indices are related to stock biomass via a constant of proportionality whereby there is no hyperdepletion or hyperstability in the index. Surplus production can be described by the Schaefer model, Fox model, or the flexible Pella-Tomlinson production function.

Model inputs
Catch series. CPUEs non-age specific. Priors for K, r, B0/K, process error deviates. A fixed value for the prior standard deviation in process error deviates. A CV for each abundance index that is constant over time, and if judged appropriate, an additive CV by year for each abundance index.

Model outputs
Posterior distributions for estimated parameters (r, K, Bo/K, sigma (index) if estimated, q(index)), stock biomass, MSY, annual F, F/F_{MSY}, B, B/B_{MSY}, and paired F/F_{MSY} and B/B_{MSY} estimates for Kobe plots.

Diagnostics
Plots of lognormal residuals of observed versus predicted CPUE indices by fleet, Root-Mean-Squared-Error (RMSE) and associated residuals runs-test to quantitatively evaluate the randomness of CPUE model residuals. MCMC convergence plots, plots of posterior median process error deviates by year, together with probability intervals by year, plots of post model pre-data distributions, priors, and posteriors. Retrospective patterns plots and hindcast cross-validation prediction skill. Jackknife analysis of CPUEs.

Key parameters
r, K, B0/K, B_{MSY}/K.

Uncertainties
Uncertainties in estimated parameters, model variables, shown in posterior distributions, standard deviations, coefficients of variation, probability intervals. Option to include process variance for all modeled years or only starting in the year when the first abundance index becomes available. Observation variance is separated to distinguish between fixed input variance and estimable variance, where the estimable observation variance can be set to be the same value for all abundance indices or estimated separately for each index.

Model strengths and weaknesses
The model is not age structured, so it cannot handle changes in vulnerability at age. It uses available biological parameters data to develop a prior distribution for r, consistent with an equivalent stock age structure dynamics. Training is required to run the software proficiently. As with other surplus production models, it may be biologically inaccurate and therefore might not reflect the true dynamics of the stock. JABBA runs quickly and by default generates many useful plots and diagnostic tools for stock assessments. JABBA is implemented as a flexible, user-friendly open-source tool to promote reproducibility and provide a platform for future research.

5.1.3 Stock Synthesis (SS)

As with the 2017 Stock Assessment (Anon., 2017b), the model Stock Synthesis (Methot and Wetzel, 2013) will be used in the North.

Critical Model assumptions
The Group discussed the continuity model run, noting some inconsistencies in the 2017 Stock Assessment input data that would be updated. Modelers indicated that compared to the 2017 model configuration there are many changes to the configuration of the model this time, some of which could be labor intensive to do an exact continuity model run in both ways, among others

1. The inclusion of discards and discard mortality.
2. Different time(s) split of the Japan CPUE series.
3. Updates on input size frequency data and catch series.

All biological and life history parameters will be carried over from the 2017 Stock Assessment.

The document SCRS/2022/041 presented a review and update proposal for the fleet structure for the Stock Synthesis model for N-SWO., The Group discussed it and agreed to the following changes compared to the 2017 Stock Assessment fleet structure:

- Inclusion of a "harpoon fleet", as they inform the model on the population dynamics of the larger/ older fish component of the stock, and the potential productivity of the stock as catches of the harpoon fleet in the 1950s reached 5 thousand t per year, albeit they only average 150 t in recent years. There is sufficient size information from the harpoon fisheries to inform the model, and it was suggested to assume an asymptotic selectivity pattern for this fleet.
- To create "others fleet", that will include catches from other LL fleets not elsewhere included, as well as the catches from other gears. It was decided to mimic the selectivity pattern of the US fleet (Fleet ID 2), and not include size information from other gears.

A summary of the updated fleet structure, catch, size input data, index associated, time period and other specific suggestions for each fleet is presented in **Table 12.**

One aspect of the swordfish fishery not included in the 2017 assessment model is that of the minimum legal size limits adopted by ICCAT in 1991 (Rec. 90-02) and 1996 (Rec. 95-10). Rec. 90-02 required CPCs to adopt a minimum size limit of 125 cm LJFL (25 kg live weight) with a 15% allowance for undersized fish. Rec. 95-10 allowed CPCs the additional choice of adopting a 119 cm LJFL with no allowance for undersize fish. The 2022 assessment will explicitly take these regulations into account by estimating dead discards resulting from the regulations (in length) within the assessment model, based on length frequency data. Reported dead discards will therefore not be included in the "catch" section of input data, as is typically done with stock assessment approaches; it is assumed that these fish were discarded in compliance with the minimum size regulations. See Schirripa and Hordyk (2021) for details on this method.

The Group also discussed the time blocks for the JPN LL fleet in particular. It was noted that compared to 2017, the current CPUE from Japan LL N-SWO was split at different years, the authors indicated that in 2021 the split of the index in 1994 was due to changes in the fishing gear and operations that imply changes in selectivity, while in the 2017 CPUE index the split was in response to the implementation of ICCAT management regulation that affected the fishery. It was also discussed the split of the Canadian LL index as in the 2017 assessment. The recommendation was to use as a continue series the Canadian LL index. The final decisions on the time blocks suggested for the stock synthesis model are provided in **Table 13** for the Japan LL fleet.

Furthermore, the following settings for the stock synthesis model were agreed by the Group for the initial model configurations of the 2022 evaluation.

- Canada longline and Canada/US harpoon selectivity are asymptotic; all other fishery selectivity is allowed to be dome shaped.

- A retention function corresponding to the minimum size limit will be implemented for each fleet (**Table 12a**).

- Fleet (and year if appropriate to account for such changes as circle hooks) specific discard/at-haulback mortality will be used where available, otherwise an average value will be used.

- Steepness will be attempted to be estimated. If the estimate is not deemed reliable it will be fixed at the previously estimated value from the 2017 Stock assessment (Anon., 2017b and h = 0.88).

Model inputs
Stock Synthesis provides a statistical framework for calibration of a population dynamics model using a diversity of fishery and survey data. SS is most flexible in its ability to utilize a wide diversity of age, size, and aggregate data from fisheries and surveys. It is designed to accommodate both age and size structure in the population and with multiple stock sub-areas. Selectivity can be cast as age specific only, size-specific in the observations only, or size-specific with the ability to capture the major effect of size-specific survivorship. While SS can accommodate a multitude of data types two are required, those being a catch time series and an index of abundance. Conversely, a model can be built that incorporates multiple areas, seasons, sexes, growth and growth morphs, as well as tagging data. Environmental data can also be used to modulate most any parameter within the model. Size and age structure, size-at-age, ageing error and bias, and sex ratio can also be incorporated.

Stock Synthesis will use the size frequency input data as presented in document SCRS/2022/060 supplemented with size information provided during the meeting, with size samples aggregated by fleet structure, and year, in 5 lower limit size bins. Size data has been standardized to straight lower jaw fork length units using the curved-straight LJFL presented at the meeting (SCRS/2022/061). It was noted that size frequency data for the Canadian and Chinese Taipei fleets will be updated to include the size sampling observations from their Domestic Observer Programmes, data that is not included in the ST04-SZ forms. The Secretariat will provide catch and size data according to the fleet structure agreed by the Group (**Table 12**) in the input formats for the stock synthesis model.

The Group discussed at length the information provided on landed and dead-discards reported by CPCs (**Table 2 and 2a**), size information provided in ST04-SZ show swordfish samples below the current minimum size restrictions of 119 cm or 125 cm LJFL or equivalent in weight (Rec. 17-02 paras 9 and 10, Rec. 17-03 paras 6 and 7) for almost all fisheries (SCRS/2022/060) that include landed as well dead discards. It was requested to clarify if the series of CPUEs provided included also retained and discarded fish. This information is important to correctly allocate within the stock synthesis model the catch and size fraction of retained vs discarded components, although it was noted that management regulations provide the option of minimum size or minimum weight retention. It was indicated that recent studies suggest a swordfish mortality at haul back of about 79% (Coelho and Muñoz-Lechuga, 2019) for EU-Portugal longline fleet with traditional J-hooks, while for the US longline fleet that use circle hooks, this mortality is lower at about 70% (Diaz, 2020) noting that those values are for the overall size range in the SWO catch. Coelho and Muñoz-Lechuga (2019) also provide an at-haulback mortality estimation specific for specimens under 125 cm LJFL for the EU-Portugal LL fleet, which is about 85%. Other studies from the South Atlantic indicated lower mortality (71.5%) possibly associated with lower temperatures and larger size class of the fish occurring within this fishery (Anon., 2017a). Live discards and mortality associated information are important to properly assess the effects of the current ICCAT on the N-SWO minimum size regulations as requested by the Commission to the SCRS.

Model outputs
The SS model output is commensurate with the complexity of the model configuration and observational data. All estimated parameters are output with standard deviations. Derived quantities include typical management benchmarks such as MSY, F_{MSY} and B_{MSY}, and SPR. Typical matrices of numbers-at-age, growth, age-length keys are also provided.

Diagnostics
Diagnostics are routinely examined through either the graphical and numeric r4SS R package or the accompanying spreadsheet, graphical as well as numeric. Diagnostics are generally a display of residuals of the fit to the observational data and derived quantities. Numerical output is also available in the form of the Hessian matrix, correlation matrix, and a parameter trace output. When run in the Markov Chain Monte Carlo MCMC mode, the posteriors are also output.

Uncertainty
Uncertainty can be captured in at least three ways: parameter standard deviation, the creation of bootstrap data files, or through MCMC techniques. The ADMB C++ software in which SS is written searches for the set of parameter values that maximize the goodness-of-fit, then calculates the variance of these parameters using inverse Hessian and MCMC methods. A management layer is also included in the model allowing uncertainty in estimated parameters to be propagated to the management quantities, thus facilitating a description of the risk of various possible management scenarios, including forecasts of possible annual catch limits.

For this assessment the variance-covariance matrix will be used to produce the uncertainty around estimates of F/F_{MSY} and B/B_{MSY} following the multivariate- delta approach (Walter and Winker, 2020).

The Group discussed the integration of uncertainty of the assessment, considering a single model uncertainty with sensitivity runs or alternatively an uncertainty grid design as has been developed with other species evaluations such as bigeye (Anon., 2021) in ICCAT. It was noted that often an uncertainty grid is used for key parameters in the model that are not possible to estimate with available data, such as natural mortality, steepness, or maturity. For the N-SWO stock, no new biological parameters were discussed at this meeting, it is expected that ongoing research on age and growth studies (SCRS/2022/008, SCRS/2022/005) will provide an update on the growth function for N-SWO, however the Group will need to review in detailed these results before they can be incorporated in the stock assessment. Therefore, the Group suggested that single model uncertainty and sensitivity analyses will be the approach to evaluate uncertainty for the present N-SWO assessment. It was further noted that in previous assessments, uncertainty from different model platforms such SPM and age-structured models were integrated as alternative option(s) to show uncertainty, particularly if the results from these models do not show similar results. This option is available for the current assessment upon reviewing the results from SPM for the N-SWO.

Key parameters
Key parameters of SS are dependent upon the model configuration created. However, since it is age-structured the rate of natural mortality is most critical. The steepness parameter is also critical as it dictates the rate of compensatory population growth.

Strength and weaknesses
SS can utilize a great number of different types of data sources to build a custom model within a consistent framework. This is its greatest strength as it allows the user to build a model with flexibility equal to that of the data. Pre-processing of data is less than some other frameworks as it is fully integrated within the model structure. Similar to a BSPM, SS has full Bayesian capability. Unlike VPA, it can be run without a catch-age-matrix by using only lengths or without lengths entirely. Consequently, no age slicing is needed. It allows for ways to explain changes in observations data that are due to changes in management or environment. Nearly all parameters can be made time varying in several ways. Forecasting is done within the integrated framework of the model construction. Some of the limitations of SS include a limited number of proficient users within the SCRS. Furthermore, because of its ability to create very complex models it can be slow to run relative to SPMs like ASPIC, but only if it is highly parameterized (i.e., run time depends on model complexity). The framework is capable of many options, so the user must be aware of model parsimony.

The Group discussed the strengths and weaknesses of including in the assessment process a surplus-production model that is similar to those embedded within the R-package that is being used for the MSE effort. The model will be fully tested within the MSE process. While the software has gone through a code review is not maintained as part of the ICCAT stock assessment software catalogue and thus has not been accepted for use to provide formal management advice. While the Group recognized the benefits of using this model as it has potential for future use, the Group currently lacks the capacity to employ this model.

5.2 South

The Group discussed potential stock assessment models to be applied to the South Atlantic, noting that the 2017 Stock Assessment included two models: JABBA and BSP2. Management advice in 2017 was derived from the JABBA assessment and there was consensus that JABBA would again be used in 2022 given that a continuity assessment would be beneficial. BSP2 is discontinued and will not be included in the 2022 assessment.

For SPMs, structural and biological uncertainty is typically represented in the form of alternative values of r and the shape m of the production function, where Schaefer and Fox formulations are the most common choices. The Group requested that efforts be made to develop prior distributions for r based on known life history information. This has previously been implemented in two ways:

1. Unifying Parameterization between ASMs and SPMs for comparison purposes (Winker *et al.*, 2020);

2. In the absence of reliable size and/or age structure information and in cases where life history parameters are uncertain, the R package FishLife was used to determine probable life history parameters from FishBase and then to generate distributions from a Multivariate Normal random generator based on predicted means and covariance matrices derived from FishLife (Winker *et al.*, 2018).

JABBA-Select was discussed as a potential model option as it incorporates life history parameters and fishing selectivity and is therefore able to distinguish between exploitable and spawning biomass. However, this model is yet to be reviewed by the WGSAM and is not currently included in the ICCAT Stock Assessment Software Catalogue.

The Group discussed the use of Integrated Age-structured models (e.g., Stock Synthesis) for the South Atlantic assessment, given that the true dynamics (i.e., size-structure) of the stock may not be fully captured by SPMs. Pertinent to this was the introduction of the minimum size limit for swordfish, the effects of which would be best captured by an Integrated Age-structured model. Implementing an Integrated Age-structured model for the South Atlantic swordfish stock assessment is a priority for the future.

5.2.1 Bayesian Surplus Production model - JABBA

The Bayesian Surplus Production model, Just Another Bayesian Biomass Assessment (JABBA); (Winker *et al*., 2018) will be used. For details see section 5.1.2 above.

5.3 Diagnostics

The procedures outlined in Carvalho (2021) and recommended by the WGSAM will be adhered to as closely as possible.

6. MSE matters

6.1 Review of current development state of the North Atlantic Swordfish MSE

SCRS/P/2022/009 provided an overview of progress on the N-Atl swordfish MSE. The process has been ongoing since 2018 and uses the 2017 North Atlantic swordfish Stock Synthesis assessment model as a base-case with 7 axes of uncertainty (steepness, natural mortality, sigmaR, weighting between CPUEs and length composition effective sample size, a catchability increase, and an environmental variable) used to construct an OM grid. The swordfish MSE technical team has conducted work on the simulation framework, performance metrics, and initial CMP development. In 2022 the OM grid will be revised, considering changes made to the 2022 SS3 assessment model.

The group acknowledged the summary of SWO MSE progress.

6.2 Presentation of the currently adopted MSE roadmap by the Commission

The currently adopted MSE roadmap by the Commission was shown to and discussed by the Group. One main item discussed was regarding Points 2 and 7 for 2022, that refer to dialogue with PA4 with regards to establishing operational management objectives and identifying performance indicators. Given that during 2022 there will be only a 1-day PA4 meeting in November, the Group suggested that the dialogue on this point may need to be continued into early 2023. To that end, the Group agreed there is likely the need for 3 meetings with PA4 during 2023: one earlier in the year for completion of those final management objectives and performance indicators, a second to receive feedback on CMPs format and construction, and a third later in the year (possibly just before the annual meeting) mainly for the SCRS to provide approximately 2-

3 selected CMPs to PA4 for consideration. SCRS has not had the opportunity to discuss with PA4 more refined objectives and the impact of various options on how CMP may be constructed. Having three meetings in 2023 allows there to be a back and forth between PA4 and SCRS to refine the CMPs (see Workplan, **Table 14**).

It was also agreed that a letter should be sent to the Chair of PA4 with the summary of the workplan, so that PA4 is aware of what the SCRS is expecting from PA4 with regards to SWO MSE inputs in later 2022 and during 2023, in each of those steps.

A revised version of the MSE roadmap reflecting those agreements from the Group is attached in **Appendix 5**.

It was noted that this version of the roadmap will continue to be worked by the Group during the year, and a final revision for the year will be prepared at the Species Groups meeting in September, after the new stock assessment has been conducted and the OMs have been reconditioned.

6.3 Further development of the MSE work during 2022

6.3.1 Discussion on reconditioning OMs considering new information from the stock assessment, and plans to finalize the OM grid

The Group discussed reconditioning the OMs considering the new information that is available for the 2022 stock assessment. The Group also discussed the plans to finalize the design of the OM grid.

One of the axes of uncertainty in the OM grid is related to including environmental effects when fitting the model to the CPUE indices. The Group acknowledged that if CPUEs were corrected for environmental effects, it might not be necesary to include an axis of uncertainty related to environment. The Group agreed to pay further attention to whether environment continues to be one of the main uncertainties, after the assessment is complete.

The Group discussed using the Combined Index as the main data source and decided that it would be useful to make the other indices also available to the cMPs. The data lags of the CPUE indices that are to be used in the upcoming stock assessment, with terminal year varying between 2019 and 2021, were discussed. The contractor confirmed that, from a technical perspective, the different terminal years for the CPUEs are not a problem for the MSE.

The Group also discussed how re-standardization of the indices in the future could impact the process of applying the cMP . For example, re-standardization of the indices in the future when new data are available may result in changes in the historical values of the index. However, the MSE assumes that the values of the historical indices will not change in the future. The Group discussed this issue and suggested conducting some analyses to investigate how much the re-standardization process is likely to change the values of the indices. For the Combined Index it was noted that a comparison between the different indices over time could provide some insight into this issue.

The Group also noted that an important assumption of the MSE is that the CPUE indices will be available in the future based on the same data sources and methods used in the past. In case of all indices there is a potential problem if for some reason the index cannot be generated in the future and then it cannot be used in an MP. And in the case of the Combined Index if a National Scientist cannot provide data in the future this assumption would not be met either. Accordingly, some analysis (e.g., dropping a data source one at a time) could be conducted to simulate potential impacts of not having all data sources.

The Group discussed the request to determine the impact of the minimum size limit on the fishery. After some discussion on the difficulties of doing this, for example the paucity of data on fish caught below the minimum size threshold, the Group determined that this could be a discrete analysis that is separate from the primary MSE and would be investigated once the OM conditioning is complete and the management procedures have been designed.

6.3.2 Review decisions points for MSE next steps including robustness tests (e.g., data lags), a red face protocol

The contractor presented an overview of the outstanding decision points for the MSE process (SCRS/P/2022/006).

During the presentation, the Trial Specification document (https://iccat.github.io/nswo-mse/TS/Trial_Specs.html) was also mentioned, where the current state of the swordfish MSE process is presented. This includes a description of the uncertainties in the grid, the contractor noted that the reasoning for the chosen uncertainties could be added to this description, instead of just stating the uncertainties and its levels.

The Group discussed the possibility of removing the relative weighting of the CPUE and catch at length (CAL) data from the uncertainty grid, as it may no longer be necessary if new features of the SS3 software that allows for the effective sample size (ESS) to be re-weighted in each OM in a relatively fast way are to be used. It was decided to re-visit this after the 2022 assessment has been finalized.

The Group discussed and agreed to move from the combined sex to the 2-sex operating models (OMs) in the MSE framework. It was agreed that it would be best for the structure of the OMs to replicate the structure of the SS3 models as closely as possible. This also allows for the possibility of larger differences in sex-specific life-history parameters (e.g. M), which current research suggests may be the case for swordfish. Spatial distribution of swordfish by sex was also discussed, in the current assessment a single area is considered and differences between sexes are given as probabilities of being male or female given the growth curve and selectivity applied, for example, larger fish in the catch have a higher probability of being female.

The Group discussed outstanding decisions related to OM validation and assumptions for the closed-loop simulation testing. Some robustness tests were briefly discussed, eg. simulating a recruitment failure, effect of the lack of data on undersized fish imposed by the minimum size regulation (e.g., setting the selectivity curves to start above the minimum landing size), mimicking the loss of data in the combined index, testing for different advice intervals. It was agreed that this work would be done once the OM grid conditioning was completed and could be addressed by the smaller MSE technical team who would report back to the Group later in the year.

OM weighting was also briefly discussed, it was noted that for now equal weight is being given to all OMs. It was argued that choosing a reference set of OMs (12-16) could lead to interpretation that these models would have higher weight. It was explained that the reference set could allow for focusing on the interpretation on performance metrics for different cMPs. Ideally this set would represent runs with the biggest differences in cMP performance, but the performance metrics would still be produced across all the OMs.

The Group discussed some red-face tests i.e., the evaluation of the plausibility of OM results given the current state of knowledge of SWO life history and fisheries for the swordfish MSE. The Group reviewed these proposed protocols and noted that the red-face tests should focus on model results (e.g., biomass trends by sex over time) rather than the model structure and inputs which would be examined during the assessment process. Finally, the Group added a list of additional potential red-face tests that were needed, and further intersessional work is required.

6.3.3 Continue work on criteria for determining exceptional circumstances taking into account the exceptional circumstances protocol for N-ALB

A draft document describing exceptional circumstances protocols was presented and discussed by the Group. These protocols were based on those developed for albacore. The Group discussed the indicators, criteria, and frequency of the EC protocols, and updated the document to make it better reflect the swordfish fishery. It was noted that, while it was good to discuss these things now, the EC protocols could not be complete until the properties of the cMPs were known (e.g., which data are used).

It was also recommended that simulation work be conducted to inform the quantitative values specified in the EC protocols. For example, robustness tests could be conducted for detecting the situations that are most likely to result in undesirable outcomes for the fishery, and EC protocols could be designed to detect when those situations are likely to be occurring. It was also noted that, as the EC protocols were still in development, it would be best to not include the tables in the report.

6.3.4 Discussion on performance indicators and advice intervals

SCRS/P/2022/010 provided an update on the development of performance metrics and advice intervals for the swordfish MSE process. A candidate set of performance metrics based on conceptual objectives (see Res. 19-14) were presented to PA4 in 2021 and the feedback from the Panel was described. This base set of performance metrics requires additional work on probability calculations, time frames, and the trade-offs associated with selecting a particular set of probability calculations (see workplan).

It was recommended to change the AAVY (average annual variability in yield) metric, as the metric of interest is actually the change in catch between management cycles rather than every year. It was also suggested adding the Status metric of the probability of being in the green space of the Kobe plot ($SB>SB_{MSY}$ and $F<F_{MSY}$) into its two separate component metrics i.e., $SB>SB_{MSY}$, $F<F_{MSY}$ independently.

It was noted that it would be best for the Group to propose some specific approaches for calculating and interpreting performance to Panel 4 to select from. For example, simulation work could be conducted to inform on the trade-offs that are associated with different management intervals.

6.3.5 Continue work on development and testing of candidate management procedures

The contractor gave a presentation on the process for developing candidate management procedures (SCRS/P/2022/007). The Group discussed the various options for developing cMPs and noted that this is an important priority (see workplan). The contractor confirmed that it was possible to store additional information from any cMP (e.g., summary statistics of model fits) and return this information in the MSE.

6.4 Discussion on communications materials needed for engagement with stakeholders

The Group discussed the need to develop an engagement plan for interactions with managers and other stakeholders in the MSE. Having completed a few years of MSE development, the Group agreed that it is time to increase the dialogue to both present preliminary results and solicit feedback on key MP elements (e.g., operational management objectives, management cycle length).

The SCRS Chair noted that the SCRS has the responsibility to communicate MSE concepts, assumptions made, and guidance on how to interpret results. The SCRS should also provide the scientific basis for any related management decisions. However, while the SCRS should convey the need for managers to engage their stakeholders (e.g., industry, NGOs) in the process, it is the managers' role to determine the level of stakeholder engagement they deem appropriate for the process, at both the ICCAT and CPC level. In this way, it is important to recognize the distinction between the roles of scientists and managers in the process.

The Group noted that ICCAT is using its Panel structure for the bulk of stock specific MSE discussions. As a result, the Group supported Panel 4 as the venue for science-management dialogue on the MSE. Although the WGSAM recommended that Standing Working Group to Enhance Dialogue. Between Fisheries Scientists and Managers (SWGSM) meetings be used for MSE dialogue, the Group thought that Panel 4 would be more appropriate since discussions could be focused only on the NSWO MSE and meeting participation could be limited to the smaller group of CPCs with an interest in the stock. It was agreed that SWGSM meetings may be more appropriate for more general harvest strategy discussions and capacity building. The Group also supported the idea of hybrid dialogue meetings, where initial discussions could be informal, and then the meeting could move behind flags when the agenda featured decision points. Regardless of meeting structure, the SCRS Chair emphasized that it is critical to allow sufficient meeting time for comprehensive discussions on these complex topics.

The Group supported the establishment of a Swordfish MSE Ambassador Programme, similar to what has been done for Atlantic bluefin tuna. Ambassador meetings allow more informal discussions about the MSE since participants speak as individuals rather than from behind a flag. Convened as separate meetings in French, Spanish and English, rather than relying upon simultaneous interpretation, the bluefin Ambassador meetings have seen the most active participation to date of any of ICCAT's MSE dialogue fora. The Chair will work to identify the language-specific ambassadors for swordfish.

The Chair presented a table outlining an MSE engagement plan, including suggested meeting schedule with the objectives and decision points for each meeting (**Table 14**). The table will be shared with the Panel 4 Chair to outline intended progress, including objectives for the next Panel 4 intersessional meeting on 13 November 2022. The Group agreed that the communications Working Group would produce summary materials for review at the September Species Group meeting, with the aim to have them available to managers and stakeholders in advance of the Panel 4 intersessional.

The MSE Expert presented a walkthrough of Slick, the Shiny App for the NSWO MSE, which is accessible here (www.harveststrategies.org). Slick allows users to select CMP and OM parameters, as well as performance indicators of interest, to view customized MSE results. The app includes 11 different plot types with annotation to guide interpretation of the results. The Group commended the utility of Slick, while cautioning that it might contain too much information for Panel 4. It was suggested that perhaps Slick could be presented at one of the Ambassador meetings instead. The MSE Expert highlighted the flexibility of Slick and ability to expand its features, including plot types (e.g., to include violin plots).

7. Other matters

SCRS/P/2022/004 provided a history of the Canadian swordfish fishery. Changes influencing fishing dynamics were divided into five categories: fishing regulations; gears; spatial patterns; bycatch mitigation; and other qualitative observations. The author noted that several of the changes highlighted in the work should be considered when National Scientists filter data and analyse for abundance trends. The author recommended that there be thorough documentation of fleet dynamics and management changes in these fisheries so that these can be reflected in index standardization and assessments.

The Group acknowledged the presentation and congratulated the author on the work. There was discussion on the need for these types of narratives for other ICCAT CPCs and fleets. It was clarified that a document with the full results of this work will be published as a DFO (Fisheries and Oceans Canada) technical report in the coming months.

8. Recommendations and Workplan Relative to Data Preparatory Sections

8.1 Recommendations

To SCRS plenary on research funding

The Group recommends that a hand-held Argos electronic satellite tag receiver be purchased for use among ICCAT Species Groups. The receiver would help find the tag and thus scientists would be able to recover more detailed tagging data, retrieved directly from the tags.

To the SCRS and ICCAT Secretariat

The Group recommends that the straight-curved lower jaw fork length relationships presented in SCRS/2022/061 be adopted for use for lengths conversions in the 2022 Stock Assessment. Pending further data collection and analysis the Group recommends that the conversion be considered for the ICCAT list of approved conversions.

To CPCs

The Group recommends that the submission of size samples to the ICCAT Secretariat, as part of the CPCs Task 1 and 2 data submission obligations, be completed using the ST04-T2SZ statistical form. Size samples reported with the ST04-T2SZ form shall include all samples collected by the CPC from all fisheries and size samples of dead and live discards (when applicable) collected by its National Observer Programme. This recommendation does not preclude CPCs from the optional reporting of size samples collected by their National Observer Programme using the ST09-DomObPrg form.

To WGSAM

Noting the spatial-temporal CPUE standardization approaches presented in this meeting (e.g. R-INLA), the Group recommends that the ICCAT Working Group on Stock Assessment Methods evaluate these modeling approaches and provide recommendations on their use in index standardizations.

To National Scientists

The Group recommends that for future assessments, CPUE analysts form a small working group several months before the assessment data preparatory meeting. Noting the limited time within the data preparatory meeting for index review and short timelines for index revisions after the meeting, the small working group would allow for closer examination and detailed discussion on modeling approaches before formal submission of indices to the data preparatory meeting.

The Group recommends that National Scientists document the history of their fleets participating in ICCAT fisheries. Reviews should document changes in gears, local and national fishing regulations, spatial patterns and other relevant factors that influence how ICCAT species are caught. These reviews are important for better accounting of fleet structure and dynamics in CPUE standardizations and assessments.

To the SWO Species Group and the SCRS plenary on research funding

The Group recommends continued financial support of the ICCAT swordfish biology programme. The Group further recommends that a proposal be developed for formalization of a Research Programme similar to those in place for bluefin tuna, sharks, and billfish. The proposal should include the Atlantic and Mediterranean stocks and have descriptions of the various research activities that the Groups are proposing, and timeframes for such work to be carried out. Determining the final amount of this proposal will be addressed at subsequent SWO Species Group and Species Groups meetings.

8.2 Recommendations and workplan relative to the MSE sections

Recommendations

The Group recommends that the Slick Shiny App (accessible through www.harveststrategies.org) be used for presenting results and visualizations of tradeoffs associated with the MSE. Slick allows users to select CMP and OM parameters, as well as performance indicators of interest, to view customized MSE results.

Workplan

The Group developed a workplan (**Table 14**) for the remainder of 2022, including details on interactions needed with PA4 and other stakeholders needed in 2022 and 2023.

11. Adoption of the report and closure

The report was adopted by the Group and the meeting was adjourned.

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Table 1. SWO total catches (t) by stock, fleet, gear and year, changed in Task 1 nominal catches. The Source indicates the type of change made (carry over, CPC preliminary estimates adopted by the Group, stock corrections based on T2CE evidence).

					YearC																					
Source (T1NC)	**Stock**	**FleetCode**	**GearCode**	**SAreaCode**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Carry over (3 yrs average)	ATN	MAR	HAND	BIL94B																				100.0	116.7	122.2
		SEN	GILL	BIL94B																		10.3	13.6	18.0	14.0	16.0
			HAND	BIL94B																						10.1
			LL	BIL94B																				46.2	46.3	53.8
	ATS	BRA	HAND	BIL96																		3.6	3.7		4.3	4.6
		GHA	GILL	BIL97																					32.4	31.2
		SEN	LL	BIL97																						46.5
		VCT	LL	BIL96																						9.3
SCRS/2022/047	ATN	CRI	LL	BIL93	0.7	0.7	0.3	0.0	1.1	3.5	2.9	1.7	3.6	11.2	6.2	11.1	22.9	21.3	22.0	29.9	34.2	26.4	43.8	43.5	23.0	18.8
Stock adjustments (T2CE)	ATN	CIV	LL	BIL94B																			21.2			
		CIV-CI-ABIDJAN	GILL	BIL94B																			18.7			
			UNCL	BIL94B																			0.7			
		GBR	LL	BIL94B								49.0														
		SEN	LL	BIL94B													147.2					83.7	160.0			
		SLE	LL	BIL94B													15.9									
	ATS	CIV	LL	BIL97																		27.4				
		GNQ	HAND	BIL97															13.1							
		SEN	LL	BIL97													116.9					89.6				
VEN (GILL) preliminary	ATN	VEN	GILL	BIL93																	5.4	3.8	5.3	5.3	3.6	1.8

Table 2. SWO Task 1 nominal catches (landings and dead discards) in tons by stock, major gear and year, between 1950 and 2020 (as of 28 March 2022).

	SWO Atlantic stocks																									
	SWO-N														SWO-S											
	Longline	Other surf.													Longline	Other surf.										TOTAL
Year	LL	BB	GN	HL	HP	HS	PS	RR	TN	TP	TR	TW	UN	Total	LL	BB	GN	HL	HS	PS	RR	TR	TW	UN	Total	
1950	1445				2201					0			0	3646			0							100	100	3746
1951	966				1615					0			0	2581			0							200	200	2781
1952	966			0	2027					0		0	0	2993			0							200	200	3193
1953	1203				2100					0		0	0	3303			0							200	200	3503
1954	305				2729					0			0	3034			0							100	100	3134
1955	619				2883					0			0	3502			0							100	100	3602
1956	374				2984					0			0	3358	1	0	0								1	3359
1957	1010				3467					0		1	100	4578	124		0							100	224	4802
1958	875				3929					0			100	4904	92	0	0								92	4996
1959	1428				4704					0		0	100	6232	71		0							100	171	6403
1960	1042				2786					0		0	0	3828	359		0							100	459	4287
1961	2060				2321							0	0	4381	816		0							200	1016	5397
1962	3202				2140								0	5342	769	0	0								769	6111
1963	9193				997							0	0	10190	1418	0	0								1418	11608
1964	10833	9			316					100		0	0	11258	2030		0								2030	13288
1965	7759	6		179	622					86		0	0	8652	2578		0								2578	11230
1966	8503	15			782					49			0	9349	1952		0								1952	11301
1967	8679	11			394					23			0	9107	1577		0								1577	10684
1968	8985	12		0	145					30			0	9172	2348		100								2448	11620
1969	9003	11		0	185					4		0	0	9203	4281		200								4481	13684
1970	9484	8		0	83					3				9578	5426										5426	15004
1971	5243	11		0	0					12			0	5266	2164	2									2166	7432
1972	4717	21		0	0					28				4766	2580										2580	7346
1973	5929	37		0	0					8			100	6074	3078										3078	9152
1974	6267	92		0	0					3				6362	2753										2753	9115
1975	8778	58	3	0	0									8839	3062										3062	11901
1976	6663	32	1	0	0									6696	2812										2812	9508
1977	6370	38		0	0					1				6409	2840		12							3	2855	9264
1978	11125	17	8	0	656		2			11		2	6	11827	2829		5			12					2846	14673
1979	11177		16	29	715									11937	3374		1						28		3403	15340
1980	12831		30	15	676								6	13558	5287		113						31		5431	18989
1981	10583		50	8	551					1			4	11197	4039		24			4			9		4076	15273
1982	13023		37	7	148									13215	6364		80						3		6447	19662
1983	14062		70	6	421					4				14563	5383		102						7		5492	20055
1984	12664		65	7	94					2			1	12833	8986		180		1	12			23	26	9227	22060
1985	14240	1	50	7	76					5			4	14383	9224		131						3	228	9586	23969
1986	18283	0	68	7	104		15			5		0	4	18486	4982	0	95						2	815	5894	24381
1987	20029	1	85	10	107					6		0		20238	5797		147						2	84	6030	26269
1988	19126	4	333	5	55		0	0		2		0		19525	12602		266					216	4	84	13172	32697
1989	15554	1	1510	8	182		1			5			0	17261	16573		191					207	0	84	17055	34316
1990	14215	0	1209	10	100		16			38		9	75	15672	16705		189					181	230	0	17305	32977
1991	14491	0	217	21	75		5			8		42	75	14934	13496		124					179	93	0	13893	28826
1992	14739	2	415	51	61		3			24		24	75	15394	13422	1	116					177	97		13813	29207
1993	16212	3	324	49	28		8			3		16	95	16738	15739		172				2	202	16		16130	32868
1994	15073	5	322	21	24		5			14		37		15501	17839	0	110				1	190	24	794	18958	34460
1995	16390	4	400	23	190		8	1		13		38	38	17105	21584		165				1	178	2		21931	39036
1996	14384	7	479	0	94		99	7		8	1	117	26	15222	17860	0	263					166	1		18289	33511
1997	12643	4	67	1	90		11	16		8	0	172	12	13025	18320		73					148	1		18542	31567
1998	11538	5	472		241		41	10		2	1	10	9	12329	13758		131	3				135			14027	26356
1999	11242	3	248	5	18		40	21		13	2	26	4	11622	14829	356	150					129	38		15502	27124
2000	11058	13	158	9	95		23	16		6	2	72	1	11453	15450	18	137			4		120	0		15728	27181
2001	9574	1	266	9	129		17	2		7		6	2	10011	14302	144	550	7				120	5	0	15128	25139
2002	9406	3	73	12	41		1	22		4		83	8	9654	13577	7	391					120	10		14104	23758
2003	10952	1	114	23	147		1	6		7	0	156	37	11444	11714	4	777	3				120	16		12634	24078
2004	11723	3	83	24	88		1	25		3	2	112	7	12071	12558	0	395					126	2	0	13082	25153
2005	11854	10	16	40	193			62		5	3	187	11	12380	12915		96	5				147	1		13163	25544
2006	11111	2	7	38	204			53		8	0	97	8	11528	13984		73	1				138			14196	25724
2007	11751	0	11	129	267		0	68		8	7	54	9	12306	15408		82	1		0		138			15629	27935
2008	10587	0	6	97	258		0	76	0	2	2	24	9	11061	12027		201	11		0		172			12411	23472
2009	11596	1	34	128	248		0	32	0	4	1	36	9	12088	12359		178			0		188	2		12727	24814
2010	11123	0	19	129	177		1	52		5	0	55	8	11569	12337	9	158					193	1		12698	24267
2011	12189	1	86	121	208		0	54		5	0	36	9	12709	10928	49	164	4		0		60	0	0	11205	23914
2012	13367	0	63	231	98		0	71		2	1	45	12	13890	10395	63	120	1		23		84		0	10686	24576
2013	11565	1	4	168	275	0	0	22	0	1	0	40	2	12078	8958		168	16		1		60			9204	21282
2014	10245	0	9	151	233		0	35		0	0	33	0	10708	9781		94			0		94	0		9970	20678
2015	10361	0	37	128	98		0	46		0	1	81		10752	10090		104	5		0		145			10345	21097
2016	10045	0	33	228	85			27		1	0	108	0	10529	10463		67	4				77			10611	21139
2017	9765		133	266	175		3	34	0		1	93	1	10471	10259		55	4		1		65			10383	20854
2018	8656	0	30	277	34		0	36	0	0	2	107	1	9144	10377		17	6		5			1	0	10405	19549
2019	9749	34	28	380	33		0	64		0	0	90	3	10381	10074		49	4					3		10131	20512
2020	10025	1	25	355	50		1	53	2	0	2	144	3	10659	8936	15	42	5		0			30		9029	19688

Table 2a. SWO-ATL estimated catches (landings + dead discards, t) of swordfish (*Xiphias gladius*) by area, gear and flag.

			1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total ATL			32977	28826	29207	32868	34460	39036	33511	31567	26356	27124	27181	25139	23758	24078	25153	25544	25724	27935	23472	24814	24267	23914	24576	21282	20678	21097	21139	20854	19549	20512	19688
	ATN		15672	14934	15394	16738	15501	17105	15222	13025	12329	11622	11453	10011	9654	11444	12071	12380	11528	12306	11061	12088	11569	12709	13890	12078	10708	10752	10529	10471	9144	10381	10659
	ATS		17305	13893	13813	16130	18958	21931	18289	18542	14027	15502	15728	15128	14104	12634	13082	13163	14196	15629	12411	12727	12698	11205	10686	9204	9970	10345	10611	10383	10405	10131	9029
Landings	ATN	Longline	14215	14276	14356	15804	14365	15864	13822	12204	11062	10717	9922	8678	8799	10334	11410	11531	10896	11478	10352	11445	10975	11796	12976	11366	10089	10194	9941	9616	8504	9445	9912
		Other surf.	1457	443	655	526	428	715	812	370	782	376	393	432	240	486	341	516	409	546	465	485	441	511	512	513	463	391	483	705	488	632	635
	ATS	Longline	16705	13496	13422	15739	17839	21584	17859	18299	13748	14823	15448	14302	13576	11714	12558	12915	13984	15318	12022	12359	12189	10854	10255	8958	9736	10047	10461	10148	10351	10025	8879
		Other surf.	600	397	391	391	1119	347	429	222	269	672	278	826	527	920	523	248	212	221	384	368	361	277	291	246	189	254	148	124	27	57	93
Discards	ATN	Longline	0	215	383	408	708	526	562	439	476	525	1137	896	607	618	313	323	215	273	235	151	148	392	391	199	156	167	105	149	152	304	113
		Other surf.	0	0	0	0	0	0	26	12	9	4	1	6	8	5	7	10	8	8	9	7	5	9	10	0	0	0	0	0	0	0	
	ATS	Longline	0	0	0	0	0	0	1	21	10	6	1	0	0	0	1	0	0	91	6	0	147	74	140	0	46	43	2	111	26	50	57
		Other surf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
Landings	ATN CP	Barbados	0	0	0	0	0	0	33	16	16	12	13	19	10	21	25	44	39	27	39	20	13	23	21	16	21	29	20	21	18	10	12
		Belize	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1	112	106	184	141	142	76	1	3	59	145	117	111
		Brazil	0	0	0	0	0	0	0	0	0	0	117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Canada	911	1026	1547	2234	1676	1610	739	1089	1115	1119	968	1079	959	1285	1203	1558	1404	1348	1334	1300	1346	1551	1489	1505	1604	1579	1548	1188	782	995	1334
		China PR	0	0	0	73	86	104	132	40	337	304	22	102	90	316	56	108	72	85	92	92	73	75	59	96	60	141	135	81	86	92	96
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Côte d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	30	0	0	0	0	0	27	62	0	0	26
		EU-Denmark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU-España	6386	6633	6672	6598	6185	7176	5547	5140	4084	3996	4595	3968	3957	4586	5376	5521	5448	5564	4366	4949	4147	4889	5622	4084	3750	4013	3916	3588	3186	3112	3587
		EU-France	75	75	75	95	46	84	97	164	110	104	122	0	74	169	102	178	92	46	14	15	35	16	94	44	28	66	90	79	80	82	90
		EU-Germany	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		EU-Ireland	0	0	0	7	0	0	15	15	132	81	35	17	5	12	1	1	3	2	2	1	1	2	5	2	3	15	15	10	13	3	24
		EU-Netherlands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
		EU-Poland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU-Portugal	475	773	542	1961	1599	1617	1703	903	773	777	732	735	766	1032	1320	900	949	778	747	898	1054	1203	882	1438	1241	1420	1460	1871	1691	2392	2070
		EU-Rumania	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		FR-St Pierre et Miquelon	0	0	0	0	0	0	0	0	0	0	0	0	10	3	36	48	0	82	48	17	90	1	0	18	3	0	0	0	0	0	
		Great Britain	0	0	0	2	3	1	5	11	0	2	1	0	0	0	0	0	49	0	0	2	0	0	0	0	0	0	0	0	0	0	0
		Grenada	1	2	3	13	0	1	4	15	15	42	84	0	54	88	73	56	30	26	43	0	0	0	0	0	0	39	29	36	36	22	15
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Iceland	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Japan	1051	992	1064	1126	933	1043	1494	1218	1391	1089	161	0	0	0	575	705	656	889	935	778	1062	523	639	300	545	430	379	456	325	355	413
		Korea Rep	51	3	3	19	16	16	19	15	0	0	0	0	0	0	0	51	65	175	157	3	0	0	0	64	35	0	9	19	9	9	14
		Liberia	3	0	7	14	26	28	28	28	28	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	95	5	7	3
		Maroc	91	110	69	39	36	79	462	267	292	119	114	523	223	329	335	339	341	237	430	724	968	782	770	1062	1062	850	900	900	1050	1067	1058
		Mexico	0	0	0	6	14	10	22	14	28	24	37	27	34	32	44	41	31	35	34	32	35	38	40	33	32	31	36	64	44	30	21
		Norway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Panama	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Philippines	0	0	0	0	0	0	0	0	0	0	0	1	4	44	5	0	8	0	22	28	0	17	36	9	14	0	0	0	0	0	
		Russian Federation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Senegal	0	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38	0	28	11	148	44	43	49	78	146	224	108	117	80
		Sierra Leone	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	
		St Vincent and Grenadines	3	0	3	23	0	4	3	1	0	1	0	22	22	7	7	7	51	7	34	13	11	8	4	40	102	33	46	26	12	7	
		Trinidad and Tobago	66	71	562	11	180	150	158	110	130	138	41	75	92	78	83	91	19	29	48	30	21	16	14	16	26	17	13	36	3	6	8
		UK-Bermuda	0	0	0	0	0	1	1	5	5	3	3	2	0	0	1	1	0	3	4	3	3	3	1	1	1	1	2	1	2	2	6
		UK-British Virgin Islands	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	7	0	3	0	0	4	0	0	0	0	0	0	0	0	
		UK-Turks and Caicos	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	17	0	0	0	0	0	0	
		USA	5519	4310	3852	3783	3366	4026	3559	2987	3058	2908	2863	2217	2384	2513	2380	2160	1873	2463	2387	2730	2274	2551	3393	2824	1809	1581	1408	1294	1135	1449	1351
		USSR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Venezuela	9	75	103	73	69	54	85	20	37	30	44	21	34	45	53	55	22	30	11	13	24	18	25	24	24	34	56	58	36	35	16
	NCC	Chinese Taipei	270	577	441	127	507	489	521	509	286	285	347	299	310	257	30	140	172	103	82	89	88	192	166	115	78	115	148	78	162	115	158
		Costa Rica	0	0	0	0	0	0	0	0	0	1	1	0	0	1	4	3	2	4	11	6	11	23	21	22	30	34	26	44	43	47	42
		Guyana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	10	5	2	5
	NCO	Cuba	47	23	27	16	50	86	7	7	7	7	0	0	10	3	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Dominica	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
		Faroe Islands	0	0	0	0	0	0	0	0	0	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	714	43	35	111	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Saint Kitts and Nevis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
		Seychelles	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Sta Lucia	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	3	0	0	2	0	0	0	0	0	0	0	0	1	0	0	
		Vanuatu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35	29	14	0	0	0	10	23	15	2	4	7	0	0	0	0	
	ATS CP	Angola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	18	0	0	13	0	0	
		Belize	0	0	0	0	0	1	0	0	0	17	8	0	0	0	0	0	0	120	32	111	121	207	197	136	45	111	176	166	115	55	2
		Brazil	1696	1312	2609	2013	1571	1975	1892	4100	3847	4721	4579	4082	2910	2920	2998	3785	4430	4153	3407	3386	2926	3033	2833	2384	2892	2599	2938	2410	2798	2863	2110
		China PR	0	0	0	0	0	0	0	0	0	29	534	344	200	423	353	278	91	300	473	470	291	296	248	316	196	206	328	222	302	355	211	89
		Curaçao	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Côte d'Ivoire	8	18	13	14	20	19	26	18	25	26	20	19	19	43	29	31	39	17	24	145	156	58	89	133	68	48	58	0	57	123	19
		EU-Bulgaria	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU-España	6166	5760	5651	6974	7937	11290	9622	8461	5832	5758	6388	5789	5741	4527	5483	5402	5300	5283	4073	5183	5801	4700	4852	4184	4113	5059	4992	4654	4404	4224	4442
		EU-France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
		EU-Lithuania	0	0	0	0	794	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		EU-Portugal	0	0	1	0	0	380	389	441	384	381	392	393	380	354	345	493	440	428	271	367	232	263	184	125	252	236	250	466	369	323	335
		El Salvador	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Gabon	0	0	0	0	0	0	0	0	0	0	0	0	0	9	2	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	
		Ghana	146	73	69	121	51	103	140	44	106	121	117	531	372	734	343	55	32	65	177	132	116	60	54	37	26	56	36	55	6	32	31
		Great Britain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	
		Guatemala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Guinea Ecuatorial	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	
		Honduras	0	0	3	0	0	6	4	5	2	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	6708	4459	2870	5256	4699	3619	2197	1494	1186	775	790	685	833	924	686	480	1090	2155	1600	1340	1314	1233	1162	684	976	659	637	915	640	647	551
		Korea Rep	50	147	147	198	164	164	7	18	7	5	10	0	2	24	70	36	94	176	223	10	0	0	42	47	53	5	19	11	18	9	15
		Namibia	0	0	0	0	22	0	0	0	0	730	469	751	504	191	549	832	1118	1038	518	25	417	414	85	129	395	225	466	600	881	811	789
		Nigeria	0	0	3	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Panama	0	0	0	0	0	0	0	0	29	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Philippines	0	0	0	0	0	0	0	0	0	0	0	6	1	8	1	1	4	58	41	49	14	35	15	35	58	0	0	0	0	0	
		S Tomé e Príncipe	181	179	177	202	190	178	166	148	135	129	120	120	120	120	126	147	138	138	183	188	193	60	84	60	94	145	77	65	1	3	30
		Senegal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77	138	195	180	117	162	178	143	97	90	0	92	166	46
		South Africa	0	5	9	4	1	4	1	1	240	143	328	547	649	293	295	199	186	207	142	170	145	97	50	171	152	218	164	189	189	251	149
		St Vincent and Grenadines	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	7	16	4	3	2	2	19	0	5	9	4	15	9
		UK-Sta Helena	0	0	0	0	0	0	0	0	0	0	0	20	4	2	2	0	0	0	0	0	0	0	0	5	6	2	0	0	0	0	
		USA	0	0	0	0	0	0	171	396	160	179	142	43	200	21	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		USSR	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Uruguay	302	156	210	260	165	499	644	760	889	650	713	789	768	850	1105	843	620	464	370	501	222	179	40	103	0	0	0	0	0	0	
	NCC	Chinese Taipei	900	1453	1686	846	2829	2876	2873	2562	1147	1168	1303	1149	1164	1254	745	744	377	671	727	612	410	424	379	582	406	511	478	416	446	346	353
	NCO	Argentina	230	88	88	14	24	0	0	0	0	38	0	5	10	8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	
		Benin	28	28	26	28	25	24	24	10	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cambodia	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Cuba	448	209	246	192	452	778	60	60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Mixed flags (FR+ES)	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		NEI (Flag related)	439	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Seychelles	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Togo	3	5	5	8	14	14	64	0	0	0	0	0	0	0	9	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Vanuatu	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	26	6	3	0	3	1	3	0	1	1	0	0	0	0	
Discards	ATN CP	Canada	0	0	0	0	0	0	0	5	52	35	50	26	33	79	45	106	38	61	39	9	15	8	111	59	12	8	11	21	5	2	2
		EU-France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		Japan	0	0	0	0	0	0	0	0	0	0	598	567	319	263	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	6
		Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	170	46	19	0	2	0	0	0	0	
		Mexico	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
		UK-Bermuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		USA	0	215	383	408	708	526	588	446	433	494	490	308	263	282	275	227	185	220	205	148	138	223	217	120	137	137	90	111	140	287	91
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	7	18	4	18	7	7	14
	ATS CP	Brazil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	6	0	0	0	0	0	0	0	0	0	0	0	
		EU-France	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
		Japan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Korea Rep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	147	70	23	0	0	0	0	0	0	0	
		South Africa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		USA	0	0	0	0	0	0	1	21	10	6	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	NCC	Chinese Taipei	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	117	0	45	43	2	111	26	49	57

Table 3. Reported SWO dead discards (DD) and live releases (DL) by stock, major gears, and year. No information was yet reported to SWO on mortality estimates obtained from live releases (DM).

	DD (discarded dead)						DL (discarded live)					
	SWO-N			SWO-S			SWO-N			SWO-S		
Year	Longline	Other surf.	Total	Longline	Other surf.	Total	Longline	Other surf.	Total	Longline	Other surf.	Total
1991	215		215									
1992	383		383									
1993	408		408									
1994	708		708									
1995	526		526									
1996	562	26	588	1		1						
1997	439	12	451	21		21						
1998	476	9	485	10		10						
1999	525	4	529	6		6						
2000	1137	1	1138	1		1	331		331			
2001	896	6	902	0	0	0	329		329			
2002	607	8	615	0		0	224		224			
2003	618	5	623	0		0	133		133			
2004	313	7	320	1		1	339		339			
2005	323	10	333				123		123			
2006	215	8	223				1		1			
2007	273	8	281	91		91	0		0	54		54
2008	235	9	244	6		6	0		0	3		3
2009	151	7	157				0		0			
2010	148	5	153	147		147	1		1	10		10
2011	392	9	402	74		74	0		0			
2012	391	10	402	140		140	0		0			
2013	199	0	199	0		0	0	0	0	0		0
2014	156	0	156	46		46	0	0	0	0		0
2015	167	0	167	43	0	43	29	0	29			
2016	105	0	105	2		2	47	0	47	0		0
2017	149	0	150	111	0	111	64	0	64	0	0	0
2018	152	0	152	26	1	27	84	0	84			
2019	304	0	304	50		50	31		31			
2020	113	0	113	57	0	57	45	0	45			

Table 4. SWO-N 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		14934	15394	16738	15501	17105	15222	13025	12329	11622	11453	10011	9654	11444	12071	12380	11528	12306	11061	12088	11569	12709	13890	12078	10708	10752	10529	10471	9144	10381	10659			
SWO	ATN	CP	EU-España	LL	t1	6506	6351	6392	6027	6948	5519	5133	4079	3993	4581	3967	3954	4585	5373	5511	5446	5564	4366	4949	4147	4885	5620	4082	3750	4013	3915	3586	3186	3112	3587	1	38.8%	39%
SWO	ATN	CP	EU-España	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	1		
SWO	ATN	CP	USA	LL	t1	4399	4124	4044	3960	4452	4015	3399	3433	3364	3316	2498	2598	2757	2591	2273	1961	2474	2405	2691	2204	2572	3347	2812	1816	1593	1389	1301	1106	1456	1150	2	22.1%	61%
SWO	ATN	CP	USA	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	2		
SWO	ATN	CP	Canada	LL	t1	953	1487	2206	1654	1421	646	1005	927	1136	923	984	954	1216	1161	1470	1238	1142	1115	1061	1182	1351	1502	1290	1383	1489	1473	1034	753	965	1286	3	9.9%	71%
SWO	ATN	CP	Canada	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	bc	abc	abc	abc	abc	bc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	3		
SWO	ATN	CP	EU-Portugal	LL	t1	757	497	1950	1579	1593	1702	902	772	776	731	731	765	1032	1319	900	949	778	747	898	1054	1202	882	1438	1241	1420	1459	1871	1670	2346	2044	4	9.8%	81%
SWO	ATN	CP	EU-Portugal	LL	t2	abc	ac	ab	ab	ab	ab	ab	ab	ab	abc	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	4		
SWO	ATN	CP	Japan	LL	t1	992	1064	1126	933	1043	1494	1218	1391	1089	759	567	319	263	575	705	656	889	935	778	1062	523	639	300	545	430	379	456	325	362	419	5	6.0%	87%
SWO	ATN	CP	Japan	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	bc	bc	bc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	ab	5		
SWO	ATN	CP	Maroc	LL	t1	92	41	27	7	28	35	239	101	35	38	264	154	223	255	325	333	229	428	720	963	700	700	1000	1000	800	800	750	950	950	936	6	3.6%	90%
SWO	ATN	CP	Maroc	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	bc	abc	abc	abc	abc	abc	bc	abc	a	a	abc	bc	abc	ab	abc	abc	abc	abc	6		
SWO	ATN	NCC	Chinese Taipei	LL	t1	577	441	127	507	489	521	509	286	285	347	299	310	257	30	140	172	103	82	89	88	192	193	115	85	133	152	96	169	122	172	7	1.9%	92%
SWO	ATN	NCC	Chinese Taipei	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	7		
SWO	ATN	CP	Canada	HP	t1	73	60	28	22	189	93	89	240	18	95	121	38	147	87	193	203	267	258	248	176	208	97	275	233	98	85	175	34	33	50	8	1.1%	93%
SWO	ATN	CP	Canada	HP	t2	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	8		
SWO	ATN	CP	China PR	LL	t1			73	86	104	132	40	337	304	22	102	90	316	56	108	72	85	92	92	73	75	59	96	60	141	135	81	86	92	96	9	0.8%	94%
SWO	ATN	CP	China PR	LL	t2			-1	-1	-1	-1	-1	a	a	a	a	a	a	a	a	ab	a	ab	ab	ab	ab	ab	ab	a	ab	abc	abc	abc	ab	abc	9		
SWO	ATN	CP	Trinidad and Tobago	LL	t1	71	562	11	180	150	158	110	130	138	41	75	92	78	83	91	19	29	48	30	21	16	14	16	26	17	13	36	3	6	8	10	0.6%	95%
SWO	ATN	CP	Trinidad and Tobago	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	a	a	a	a	a	a	a	a	a	ab	ab	ab	a	ab	b	10		
SWO	ATN	CP	USA	HL	t1			38			0	1		5	9	9	12	21	23	35	33	125	94	125	129	121	155	105	88	77	76	62	132	205	219	11	0.5%	95%
SWO	ATN	CP	USA	HL	t2			-1			-1	b	b	c	bc	bc	c	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	bc	11		
SWO	ATN	CP	EU-France	TW	t1				13	13	97	164			60		74	138	102	178	91	46	14	12	32	15	13	35	25	63	87	76	74	70	86	12	0.4%	96%
SWO	ATN	CP	EU-France	TW	t2				a	-1	-1	-1			-1		-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	ab	-1	-1	ab	-1	abc	-1	12		
SWO	ATN	CP	Maroc	GN	t1	9	4	2	13	32	322	13	179	60	51	243	64	98	76	9						80										13	0.3%	96%
SWO	ATN	CP	Maroc	GN	t2	-1	-1	-1	-1	-1	-1	-1	c	ac	ac	ac	-1	b	b	b						-1										13		
SWO	ATN	CP	Belize	LL	t1																	9	1	112	106	184	141	142	76	1	3	59	145	117	111	14	0.3%	96%
SWO	ATN	CP	Belize	LL	t2																	a	a	ab	ab	ab	ab	a	a	ab	a	ab	abc	ab	abc	14		
SWO	ATN	CP	EU-España	GN	t1	124	316	202	150	223	20																									15	0.3%	96%
SWO	ATN	CP	EU-España	GN	t2	ab	b	-1	-1	-1	-1																									15		
SWO	ATN	CP	Venezuela	LL	t1	73	101	68	60	45	74	11	7	9	30	12	25	29	46	48	15	19	5	8	16	13	18	20	18	29	53	52	31	31	14	16	0.3%	97%
SWO	ATN	CP	Venezuela	LL	t2	b	b	b	b	b	b	b	b	ab	ab	b	b	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	16		

Table 5. SWO-S 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.

				T1 Total		13893	13813	16130	18958	21931	18289	18542	14027	15502	15728	15128	14104	12634	13082	13163	14196	15629	12411	12727	12698	11205	10686	9204	9970	10345	10611	10383	10405	10131	9029			
Speci	Sto	Stat	FlagName	GearG	DS	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Rank	%	%cum
SWO	ATS	CP	EU-España	LL	t1	5760	5651	6974	7937	11290	9622	8461	5832	5758	6388	5789	5741	4527	5483	5402	5300	5283	4073	5183	5801	4700	4852	4184	4113	5059	4992	4654	4404	4224	4442	1	42.5%	42%
SWO	ATS	CP	EU-España	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	1		
SWO	ATS	CP	Brazil	LL	t1	1312	2609	2013	1571	1970	1892	4100	3844	4721	4579	4075	2903	2917	2984	3780	4430	4243	3413	3386	2926	2984	2831	2381	2892	2594	2935	2406	2792	2859	2105	2	22.4%	65%
SWO	ATS	CP	Brazil	LL	t2	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	a	a	a	a	ab	ab	ab	2		
SWO	ATS	CP	Japan	LL	t1	4459	2870	5256	4699	3619	2197	1494	1186	775	790	685	833	924	686	480	1090	2155	1600	1340	1314	1233	1162	684	976	659	637	915	640	648	551	3	11.5%	76%
SWO	ATS	CP	Japan	LL	t2	ab	ab	ab	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		
SWO	ATS	NCC	Chinese Taipei	LL	t1	1453	1686	846	2829	2876	2873	2562	1147	1168	1303	1149	1164	1254	745	744	377	671	727	612	410	428	496	582	451	554	480	527	472	395	410	4	7.8%	84%
SWO	ATS	NCC	Chinese Taipei	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc	abc	abc	abc	4		
SWO	ATS	CP	Uruguay	LL	t1	156	210	260	165	499	644	760	889	650	713	789	768	850	1105	843	620	464	370	501	222	179	40	103								5	2.9%	87%
SWO	ATS	CP	Uruguay	LL	t2	a	a	a	a	a	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab								5		
SWO	ATS	CP	Namibia	LL	t1				22					374	452	607	504	187	549	832	1118	1038	518	25	408	366	22	129	395	225	466	600	881	811	774	6	2.8%	90%
SWO	ATS	CP	Namibia	LL	t2				a					a	-1	ab	a	-1	a	ab	ab	ab	ab	ab	ab	ab	a	ab	a	a	a	abc	abc	abc	abc	6		
SWO	ATS	CP	EU-Portugal	LL	t1					380	389	441	384	381	392	393	380	354	345	493	440	428	271	367	232	263	184	125	252	236	250	466	369	323	335	7	2.2%	92%
SWO	ATS	CP	EU-Portugal	LL	t2					a	a	ab	ab	ab	ab	ab	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	a	7		
SWO	ATS	CP	China PR	LL	t1								29	534	344	200	423	353	278	91	300	473	470	291	296	248	316	196	206	328	222	302	355	211	89	8	1.6%	94%
SWO	ATS	CP	China PR	LL	t2								a	a	a	a	a	a	a	a	a	a	ab	ab	ab	ab	ab	ab	abc	ab	abc	abc	abc	ab	abc	8		
SWO	ATS	CP	South Africa	LL	t1					1			240	143	327	547	649	293	295	199	186	207	142	170	145	97	50	171	152	218	164	189	189	251	149	9	1.3%	95%
SWO	ATS	CP	South Africa	LL	t2					-1			ab	ab	ab	ac	abc	ab	ab	ab	ab	ab	ab	ab	ab	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	9		
SWO	ATS	CP	Ghana	GN	t1	73	69	121	51	103	140	44	106	121	117	531	372	734	343	55	32	65	177	132	116	60	54	37	26	56	36	55	6	32	31	10	1.0%	96%
SWO	ATS	CP	Ghana	GN	t2	-1	-1	-1	-1	-1	ab	b	ab	b	ab	ab	ab	ab	ab	ab	ab	ab	a	ab	a	a	a	a	a	a	a	a	a	-1	-1	10		
SWO	ATS	CP	S Tomé e Príncipe	TR	t1	179	177	202	190	178	166	148	135	129	120	120	120	120	126	147	138	138	172	188	193	60	84	60	94	145	77	65				11	0.9%	97%
SWO	ATS	CP	S Tomé e Príncipe	TR	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1				11		
SWO	ATS	NCO	Cuba	LL	t1	209	246	192	452	778	60	60																								12	0.5%	97%
SWO	ATS	NCO	Cuba	LL	t2	-1	-1	-1	-1	-1	-1	-1																								12		
SWO	ATS	CP	Korea Rep	LL	t1	147	147	198	164	164	7	18	7	5	10	0	2	24	70	36	94	176	223	10	147	70	65	47	53	5	19	11	18	9	15	13	0.5%	98%
SWO	ATS	CP	Korea Rep	LL	t2	ab	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	a	-1	a	-1	abc	abc	a	abc	ab	abc	ab	abc	13		

Table 6. Summary of SWO conventional tagging data available in ICCAT. Number of SWO releases by year and associated recoveries by year. Also shown, the number of recoveries without release information (Unk), and recoveries without recovery dates.

Releases		Recoveries	Recoveries (year)																																																		
Year	Total	Total	1966	1968	1969	1970	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2012	2013	2014	2016	2018	2019	2020	?
1940	2																																																					
1961	2																																																					
1962	1																																																					
1963	2																																																					
1964	58	2	2																																																			
1965	49	1			1																																																	
1966	34	1			1																																																	
1967	25	1															1																																					
1968	28	8		1	2	2	1	1						1																																								
1969	30	2				1				1																																												
1970	91	11				6	1		1	1	1		1																																									
1971	12																																																					
1972	7																																																					
1973	1																																																					
1974	32	2								1		1																																										
1975	25	2											1			1																																						
1976	10																																																					
1977	55	2												1	1																																							
1978	178	13												2	2	4	3	2																																				
1979	118	5													3				1		1																																	
1980	490	26													4	3	4	7		2	4	1				1																												
1981	267	27														2	8	8	6	1				1	1																													
1982	166	4															2		2																																			
1983	162	6																1	2	1	1			1																														
1984	168	5																		1	1				1		1	1																										
1985	204	10																			3	1	1	1	4																													
1986	404	17																				3	4	5	1						4																							
1987	411	18																				2	3	7	4			1	1																									
1988	475	15																					1	6	2	1	1	1		1	1	1																						
1989	217	3																							1			1	1																									
1990	531	11																							1	4		2	4																									
1991	1604	53																								4	9	15	12	7	1		2	1			1				1													
1992	1697	56																									5	21	17	6	4		2			1																		
1993	1542	61																										6	23	6	7	6	3	2	2	2		1	1		1	1												
1994	1919	53																											5	15	5	9	8	2	4	1	2	1																1
1995	1174	37																												4	8	8	5	3	8																			1
1996	680	25																													6	5	5	4	4			1																
1997	769	28																														5	10	3	2	2	2		2		1					1								
1998	397	21																															2	6	4	4		2	2															1
1999	258	8																																	1	3		2		2														
2000	193	12																																	1	7	3						1											
2001	159	2																																			1																	1
2002	282	11																																			2	3	2															4
2003	253	9																																				2	1	2	1	1												2
2004	284	19																																						6	3	2		1	1									6
2005	344	11																																							4	1	2											4
2006	779	20																																							1	4	3		1				1					10
2007	352	13																																								2	2	4	2					1			2
2008	96	6																																									1	2		1							2
2009	38	2																																											1	1							
2010	12	1																																													1						
2011	38	3																																												1	2						
2012	56	1																																														1					
2013	64																																																					
2014	16																																																					
2015	6																																																					
2016	19	1																																																1			
2017	3																																																					
2018	1																																																					
2019	239	14																																																	14		
2020	168	14																																																		14	
Unk	14	11																												2	1	3				1	1			1				1		1							
Total	17711	684	2	1	4	9	2	1	1	3	1	1	2	4	10	10	18	18	11	5	10	7	9	21	15	10	16	48	63	41	37	37	37	21	26	21	12	12	8	11	12	11	9	8	5	5	3	1	1	2	14	14	34

Table 7 Summary of swordfish (*Xiphias gladius*) conventional tagging data: number of recoveries grouped by number of years at liberty in each release year. The last column shows the recovery rate (%) in each release year.

			Years at liberty									
Year	Releases	Recaptures	< 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10+	15+	Unk	% recapt*
1940	2											
1961	2											
1962	1											
1963	2											
1964	58	2		2								3%
1965	49	1				1						2%
1966	34	1				1						3%
1967	25	1								1		4%
1968	28	8	1	2	2	1		1	1			29%
1969	30	2		1				1				7%
1970	91	11	6		1		1	3				12%
1971	12											
1972	7											
1973	1											
1974	32	2		1		1						6%
1975	25	2			1			1				8%
1976	10											
1977	55	2		1	1							4%
1978	178	13	1	3	3	2	4					7%
1979	118	5	2	1			1	1				4%
1980	490	26	4	6	7	1		7	1			5%
1981	267	27	8	10	5	2		2				10%
1982	166	4	2	2								2%
1983	162	6	2	2	1			1				4%
1984	168	5		2				3				3%
1985	204	10	2	2	1	1	3	1				5%
1986	404	17	3	3	5	2		4				4%
1987	411	18	5	6	4	1		2				4%
1988	475	15	5	4	1		2	3				3%
1989	217	3		1			1	1				1%
1990	531	11	3	2	2	4						2%
1991	1604	53	12	8	14	12	2	3	2			3%
1992	1697	56	12	24	11	3	3	3				3%
1993	1542	61	21	11	7	7	4	8	3			4%
1994	1919	53	15	7	10	5	6	9			1	3%
1995	1174	37	9	5	9	3	8	2			1	3%
1996	680	25	10	3	7	2	2	1				4%
1997	769	28	11	6	1	3	3	3	1			4%
1998	397	21	6	4	5	1	2	2			1	5%
1999	258	8	1	2	1	1	1	2				3%
2000	193	12	5	5	1			1				6%
2001	159	2		1							1	1%
2002	282	11	4	3							4	4%
2003	253	9	3	1	2		1				2	4%
2004	284	19	5	2	3	1		2			6	7%
2005	344	11	2	3	1	1					4	3%
2006	779	20	4	3	1	1		1			10	3%
2007	352	13	4	2	4				1		2	4%
2008	96	6	2	1		1					2	6%
2009	38	2		1	1							5%
2010	12	1			1							8%
2011	38	3	1	2								8%
2012	56	1			1							2%
2013	64											
2014	16											
2015	6											
2016	19	1			1							5%
2017	3											
2018	1											
2019	239	14	14									6%
2020	168	14	14									8%
?	14	11									11	79%
Grand Total	17711	684	171	145	115	58	44	68	9	1	34	3.9%

Table 8. CPUE Evaluation table for available abundance indices in North Atlantic for the 2022 Stock Assessment.

Stock	North	North	North	North	North	North	North	North	North	North
Will be used in current stock assessment? State model/s.	Yes (single index)	No	Yes	Yes only for production model (weight)	Yes only for Stock Synthesis	Yes	Yes	No	Yes	Yes
SCRS Doc No:	SCRS/2022/048	SCRS/2022/048	SCRS/2022/054	SCRS/2021/087	SCRS/2021/089	SCRS/2022/046	SCRS/2022/055	SCRS/2022/059	SCRS/2022/050	SCRS/2022/056
Index Name:	CAN LL	CAN LL Hab	PRT LL	SPN LL	SPN LL Age	JPN LL	USA LL	GOM Larval	CTP LL	MOR LL
Data Source (state if based on logbooks, observer data etc.):	Logbooks	Logbooks	Observers, Self-sampling	Landings and voluntary trip records provided by the fleet	Landings and voluntary trip records provided by the fleet	Logbooks;	Observer Program	fishery independent survey data	Logbooks	Landing statistics
Does the index include discarded and retained fish?	Retained only	Retained only	Both	Retained only	Retained only	1976-1999 and 2006-2020: retained only; 2000-2005: Retained and possibly Discarded data	Both	NA	Retained only	Retained only
Do the authors indicate the percentage of total effort of the fleet the CPUE data represents?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	No
If the answer to 1 is yes, what is the percentage?	81-90%	71-80%	11-20%	71-80%	31-40%	91-100%	0-10%		91-100%	91-100%
Are sufficient diagnostics provided to assess model performance?	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
How does the model perform relative to the diagnostics	Well	Well	Well	Well	Well	Well	Well	Mixed	Well	Well
Documented data exclusions and classifications?	Yes	Yes	Yes	NA	Yes	Yes	Yes	Yes	Yes	No
Data exclusions appropriate?	Yes	Yes	Yes	NA	Yes	Yes	Yes	NA	Yes	NA
Data classifications appropriate?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Yes	NA
Geographical Area	Atl NW	Atl NW	Atl NE	Atl N	Atl N	Atl N	Atl NW	Atl NW	Atl N	Atl NE
Data resolution level	trip	trip	Set	trip	trip	Set	Set	OTH	Set	trip
Ranking of Catch of fleet in TINC database (use data catalogue)	1-5	1-5	1-5	1-5	1-5	1-5	1-5		6-10	6-10
Length of Time Series	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years	longer than 20 years	11-20 years
Are other indices available for the same time period?	Few	Few	Many	Few	None	Few	Few	Few	Few	Many
Are other indices available for the same geographic range?	Few	Few	Few	Few	None	Few	None	Few	Few	Few
Does the index standardization account for Known factors that influence catchability/selectivity? (e.g. Type of hook, bait type, depth etc.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Estimated annual CVs of the CPUE series	Low	Low	Medium	Low	Low	High	Low	High	Low	Low
Annual variation in the estimated CPUE exceeds biological plausibility	Unlikely	Unlikely	Possible	Unlikely	Possible	Unlikely	Possible	Likely	Possible	Possible
Are data adequate for standardization purposes?	Yes	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	Yes
For fisheries independent surveys: what is the survey type?								Larval		
For 19: Is the survey design clearly described?								Yes		
Other comments	Early in time series the logbooks were voluntary and reflect less of the total effort.	Habitat suitability variable replaces lat/lon and month; 20% of hab suitability values are 0	Tweetie GLM with habitat			Drop 2000 to 2005 due to the quarlity of logbook data. Two periods 1976-1993; 1994-2020. CV: High however this value was credible interval.		use this for post evaluation to compare trends with the outputs of SSB and Recruitment	(2) for recent years, (5-7) use all available data; time series separated by period: 1968-1989, 1998-2020	

Table 9. Indices of swordfish relative abundance in the North Atlantic for the 2022 stock assessment.

	CANLL		PRTLL		SPNLL		SPNLLage1		SPNLLage2		SPNLLage3		SPNLLage4		SPNLLage5		JPNLL1		JPNLL2		USALL		CTPLL1		CTPLL2		MORLL	
Year	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**
1959																												
1960																												
1961																												
1962	116.91	0.19																										
1963	215.33	0.07																										
1964	83.15	0.06																										
1965	57.61	0.06																										
1966	60.04	0.06																										
1967	80.20	0.05																										
1968	53.97	0.05																							0.18	0.12				
1969	52.05	0.05																							0.22	0.10				
1970	66.69	0.06																							0.17	0.08				
1971																									0.23	0.09				
1972																									0.21	0.12				
1973																									0.23	0.12				
1974																									0.21	0.10				
1975																									0.12	0.10				
1976																	0.52	0.12					0.05	0.10				
1977																	0.66	0.15					0.06	0.09				
1978																	0.80	0.18					0.06	0.11				
1979	95.11	0.10															0.64	0.16					0.07	0.15				
1980	81.56	0.08															0.49	0.14					0.15	0.13				
1981	86.26	0.10															0.65	0.15					0.15	0.11				
1982	67.35	0.11					0.20	0.32	0.85	0.23	0.78	0.21	1.25	0.22	1.35	0.21	0.58	0.12					0.14	0.11				
1983	57.80	0.11					0.31	0.25	0.73	0.18	0.83	0.17	0.99	0.18	1.04	0.16	0.56	0.18					0.13	0.10				
1984	58.15	0.11					0.31	0.25	0.60	0.18	0.82	0.17	1.02	0.17	1.10	0.15	0.61	0.15					0.10	0.09				
1985	67.65	0.11					0.30	0.25	0.85	0.18	0.90	0.17	1.05	0.17	1.01	0.15	0.56	0.16					0.08	0.09				
1986	113.24	0.11			253.19	0.02	0.44	0.24	1.08	0.18	0.99	0.16	0.99	0.17	0.91	0.15	0.39	0.15					0.10	0.09				
1987	81.97	0.11			273.81	0.03	0.68	0.25	1.59	0.18	1.25	0.17	1.10	0.17	0.93	0.15	0.38	0.13					0.08	0.11				
1988	78.36	0.11			240.09	0.03	0.83	0.24	1.34	0.18	1.07	0.16	0.93	0.17	0.80	0.15	0.37	0.16					0.06	0.22				
1989	73.80	0.10			245.30	0.03	0.69	0.24	1.55	0.18	0.96	0.16	0.85	0.17	0.72	0.15	0.42	0.17					0.06	0.25				
1990	106.69	0.09			240.26	0.03	0.39	0.24	1.73	0.18	1.27	0.16	0.87	0.17	0.69	0.15	0.48	0.23										
1991	71.23	0.07			245.88	0.03	0.35	0.24	1.27	0.18	1.33	0.16	1.03	0.17	0.78	0.15	0.49	0.27										
1992	83.74	0.07			243.18	0.03	0.38	0.24	1.24	0.18	1.22	0.16	1.06	0.17	0.89	0.15	0.43	0.33										
1993	72.77	0.05			213.72	0.03	0.47	0.24	1.24	0.18	1.05	0.16	0.86	0.17	0.76	0.15	0.57	0.35			0.89	0.09						
1994	52.19	0.04			208.29	0.02	0.47	0.24	1.35	0.18	0.91	0.16	0.74	0.17	0.64	0.15			0.64	0.47	0.93	0.09						
1995	64.60	0.05			232.78	0.02	0.49	0.24	1.73	0.17	1.25	0.16	0.85	0.17	0.68	0.14			0.48	0.33	0.94	0.09						
1996	39.61	0.05			198.58	0.02	0.49	0.24	1.11	0.17	0.92	0.16	0.68	0.17	0.54	0.14			0.50	0.40	0.74	0.10						
1997	56.90	0.05			201.67	0.02	1.02	0.24	1.30	0.17	0.75	0.16	0.58	0.17	0.44	0.15			0.53	0.38	0.94	0.09			0.23	0.13		
1998	78.93	0.05			209.82	0.02	0.90	0.24	1.82	0.17	0.78	0.16	0.52	0.17	0.45	0.15			0.59	0.66	1.33	0.10			0.25	0.15		
1999	105.15	0.05	174.44	0.16	227.91	0.02	1.07	0.24	2.13	0.18	1.13	0.16	0.60	0.17	0.37	0.15			0.57	0.25	1.31	0.10			0.08	0.10		
2000	77.97	0.06	255.88	0.20	313.04	0.02	1.07	0.24	2.54	0.18	1.44	0.16	0.85	0.17	0.64	0.15					1.01	0.09			0.11	0.13		
2001	89.89	0.05	200.41	0.21	290.93	0.02	1.16	0.24	2.43	0.18	1.33	0.16	0.69	0.17	0.50	0.15					1.01	0.09			0.11	0.11		
2002	142.52	0.06	179.82	0.19	274.23	0.02	0.84	0.24	1.88	0.18	1.19	0.16	0.70	0.17	0.54	0.15					0.89	0.09			0.13	0.10		
2003	99.17	0.06	243.86	0.20	282.56	0.02	0.83	0.24	2.04	0.18	1.34	0.16	0.84	0.17	0.62	0.15					0.79	0.09			0.11	0.11		
2004	91.75	0.05	368.22	0.20	287.22	0.03	0.81	0.24	1.45	0.18	0.87	0.16	0.66	0.17	0.52	0.15					0.81	0.09			0.07	0.09		
2005	108.85	0.05	324.09	0.22	286.60	0.03	0.81	0.24	1.52	0.18	0.86	0.17	0.52	0.17	0.50	0.15					1.34	0.09			0.09	0.09	460.41	0.12
2006	94.68	0.05	282.68	0.18	261.19	0.03	1.22	0.25	1.59	0.18	0.77	0.17	0.50	0.17	0.51	0.15			0.32	0.34	1.07	0.09			0.15	0.09	260.97	0.11
2007	88.35	0.06	324.21	0.17	303.70	0.03	1.50	0.25	2.15	0.19	0.85	0.17	0.41	0.18	0.53	0.16			0.52	0.33	1.34	0.09			0.09	0.11	220.15	0.11
2008	111.88	0.06	312.69	0.18	347.41	0.03	1.35	0.25	3.11	0.19	1.18	0.17	0.56	0.18	0.59	0.16			0.57	0.32	1.21	0.09			0.06	0.11	344.51	0.12
2009	96.17	0.06	350.80	0.19	313.18	0.03	0.61	0.26	2.36	0.19	1.28	0.17	0.64	0.18	0.60	0.16			0.58	0.29	1.04	0.09			0.07	0.12	310.44	0.12
2010	143.17	0.06	306.15	0.20	312.27	0.03	0.74	0.25	2.37	0.18	1.12	0.17	0.53	0.18	0.49	0.16			0.58	0.33	0.75	0.09			0.06	0.11	479.56	0.11
2011	107.59	0.06	310.57	0.18	332.83	0.03	1.20	0.25	1.64	0.18	0.98	0.17	0.65	0.18	0.65	0.16			0.49	0.33	1.04	0.09			0.12	0.11	323.90	0.11
2012	112.77	0.06	336.72	0.17	338.17	0.03	0.85	0.25	2.42	0.19	1.05	0.17	0.65	0.18	0.92	0.16			0.64	0.41	1.05	0.09			0.16	0.12	351.75	0.11
2013	110.57	0.06	355.74	0.16	336.54	0.03	0.67	0.26	1.74	0.19	0.93	0.18	0.60	0.18	0.68	0.16			0.36	0.42	0.92	0.09			0.09	0.12	319.07	0.11
2014	89.17	0.06	310.86	0.16	325.51	0.03	0.63	0.26	1.93	0.19	1.16	0.17	0.84	0.18	0.97	0.16			0.48	0.54	0.73	0.09			0.10	0.15	231.60	0.11
2015	92.03	0.06	309.59	0.15	323.18	0.03	0.87	0.26	2.62	0.19	1.45	0.17	1.03	0.18	1.14	0.16			0.53	0.43	0.75	0.09			0.10	0.11	237.66	0.11
2016	69.06	0.06	344.11	0.15	357.17	0.04			1.30	0.19	0.92	0.17	0.72	0.18	1.00	0.16			0.46	0.43	0.76	0.09			0.08	0.11	384.18	0.13
2017	64.41	0.05	319.88	0.16	325.28	0.04			1.35	0.19	0.77	0.18	0.65	0.18	1.00	0.17			0.56	0.43	0.79	0.09			0.08	0.10	596.27	0.12
2018	56.81	0.06	344.48	0.14	317.19	0.04			1.79	0.20	0.87	0.18	0.61	0.19	0.75	0.17			0.51	0.45	0.96	0.09			0.09	0.11	437.93	0.11
2019	84.94	0.06	462.67	0.14	318.24	0.04			2.88	0.20	1.32	0.18	0.81	0.19	1.09	0.18			0.50	0.56	1.13	0.09			0.09	0.10	486.00	0.13
2020	80.73	0.06	449.62	0.12															0.55	0.38	1.11	0.10			0.11	0.10	543.34	0.12
2021	78.02	0.06																			1.40	0.10						

Table 10. CPUE Evaluation table for available abundance indices in South Atlantic for the 2022 Stock Assessment.

Stock	**South**	**South**	**South**	**South**	**South**	**South**	**South**
Will be used in current stock assessment? State model/s.	Yes	Yes (weight)	Yes	Yes	No	Yes	Yes
SCRS Doc No:	SCRS/2022/057	SCRS/2021/088	SCRS/2022/046	SCRS/2017/078	SCRS/2013/101	SCRS/2022/049	SCRS/2022/051
Index Name:	BRA LL	SPN LL	JPN LL	URU LL	URU LL hist	ZAF LL	CTP LL
Data Source (state if based on logbooks, observer data etc.):	Logbooks	Landings and voluntary trip records provided by the fleet	Logbooks	Observer Program	Logbooks	Logbooks	Logbooks
Does the index include discarded and retained fish?	Retained Only	Retained only	Retained Only	Both	Retained Only	Retained Only	Retained only
Do the authors indicate the percentage of total effort of the fleet the CPUE data represents?	Yes	Yes	Yes	No	Yes	Yes	Yes
If the answer to 1 is yes, what is the percentage?	71-80%	91-100%	91-100%		91-100%	71-80%	91-100%
Are sufficient diagnostics provided to assess model performance?	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient	Sufficient
How does the model perform relative to the diagnostics	Well	Well	Well	Well	Well	Well	Well
Documented data exclusions and classifications?	Yes	NA	Yes	Yes	Yes	Yes	NA
Data exclusions appropriate?	Yes	NA	Yes	Yes	Yes	Yes	NA
Data classifications appropriate?	Yes	Yes	Yes	Yes	Yes	Yes	NA
Geographical Area	Atl SW	Atl S	Atl S	Atl SW	Atl SW	Atl SE	Atl S
Data resolution level	Set	trip	Set	Set	Set	Set	Set
Ranking of Catch of fleet in TINC database (use data catalogue)	1-5	1-5	1-5	1-5	1-5	6-10	1-5
Length of Time Series	longer than 20 years	longer than 20 years	longer than 20 years	11-20 years	longer than 20 years	11-20 years	longer than 20 years
Are other indices available for the same time period?	Many	Many	Few	Many	Many	Many	Many
Are other indices available for the same geographic range?	Few	Few	Few	Few	Few	None	Few
Does the index standardization account for Known factors that influence catchability/selectivity? (e.g. Type of hook, bait type, depth etc.)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Estimated annual CVs of the CPUE series	Low	Low	Medium	Variable	Variable	Low	Low
Annual variation in the estimated CPUE exceeds biological plausibility	Unlikely	Unlikely	Possible	Possible	Possible	Possible	Possible
Are data adequate for standardization purposes?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Is this standardised CPUE time series continuous?	Yes	Yes	No	Yes	Yes	Yes	No
For fisheries independent surveys: what is the survey type?							
For 19: Is the survey design clearly described?							
Other comments	Not to split the time series (1994-2020)		Two periods 1976-1993; 1994-2020. CV: High however this value was credible interval.	Gear configuration and environmental factors were used.	Gear configuration and environmental factors were used.		(2) for recent years, (5-7) use all available data; only late period was used previously (1998-2020)

Table 11. Indices of swordfish relative abundance in the South Atlantic for the 2022 Stock Assessment.

	BRALL		SPNLL		JPNLL1		JPNLL2		URULL*		ZAFLL		CTPLL1		CTPLL2	
Year	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**	**Index**	**CV**
1968													0.33	0.09		
1969													0.26	0.07		
1970													0.28	0.06		
1971													0.32	0.07		
1972													0.25	0.07		
1973													0.27	0.09		
1974													0.25	0.08		
1975													0.21	0.08		
1976					1.11	1.05							0.12	0.08		
1977					1.26	1.15							0.13	0.07		
1978					1.09	1.23							0.15	0.07		
1979					1.21	0.69							0.19	0.08		
1980					1.43	0.53							0.19	0.07		
1981					1.02	0.34							0.20	0.07		
1982					0.91	0.25							0.18	0.07		
1983					0.89	0.25							0.18	0.08		
1984					1.21	0.21							0.21	0.09		
1985					1.61	0.22							0.16	0.08		
1986					1.21	0.36							0.14	0.07		
1987					2.01	0.22							0.16	0.07		
1988					1.60	0.14							0.19	0.09		
1989			522.86	0.05	1.19	0.14							0.21	0.09		
1990			396.32	0.04	1.75	0.14							0.18	0.08		
1991			384.85	0.03	0.81	0.14										
1992			349.28	0.03	0.74	0.18										
1993			302.03	0.03	0.80	0.25										
1994	1.05	0.11	345.98	0.03			0.68	0.35								
1995	1.44	0.08	395.59	0.03			0.58	0.31								
1996	1.58	0.07	355.34	0.03			0.56	0.20								
1997	1.49	0.08	337.81	0.02			0.47	0.17								
1998	1.26	0.09	328.53	0.02			0.46	0.17							0.15	0.08
1999	1.06	0.11	355.55	0.03			0.47	0.17							0.10	0.06
2000	0.95	0.12	429.92	0.03			0.45	0.16							0.13	0.06
2001	0.88	0.13	380.51	0.02			0.46	0.17	6.47						0.10	0.05
2002	0.90	0.12	364.60	0.02			0.48	0.17	4.13	0.76					0.10	0.05
2003	1.04	0.11	320.91	0.03			0.39	0.21	6.17	0.43					0.10	0.05
2004	0.84	0.13	312.41	0.03			0.37	0.27	5.22	0.42	541.84	0.09			0.07	0.04
2005	0.86	0.13	379.16	0.03			0.48	0.25	5.21	0.43	465.71	0.09			0.07	0.05
2006	0.98	0.11	382.24	0.03			0.72	0.21	5.50	0.34	396.90	0.09			0.10	0.05
2007	1.21	0.09	371.56	0.03			0.65	0.26	4.96	0.39	387.23	0.09			0.08	0.05
2008	1.10	0.10	359.35	0.03			0.59	0.24	3.23	0.44	324.83	0.09			0.09	0.05
2009	1.08	0.10	393.05	0.03			0.49	0.27	3.51	0.41	314.95	0.09			0.08	0.05
2010	1.06	0.12	381.83	0.03			0.55	0.25	3.29	0.45	355.08	0.09			0.06	0.05
2011	1.04	0.12	369.94	0.03			0.34	0.26	2.00	0.43	239.93	0.10			0.07	0.05
2012	0.99	0.11	394.41	0.03			0.45	0.36	5.08	0.47	250.16	0.10			0.07	0.05
2013	0.87	0.13	397.74	0.03			0.48	0.29			379.34	0.09			0.09	0.06
2014	0.95	0.12	416.85	0.03			0.60	0.32			319.59	0.09			0.07	0.05
2015	1.12	0.10	450.24	0.03			0.58	0.36			406.65	0.09			0.08	0.06
2016	0.99	0.11	491.22	0.04			0.63	0.38			436.31	0.09			0.08	0.06
2017	0.79	0.14	479.27	0.04			0.72	0.38			323.26	0.09			0.07	0.06
2018	0.88	0.13	421.23	0.03			0.67	0.52			263.44	0.09			0.06	0.06
2019	0.68	0.16	419.14	0.03			0.71	0.65			376.82	0.09			0.06	0.06
2020	0.63	0.18					0.78	0.73			240.58	0.09			0.07	0.06
2021																

* this index was not updated because the fishery has ceased.

Table 12. Fleet structure for North Atlantic swordfish Stock Synthesis model agreed by the Group for the 2022 Stock Assessment.

FL	Fishery ID	Description	Time	Catch/Size (FlagName*)	Catch/Size	CPUE	CPUE: Retained/Discards	Size: Retained/Discards
1	SPNLL	EU-Spain LL (longline)	1950-2020	EU-España	LL	1982-2019 by age	Retained	Retained
2	USALL	USA LL	1950-2020	USA	LL	1993-2020	Both	Both
3	CANLL	Canada LL	1950-2020	Canada	LL	1962-2020	Retained	Both
4	JPNLL1	Japan LL early	1950-1993	Japan	LL	1976-1993	Retained	Both
5	JPNLL2**	Japan LL late	1994-2020	Japan	LL	1994-2020 (no 2000-2005)	Retained	Both
6	PORLL	EU-Portugal LL	1950-2020	EU-Portugal	LL	1999-2020	Both	Both
7	CTPLL1	Chinese Taipei LL early	1950-1989	Chinese Taipei	LL	1968-1989	Retained	Both
8	CTPLL2	Chinese Taipei LL late	1990-2020	Chinese Taipei	LL	1997-2020	Retained	Both
9	MORLL	Morocco LL	1950-2020	Maroc	LL	2005-2020	Retained	Retained
10	Harpoon	Canada/USA Harpoon	1950-2020	Canada, USA	HP	-	-	-
11	Others	LL by the other CPCs, and all other gears except HP	1950-2020	LL (except the flags listed above), and all other gears except HP	All others Size: borrow USALL FL	-	-	-

*   FlagName is in ICCAT database
** Time block is defined: 1994-2009, 2010-2020

Table 12a. Type of swordfish length measurement submitted to ICCAT (ST04-SZ) and minimum size adopted by CPCs. Information compiled from national scientists' questionnaire responses.

Fleet	Length type	Min size implemented
Spain	Retain / discard	125
USA	Retain / discard	119
Canada	Retain / discard	125
Japan early	Retain / discard	125
Japan late	Retain / discard	125
Portugal	Retain / discard	125
Chinese Taipei	Retain	119
Morocco	Retain	125
Others	N/A	N/A

Table 13. The following time blocks will be applied to Japanese longline fleets (FL 5 and 6).

	JPNLL_early Block 1		JPNLL_late Block 2				
Data Source	first yr.	last yr.	first yr.	last yr.	first yr.	last yr.	Note
Catch	1950	1993	1994	2020			
CPUE (retained only)	1976	1993	1994	2020			remove 2000-2005
Survey (observer)							
Selectivity (Length)	1950	1993	1994	2009	2010	2020	

Table 14. MSE Workplan for northern swordfish.

Event	Description	Timeline	Decision points
CMP development	CMP development from MSE technical team and national scientists	-CMP development can begin immediately with the current OMs and further tuned once OM reconditioning is complete (August 2022, see below) - the first set of CMPs should be presented to SWO Technical Working Group by **late 2022** -Ongoing through 2023, with frequent, informal meetings	
OM reconditioning	MSE Expert to update MSE to reflect new data and assumptions from 2022 stock assessment model	July-August 2022	
Annual Species Group meeting	The species group will review the work of the technical team, propose revisions, and as appropriate approve the work of the technical team	September 2022	Review and approve any revisions to the OM grid, performance metrics and MP development
Panel 4 meeting	SCRS to provide both oral and written summary of MSE progress and Panel 4 to provide feedback,	13 November 2022 + 2022 Annual Meeting	Panel 4 to provide feedback on performance metrics and advice intervals; PA4 to draft final operational management objectives; agreement on the workplan for following year
First 2023 SWO intersessional SG meeting	The species group will review the work of the technical team, propose revisions, and as appropriate, approve the work of the technical team	Early 2023; short, 2-day meeting	Review and approve any revisions to the MSE framework, performance metrics and CMPs as needed
Ambassador session	Overview of SWO MSE for stakeholders/managers, with updated oral and written summaries. Walkthrough of Shiny App.	Before 1st 2023 Panel 4 meeting	

Panel 4, meeting 1	Update on MP creation; any revisions to OM grid; final version of PMs	Early 2023	Tuning parameters; finalized hierarchy of PMs; receive feedback on MP characteristics (e.g. how much can TAC change / year, etc.)
Second 2023 SWO intersessional SG meeting	The species group will review the work of the technical team, propose revisions, and as appropriate, approve the work of the technical team	Mid-2023	Review and approve any revisions to the MSE framework, performance metrics and CMPs as needed
Ambassador session	Overview of SWO MSE for stakeholders/managers, with updated oral and written summaries.	Before 2nd 2023 Panel 4 meeting	
Panel 4, meeting 2	Present final set of approximately 2-3 CMPs	Mid-2023	Receive feedback on CMP format and construction
Annual Species Group meeting	The species group will review the work of the technical team, propose revisions, and as appropriate, approve the work of the technical team	September 2023	Review and approve any revisions to MPs. Cull CMPs to 2-3 for presentation to the PA4
Ambassador session	Overview of SWO MSE for stakeholders/managers, with updated oral and written summaries.	Before 3rd 2023 Panel 4 meeting	
Panel 4, meeting 3	CMP discussion	October 2023	PA4 to review final CMP options and recommend approximately 2-3 to the Commission for adoption
Annual Meeting	Commission to adopt final MP	November 2023	Commission to adopt final MP and possibly exceptional circumstances protocol

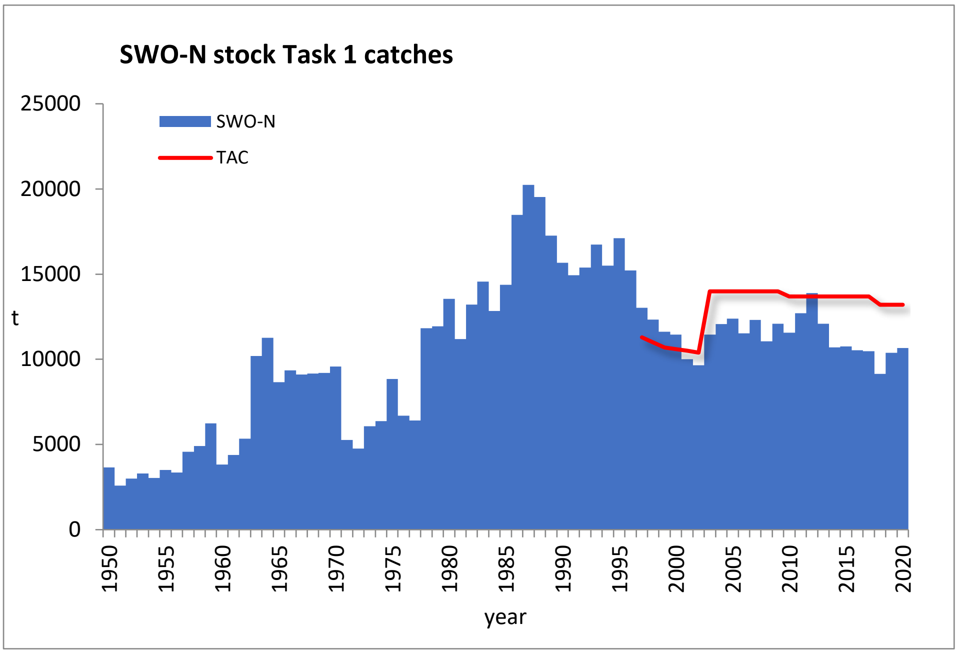

Figure 1. Total SWO-N catches (t, landings and dead discards) by major gear between 1950 and 2020.

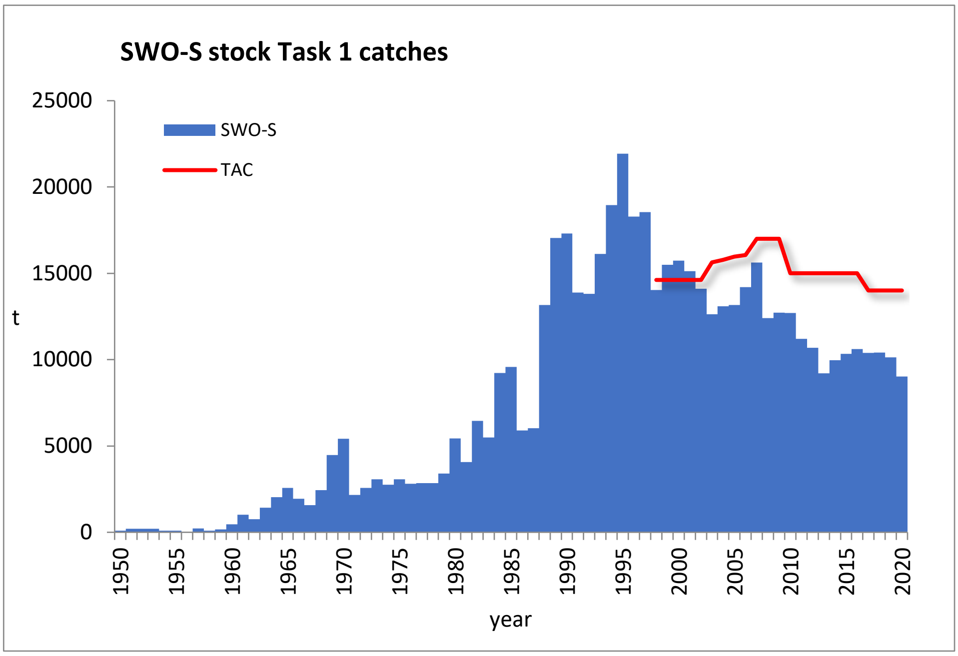

Figure 2. Total SWO-S cumulative catches (t, landings and dead discards) by major gear between 1950 and 2020.

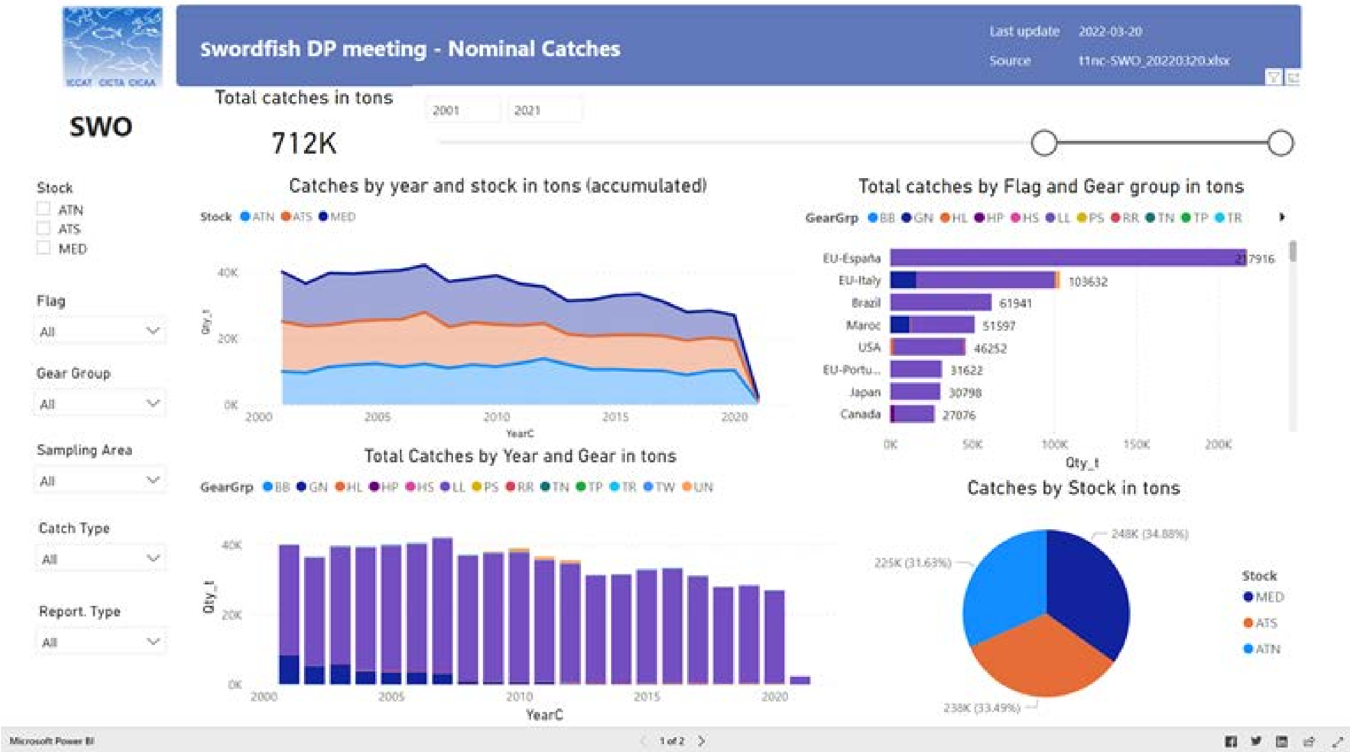

Figure 3. Screenshot of the dashboard developed for T1NC with SWO and the three stocks.

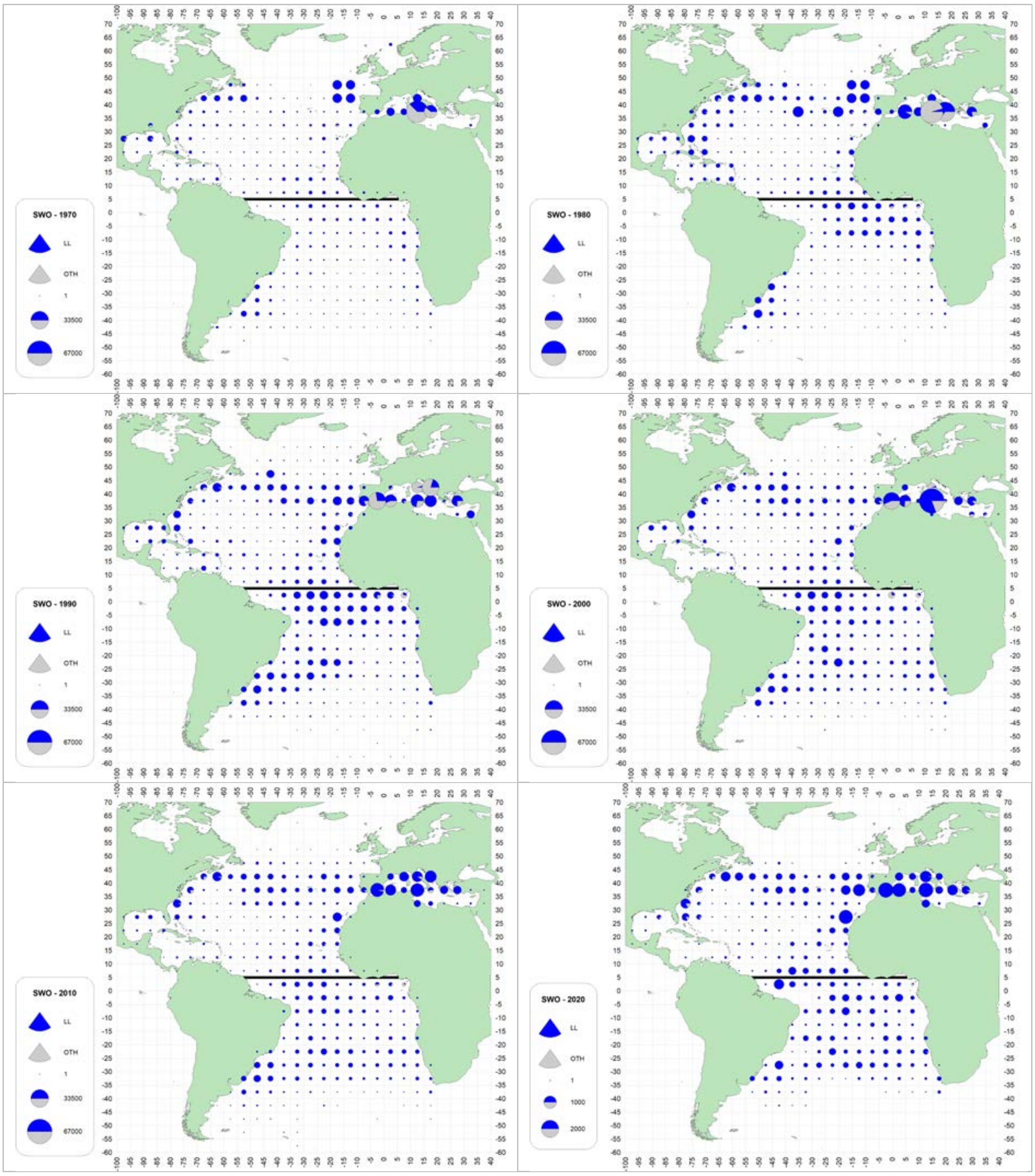

Figure 4. SWO CATDIS maps by decade (1970-2020). Last decade only contains 1 year.

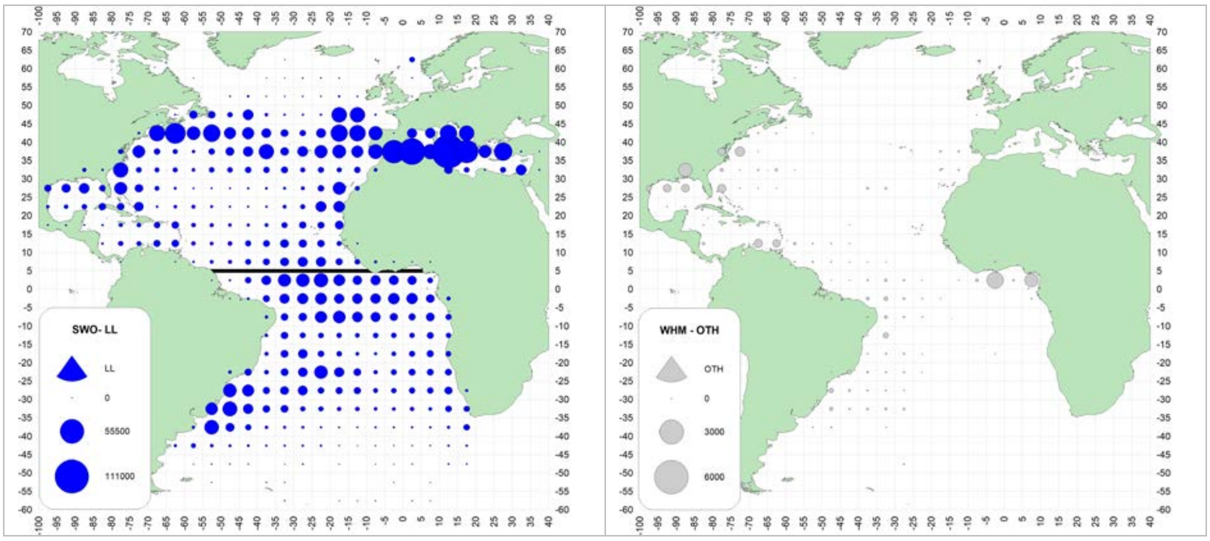

Figure 5. SWO CATDIS maps (all years combined, 1950-2020) for longline (LL) and other surface gears.

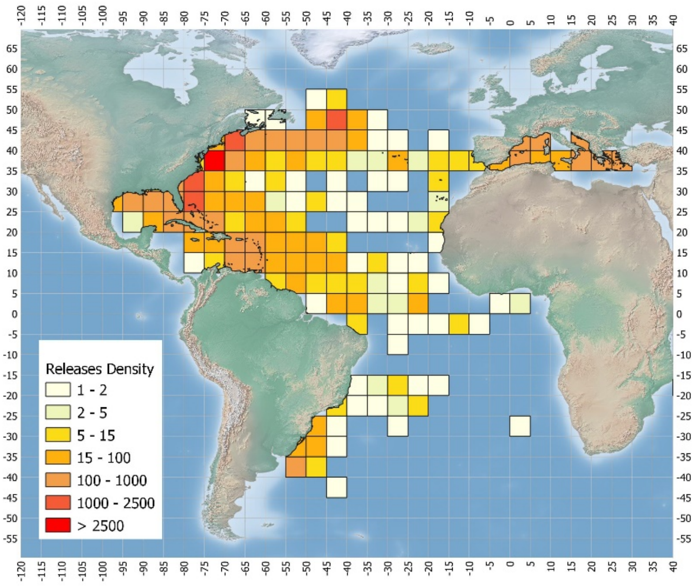

Figure 6. Density of SWO conventional tags released in a 5x5 square grid, in the ICCAT area.

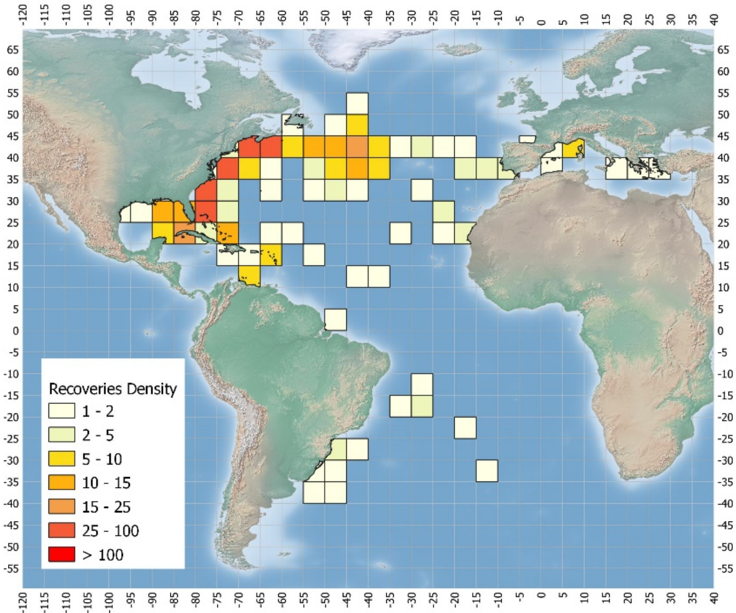

Figure 7. Density of SWO conventional tags recovered in a 5x5 square grid, in the ICCAT area.

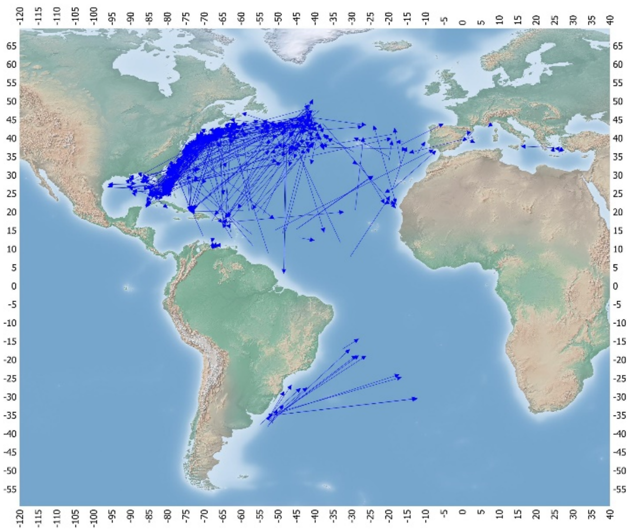

Figure 8. Apparent movement (arrows: release to recovery location) of the SWO conventional tagging.

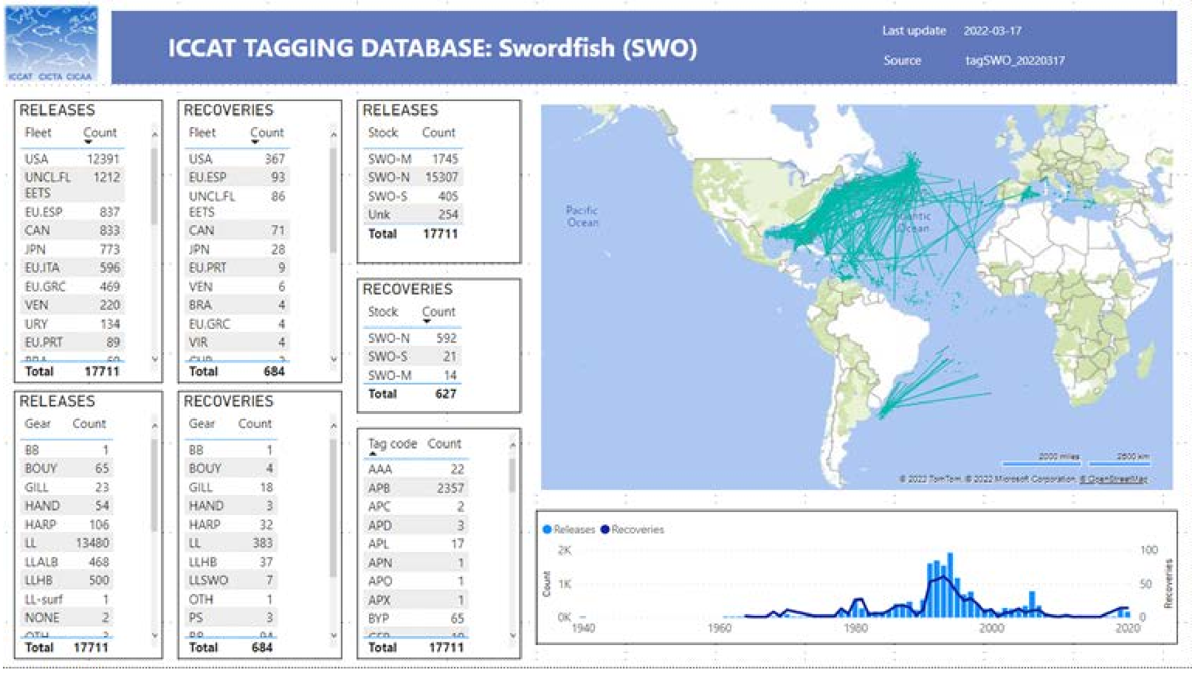

Figure 9. Snapshot of the dashboard on Conventional Tagging (SWO).

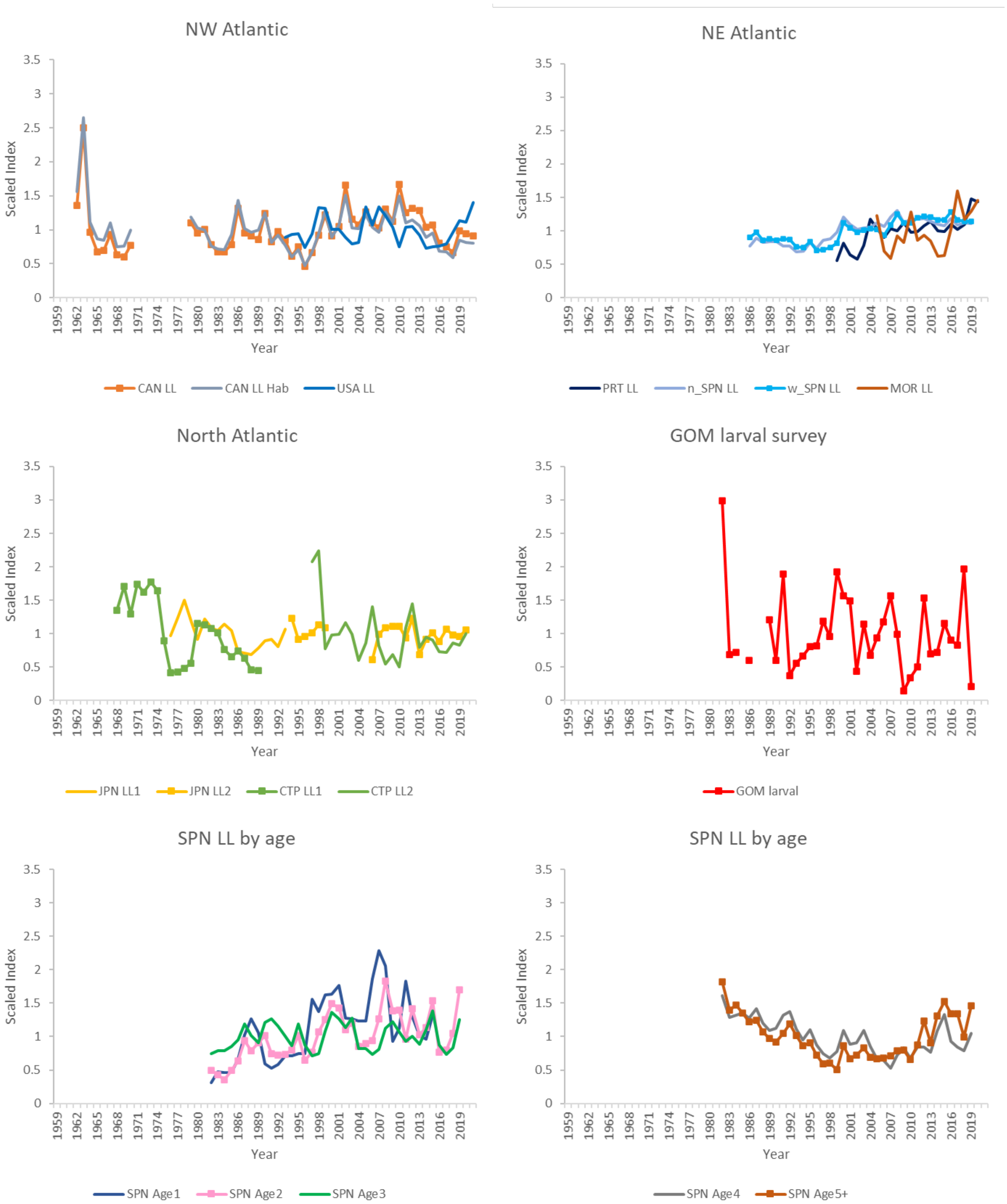

Figure 10. Indices of swordfish relative abundance for the North Atlantic.

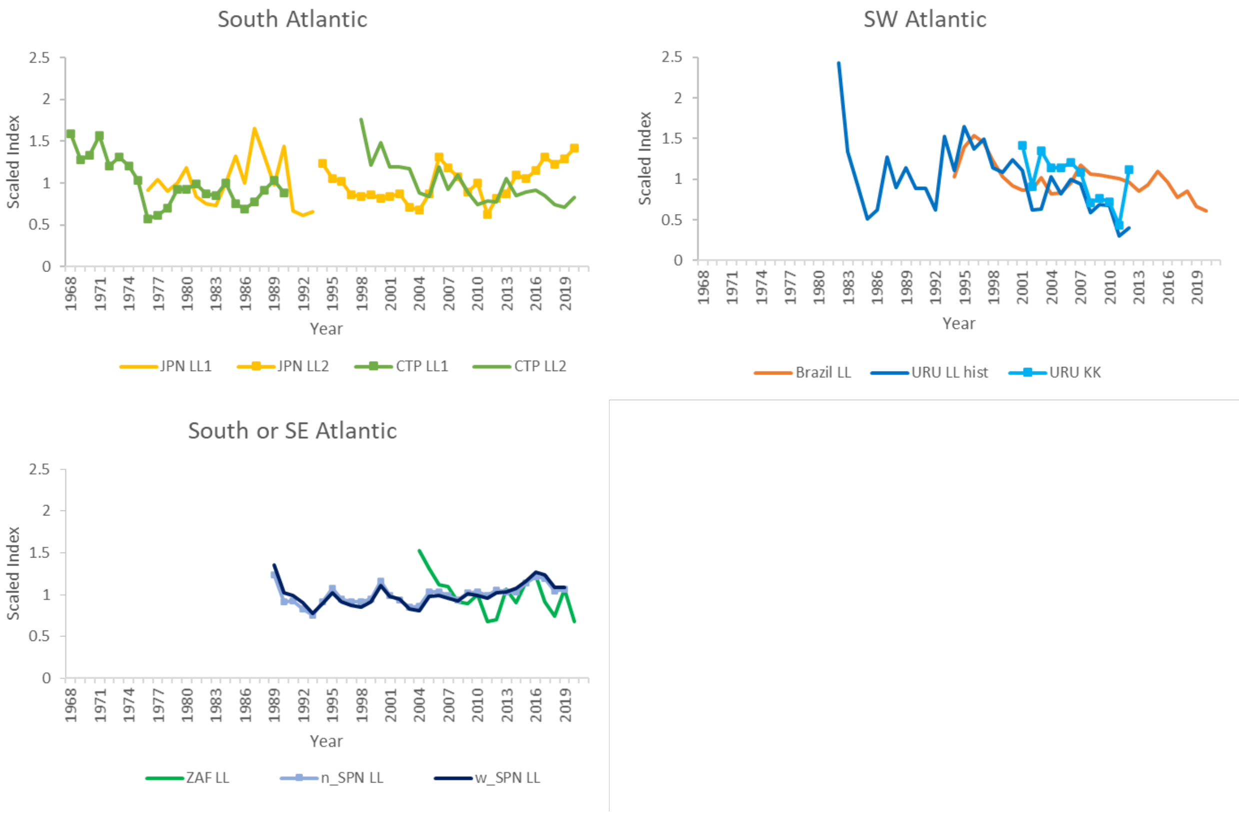

Figure 11. Indices of swordfish relative abundance for the South Atlantic.

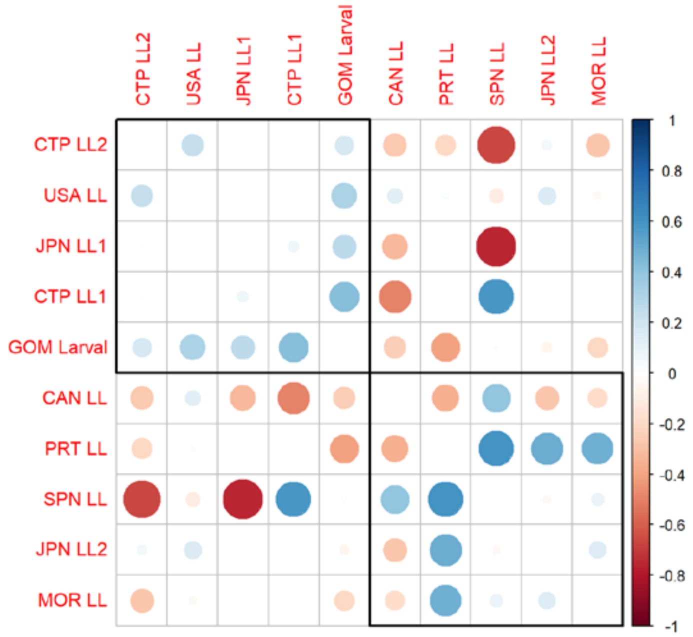

Figure 12. Plot of the correlation matrix, blue indicate a positive correlation and red negative for the North Atlantic swordfish stock. The order of the indices and the rectangular boxes are chosen based on a hierarchical cluster analysis using a set of dissimilarities for the indices being clustered. CAN-LL without Habitat model and SPN-LL in weight were applied.

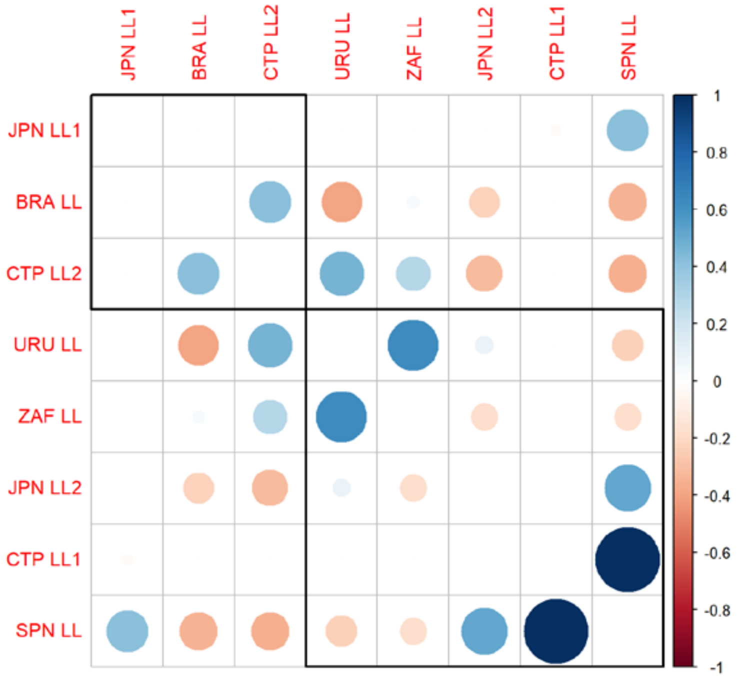

Figure 13. Plot of the correlation matrix, blue indicates a positive correlation and red negative for the South Atlantic swordfish stock. The order of the indices and the rectangular boxes are chosen based on a hierarchical cluster analysis using a set of dissimilarities for the indices being clustered. SPN_LL in weight and URU_LL since 2001.

Appendix 1

Agenda

Objectives

The SCRS will include data up to 2020 during the 2022 assessment of Atlantic swordfish. Updates of relevant biological parameters and relative abundance indices (individual and combined) are requested for the new assessment including data until 2021 when available. In addition, during the meetings relevant matters related to the North Atlantic swordfish MSE development will be discussed.

Tentative Agenda

1. Opening, adoption of the Agenda and meeting arrangements
2. Review of historical and new information on biology
3. Review of fishery statistics
   - 3.1 Task 1 (catches) data
   - 3.2 Task 2 (catch-effort and size samples) data
   - 3.3 Catch-at-size, Catch-at-age, Weight at Age
   - 3.4 Tagging data
4. Indices of abundance (individual and combined indices)
   - 4.1 North
   - 4.2 South
   - 4.3 Trends and correlations in the CPUE indices
   - 4.4 Determine indices to be used in the next assessment for the base-case and sensitivity runs
5. Discussion on models to be used during the assessment and their assumptions
   - 5.1 North
   - 5.2 South
   - 5.3 Diagnostics to be used for model validation
6. MSE matters
   - 6.1 Review of current development state of the North Atlantic Swordfish MSE
   - 6.2 Presentation of the currently adopted MSE roadmap by the Commission
   - 6.3 Further development of the MSE work during 2022
     - 6.3.1 Discussion on recondition OMs considering new information from the stock assessment, and plans to finalize the OM grid
     - 6.3.2 Continue work on criteria for determining exceptional circumstances taking into account the exceptional circumstances protocol for N-ALB
     - 6.3.3 Discussion on performance indicators and advice intervals
     - 6.3.4 Continue work on development and testing of candidate management procedures
7. Other matters
8. Recommendations and workplan
9. Adoption of the report and closure

Appendix 2

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Appendix 3

List of Papers and Presentations

DocRef	Title	Authors
SCRS/2022/041	Review of the fleet structure for the Stock Synthesis assessment models for the North and South Atlantic swordfish stocks	Kimoto A., Ortiz M., Taylor N.G.
SCRS/2022/046	CPUE Standardization For Atlantic Swordfish Caught By Japanese Longline Fishery: The Glmm Analisis Using R Software Package R-INLA	Iijima H
SCRS/2022/047	Revisión De Las Estadísticas Históricas De Desembarque De Pez Espada (*Xiphias Gladius*) Por Parte De La Flota De Mediana Escala En El Caribe Costarricense	Quesada, N, Pacheco Chaves, B., Miguel Carvajal, J
SCRS/2022/048	A relative index of Atlantic Swordfish abundance based on Canadian pelagic longline data (1962 to 2021)	Hanke A., Gilespie K.
SCRS/2022/049	Standardised Catch Rates Of Swordfish (*Xiphias gladius*) For The South African Pelagic Longline Fishery (2004-2020)	Parker D
SCRS/2022/050	Developing The Abundance Index Of Swordfish (*Xiphias gladius*) With Consideration Of Targeting Shift For The Chinese Taipei Tuna Longline Fishery In The North Atlantic Ocean	Su N-J., Cheng C-Y.
SCRS/2022/051	Catch Per Unit Effort Standardization of Swordfish (*Xiphias gladius*) for the Chinese Taipei Tuna Longline Fishery in the South Atlantic Ocean	Su N-J., Cheng C-Y.
SCRS/2022/052	Update On The Satellite Tagging Of Atlantic And Mediterranean Swordfish	Rosa D., Garibaldi F., Snodgrass D., Orbesen E., Santos C., Macias D., Ortiz de Urbina J.,Forselledo R., Miller P., Domingo A., Brown C., Coelho R.
SCRS/2022/054	Standardized CPUE For Swordfish Captured By The Portuguese Pelagic Longline Fishery In The North Atlantic Ocean	Coelho R., Rosa, D., Barbosa, C., Goes, S., Lino, P
SCRS/2022/055	Standardized Catch Indices Of Atlantic Swordfish, *Xiphias gladius*, From The United States Pelagic Longline Observer Program	Lauretta M.
SCRS/2022/056	Updated Standardized Catch Rate Of Swordfish (*Xiphias Gladius*) From The Moroccan Longline Fishery Operating South Of The Moroccan Atlantic Waters	Ikkiss A., Baibbat SA, Noureddine A, Jilali B.
SCRS/2022/057	Catch Rates Of Swordfish From Brazilian Longline Fisheries In The South Atlantic (1994-2020)	Mourato B., Sant'Ana R., Gustavo Cardoso L., and Travassos P.
SCRS/2022/059	Annual Indices of Swordfish (*Xiphius gladius*) Spawning Biomass In The Gulf Of Mexico (1982-2019)	Ingram W
SCRS/2022/060	Review And Preliminary Analyses Of Size Samples Of North And South Atlantic Swordfish Stocks (*Xiphias gladius*)	Ortiz M., Kimoto A.
SCRS/2022/061	Preliminary Relationship Between Straight And Curved Lower Jaw Fork Length For Swordfish (*Xiphias gladius*) In The North Atlantic	Coelho R., Barbosa C, Rosa D, Lino P, Gillespie K.
SCRS/P/2022/004	Accounting for Fleet Dynamics and Management Change in International Fisheries: A Case Study of the Canadian North Atlantic Swordfish Fishery	Franceschini, J., Duprey N., Hanke A., and Gillespie, K.

SCRS/P/2022/005	Update of the ageing sample collection, processing, reading and modelling: spines and otoliths	Anonymous
SCRS/P/2022/006	Review of Outstanding Decision Points for the North Atlantic Swordfish MSE Process	Hordyk A.
SCRS/P/2022/007	Development of Candidate Management Procedures for the North Atlantic Swordfish MSE	Hordyk A.
SCRS/P/2022/008	*Update on the ICCAT swordfish biology project*	Anonymous
SCRS/P/2022/009	Update On Development Of The North Atlantic Swordfish MSE	Gilespie K, Hordyk A.
SCRS/P/2022/010	Update On Development Of Performance Indicators And Advice Intervals	Anonymous

Appendix 4

SCRS Document summaries as provided by the authors

SCRS/2022/041 The SCRS plans to conduct stock assessments for North and South Atlantic swordfish in 2022. During the review of the catch and size data, it was suggested that the ICCAT Swordfish Species Group needed to review the fleet structure used in the 2017 Stock Synthesis assessment. If the ICCAT Swordfish Species Group intends using Stock Synthesis for the assessment, this document provides some suggestions on the fleet structure for N-SWO, as well as a proposal of the fleet structure for S-SWO stock.

SCRS/2022/046 This study addressed the standardization of Atlantic swordfish CPUE using Japanese longline fishery operational data. The Japanese longline operational data to be standardized was divided into two-time series (Eary; 1976-1993, Late;1994-2020) considering data quality and divided North and South division on 5°N according to the stock assessment area. The R software package R-INLA was used for the analysis, and Bayesian estimation was applied to calculate the posterior distribution of the parameters. Model selection was performed with WAIC and LOOCV, and the spatiotemporal models were selected for all areas and periods. For standardization, the posterior means of the least-squares means were computed, including spatial effects. It was proposed not to use the 2000-2005 period in the North Atlantic area CPUE in the stock assessment because data quality during this period is very low, and the last stock assessment did not use it.

SCRS/2022/047 En el Caribe de Costa Rica la captura de pez espada es realizada por la flota comercial de mediana escala, siendo estas capturas de manera incidental. En la actualidad operan un total de 9 embarcaciones y todos sus desembarques pesqueros son inspeccionados y registrados por el Instituto Costarricense de Pesca y Acuicultura. Desde 1999 en las estadísticas pesqueras se encuentran registros de esta especie, reportándose un total de 248.10 t hasta el año 2020, con un promedio de 11.81 t por año. El año con menor registro fue el 2001 con 0.19 t y el año con mayor registro fue el 2017 con 33.03 t. La información muestra que desde 17 años antes de la incorporación de Costa Rica a ICCAT como parte colaboradora no contratante ya se capturaba el pez espada en el Caribe del país.

SCRS/2022/048 A relative index of north Atlantic Swordfish abundance was developed for the period 1962 to 2021 using trip level data. The standardizations were based on the number of Swordfish caught and involved fitting generalized additive mixed effects models that controlled for the effect of hooks, bait, Julian day, month, shark and tuna caught, area and vessel. The area specific index indicates a decline in relative abundance to levels comparable with the years prior to the institution of a rebuilding plan in 1999, however the trend in relative abundance has increased since 2019.

SCRS/2022/049 Swordfish, *Xiphias gladius*, is a target species in the South African pelagic longline fleet operating along the west and east coast of South Africa. A standardization of the CPUE of the South African longline fleet for the time series 2004-2020 was carried out with a Generalized Additive Mixed Model (GAMM) with a Tweedie distributed error. Explanatory variables of the final model included Year, Month, geo-graphic position (Lat, Long) and a targeting factor (Fishing Tactic) with three levels, derived by clus-tering of PCA scores of the root-root transformed, normalized catch composition. Vessel was included as a random effect. Swordfish CPUE had a definitive seasonal trend, with catch rates higher in winter (April - August) than the rest of the year. The standardised CPUE analysis indicates an initial decline (2004-2010) and that normalised annual CPUE estimates have largely remained below average since 2010, except for 2015-2016.

SCRS/2022/050 The Chinese Taipei tuna longline fishery has operated in the North Atlantic Ocean since the late 1960s. However, this fleet changed their targeting from albacore tuna (Thunnus alalunga) to bigeye tuna (*Thunnus obesus*) around 1990. To address the impact of targeting shift, we standardized the catch and effort data of swordfish (*Xiphias gladius*) by period for this fishery in the North Atlantic Ocean using generalized linear models (GLMs). Four periods were considered in this study, which are the whole period from 1968 to 2020, the early and late periods for 1968 1989 and 1990 2020, and the period of 1997 2020 with operation type information (the number of hooks between floats, NHBF) available for the analysis. Results were insensitive to the inclusion of gear configuration (NHBF) as an explanatory variable in the standardization model. The abundance trend of swordfish based on this fleet showed a decreasing trend in the very early period, with another following slight decrease during the 1980s; however, the trend suddenly increased to a higher level during the early 1990s as a result of targeting change, and then dropped sharply in the late 1990s and stabilized until present.

SCRS/2022/051 Catch and effort data of swordfish (*Xiphias gladius*) were standardized using generalized linear models (GLM s for the Chinese Taipei distant water tuna longline fishery in the South Atlantic Ocean. The data set was separated into f our periods to take into account of the targeting issue. A whole period of data set from 1968 2020 was considered in the analysis, while an early 196 8 1990) and two late periods1968-1990 and 1998-2020 with information on operation type (i.e., n umber of hooks between floats, NHBF) were also included in the analysis for comparison. The standardized catch per unit effort (CPUE of swordfish during 196 8 1990 and 1991 2015 showed very similar trend to t he results f or the whole period analysis (1968 2020). The i nclu sion of NHBF information in the model also produced almost identical patterns, with a slight difference in the late 1990s . In general, the abundance index for the South Atlantic swordfish showed a decreasing trend through the 1970s and stabilized during the 1980s. The trend started to de crease from the early 1990s with a further drop to lower level in the late 1990s and then stabilized over recent two decades from 1998 to 2020

SCRS/2022/052 This paper provides an update of the study on habitat use for swordfish, developed within the working plan of the Swordfish Species Group of ICCAT. A total of 26 miniPAT tags have been deployed so far in the North (n=13) and South Atlantic (n=9) and the Mediterranean (n=4). Data from eight tags was analysed for horizontal and vertical habitat use. These preliminary results showed swordfish moved in several directions, travelling considerable distances in both the North and South stocks. Swordfish spent most of the daytime in deeper waters with a mean of 540.8 m, being closer to the surface during nighttime (mean=78.3 m). The deepest dive recorded was of 1480 m. Regarding temperature, swordfish inhabited waters with temperatures ranging from 3.9ºC to 30.5ºC with a mean of 11.3ºC during daytime and 21.7ºC during nighttime. The main plan for the next phase of the project is to continue the tag deployment during 2022 in several regions of the Atlantic Ocean and Mediterranean Sea. Currently 11 tags are with the participating CPCs and nine tags are still to be attributed.

SCRS/2022/054 This document provides standardized CPUEs for swordfish captured by the Portuguese pelagic longline fishery in the North Atlantic Ocean. The analysis was based on data collected from fishery observers, port sampling and skippers logbooks (self sampling), collected between 1995 and 2020. The CPUEs were analyzed for the North Atlantic and compared between years, and were modeled with GLM Tweedie, GLM and GLMM lognormal adding a constant, and GAM models. We also tested the inclusion of a habitat index covariate, using both GAMs and GLMs approaches. In general, the nominal CPUE trends increased during the period with some inter-annual variability. The standardized CPUEs showed similar trends with an overall increase during the period, with some oscillations. The results presented here are for discussion during the 2022 SWO data-preparatory meeting. At this preliminary stage, we recommend using GLM Tweedie models, with set-level analysis and adding the habitat index as a categorical variable.

Once the final models are agreed by the SWO Species Group, those can be considered for use in the upcoming 2022 North Atlantic swordfish assessment.

SCRS/2022/055 Annual indices of swordfish relative abundance in the western Atlantic Ocean for the period 1993 to 2021 are provided, based on the United States pelagic longline observer data. A negative binomial generalized linear model evaluated multiple factors considered to affect swordfish catch rates, including year, month, fishing area, gear characteristics, and environmental conditions. Significant factors included year, month, area, target species, sea surface temperature, hook type, bait type, day/night, and light sticks. Methods followed the previous analysis and recommendations and incorporated an additional six years of data (2016 to 2021).

SCRS/2022/056 The General Linear Modelling approach (GLM), assuming a lognormal distribution error, was used to update the standardized index of abundance for the swordfish caught by the Moroccan longline fleet targeting this species south of the Moroccan Atlantic Coast during the period 2005-2020. The analysis covered 1796 trips carried out by this fleet during the same period. The explanatory variables tested were "year" and "month. The best-fit model included all variables, plus the interactions "year: month". The overall deviance explained by the model was 32%, indicating a reasonably good fitting. The index has shown an improvement since 2019, after the decline observed in 2018. The variation of the nominal and standardized CPUE shows a variability during the studied period with peaks in 2005, 2010 and 2017. The reason for such a behavior, however, was not clear.

SCRS/2022/057 Catch and effort data performed by the Brazilian tuna longline fleet in a wide area of the South Atlantic Ocean from 1994 to 2020 were analyzed. The fishing effort was distributed in a wide area of the Atlantic Ocean. The CPUE of the swordfish was standardized by a GLM using a Delta Lognormal approach. The factors used in the models were: year, quarter, vessels, clusters, hooks per floats, hooks, and the lat-long reference for each 5 by 5 spatial squares. The standardized CPUE series presented a decreasing trend between 1996 and 2001, remained relatively stable up to 2015, and steadily decreased from 2016 to 2020.

SCRS/2022/059 Fishery independent indices of spawning biomass of swordfish in the Gulf of Mexico are presented utilizing NOAA Fisheries ichthyoplankton survey data collected from 1982 through 2019 in the Gulf of Mexico. Indices were developed using the occurrence of larvae sampled with neuston gear using a zero-inflated binomial model, including the following covariates: time of day, month, area sampled, year, gear and habitat score. The habitat score was based on the presence/absence of other ichthyoplankton taxa and temperature and salinity at the sampling station.

SCRS/2022/060 Size sampling data of north and south Atlantic swordfish stocks were reviewed, and preliminary analyses were performed for its use within the stock evaluation models. Size data submitted to the Secretariat by CPCs under the Task II requirements include Catch at Size and or size samples for the major fisheries. The size samples data was revised, standardized, and aggregated to size frequencies samples by main fleet/gear type, year, and quarter. For the North and South Atlantic stock, the size sampling proportion among the major fishing gears is consistent with the proportion of the catch since 1990, most of the size samples come from the longline fisheries. The number of fish measured has decreased substantially in the last decades from both the North and South Atlantic fisheries. A review of the size frequency data by fleets indicated no shift of size data around 1993, for the main longline fleets. Size frequency data was consolidated by year, quarter, and fleetID for 5 cm bin size.

SCRS/2022/061 This document present preliminary information with regards to conversion factors between Straight Lower Jaw Fork Length (S-LJFL) and Curved Lower Jaw Fork Length (C-LJFL) for swordfish (*Xiphias gladius* Linnaeus, 1758) in the North Atlantic. This is part of an ongoing work, and the current sample is composed of 15,139 specimens sampled for both size types. A linear model was used to predict S-LJFL from C-LJFL, with Sex, Area and Month tested as covariates. Preliminary estimates for the equation parameters are provided. The covariates Sex and Month had the larger effects, while Area was not significant. An example of predictions is provided, showing that the differences between C-LJFL and S-LJFL increase as specimens grow to larger sizes, and that the differences are larger for females than for males.

SCRS/P/2022/004 Showed that patterns in stock trend are often confounded by the influence of fleet behaviour. The problem is often made more challenging by a lack of historical documentation of fleet regulations and how behaviour of fleet changes in response to national and international agreements, new gear types, and different quota allocation schemes. The objective of this project was to produce a timeline of the management changes affecting the Canadian North Atlantic Swordfish Fishery. Sources consulted for this project include international regulations (ICCAT, CITES, CMS), domestic regulation (DFO, COSEWIC), and industry associations (NSSA, SHQ). Categories of change identified include (1) regulations, (2) gear type, (3) spatial pattern, (4) qualitative observation, and (5) bycatch mitigation. Over 145 management measures, regulations, recommendations, and events impacted the Canadian fleet of the NATL SWO fishery between 1959-2021. Notable changes include mercury restrictions (1970s), ITQs (2002), introduction of circle hooks (1996 voluntary; 2012 mandatory), and external factors (deer hunting season). These outputs will support the creation of improved North Atlantic Swordfish population models and management measures that better account for fleet dynamics. We recommend better record keeping of management and fleet behaviour changes moving forward, as well as incorporating fleet dynamics into stock assessments. Although focused on the Canadian fleet, this project could be applied to other CPCs in the swordfish fishery.

SCRS/P/2022/005 presented an update on the age and growth component of the biology program for swordfish is presented. For this component, both spines and otoliths are being collected and processed for comparison of age readings between both structures. Currently, 1,073 spines and 436 otoliths have been processed and funds are available to continue processing both structures. Readings have started for the North Atlantic stock, and the reference set is continuing to be created. Growth modelling is planned to be conducted before the stock assessment and presented at the stock assessment meeting. These will be preliminary models as further samples are still being collected and processed. Further developments in this component of the biology project will also be through bomb radiocarbon validation of band pair deposition in swordfish otoliths.

SCRS/P/2022/006 summarized the outstanding decision points in five areas of the MSE process: 1) operating model (OM) conditioning, 2) OM validation, 3) development of candidate management procedures (cMPs), 4) assumptions for the closed-loop simulation testing, and 5) calculating performance of the cMPs. The majority of the decision points relate to assumptions for various aspects of the MSE framework, including the specification of default assumptions and alternatives that will be evaluated in robustness tests. The decision points will be addressed by the MSE technical group in their work in 2022, and the Trial Specifications document will be updated to reflect the assumptions and design of the swordfish MSE process.

SCRS/P/2022/007 described the process for developing candidate management procedures (cMPs) for the North Atlantic swordfish MSE. Examples were provided of various types of cMPs that can be used within the MSE framework. The key components for cMP developers to consider are the data sources used by the cMP, and the rules that will be used to convert those data into a total allowable catch (TAC) management recommendation. cMPs fall into two broad categories: model-based and empirical. Model-based cMPs can use the assessment models available in the swordfish MSE framework (e.g., surpus production or delay-difference models available in the SAMtool R package), or use custom assessment models. Empirical cMPs do not include a population dynamics model that estimates stock status, but rather rely on indicators in the data to set or modify management advice. cMP developers can use any of the 100+ empirical cMPs available in the DLMtool R package or design their own custom cMPs. Examples were provided to show how to develop custom empirical or model-based cMPs, and test those cMPs in both applying to data and evaluating in the closed-loop simulation framework.

SCRS/P/2022/008 The ICCAT swordfish biology program was established to determine spatial-temporal patterns of swordfish abundance, refine growth estimates, re-estimate maturity ogives, find genetic markers for differentiating between stocks and determining levels of stock mixing. Since the program was established in 2018, biological samples have been collected from over 4100 fish from all three stocks. This presentation provided an update on spatial-temporal sampling coverage, and briefly explained progress on all growth, maturity, and genetics studies. The presentation provided an overview of the objectives in the current project phase and identified regions where additional samples are needed.

SCRS/P/2022/009 The ICCAT North Atlantic swordfish MSE was initiated in 2018 for the purpose of establishing harvest control rules for the stock. In the initial year of development, key uncertainties were identified and an operating model (OM) grid was developed. In subsequent years the simulation framework has been further developed and the technical team has proposed a candidate set of performance metrics and advice intervals. In 2022, the OM grid will be reconditioned based on the latest stock assessment, candidate management procedures will be developed and there will be further engagement with Panel 4 and other stakeholders. The Species Group anticipates providing management advice based on a management procedure in 2023

SCRS/P/2022/010 ICCAT Resolution 19-14 established a conceptual set of performance indicators for the North Atlantic swordfish MSE. Indicators were placed into 4 categories: safety, status, stability, and yield. In 2021, the Swordfish Species Group proposed a refined performance table to Panel 4 with specific metrics, probabilities, and timeframes over which to calculate those probabilities. In 2022, the Species Group and MSE technical team will continue work on the Performance Metrics to improve their ability to examine for trade-offs between candidate management procedures. The Species Group anticipates further interaction on performance metrics with Panel 4 in 2022 and 2023.

Appendix 5

MSE Roadmap update

SCRS REVISED ROADMAP FOR THE DEVELOPMENT OF MANAGEMENT STRATEGY EVALUATION (MSE) AND HARVEST CONTROL RULES (HCR)

This schedule is intended to guide the development of harvest strategies for priority stocks identified in Rec. 15-07 (North Atlantic albacore, North Atlantic swordfish, eastern and western Atlantic bluefin tuna, and tropical tunas). It builds on the initial roadmap that was appended to the 2016 Annual Meeting report. It provides an aspirational timeline that is subject to revision and should be considered in conjunction with the stock assessment schedule that is revised annually by the SCRS*. Due to the amount of cross-disciplinary dialogue that may be needed, intersessional Panel meetings and/or meetings of the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers (SWGSM) will be necessary. The aspirational nature of this timeline assumes adoption of a final management procedure for northern albacore in 2021 and interim management procedures for bluefin tuna in 2022, and northern swordfish and tropical tunas as soon as 2023. However, the exact timeline for delivery is contingent on funding, prioritization, and other work of the Commission and SCRS.

* For 2015 through 2020, the roadmap reflects progress to-date in some detail. For 2021 onward, more general steps for the SCRS and Commission are anticipated pending outcomes of the 2021 Annual Meeting.

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2015	- Commission established management objectives in Rec. 15-04			- Commission provided initial guidance for the development of harvest strategies for priority stocks, including tropical tunas (Rec. 15-07)
2016	- SCRS conducted stock assessment - SCRS evaluated a range of candidate HCRs through MSE - PA2 identified performance indicators			- Commission identified performance indicators (Rec. 16-01). Commission adopted MSE roadmap, including plan for activities for tropical tunas for 2016-2021
2017	- SCRS evaluated the performance of candidate HCRs through MSE, using the performance indicators developed by PA2 - SWGSM narrowed the candidate HCRs and referred to Commission - Commission selected and adopted an HCR with associated TAC at the Annual Meeting (Rec. 17-04)	- SCRS conducted stock assessment - Core modelling group completed development of modelling framework	- SCRS conducted stock assessment	- SCRS reviewed performance indicators for YFT, SKJ, and BET - SWGSM recommended a multi-stock approach for development of MSE framework
2018	- SCRS contracted independent expert to	- SCRS conducted joint MSE meeting on	- SCRS conducted joint meeting	- SCRS contracted with technical

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
	complete peer review of MSE code - Call for Tenders issued for peer review - SCRS tested the performance of the adopted HCR, as well as variations of the HCR, as requested in Rec. 17-04 - SCRS developed criteria for the identification of exceptional circumstances	BFT/SWO - SCRS reviewed but could not adopt reference set of Oms - SCRS began testing candidate management procedures (MPs) - SWGSM considered qualitative management objectives - BFT WG reviewed progress and developed detailed road map - Commission adopted conceptual management objectives (Res. 18-03)	on BFT/SWO MSE - SCRS contracted MSE technical expert to develop OM framework, define initial set of OMs, and conduct initial conditioning of OMs - SWGSM considered qualitative management objectives	experts: start development of MSE framework (phase I) - SCRS conducted bigeye tuna stock assessment
2019	- SCRS addressed recommendations of the peer reviewer - SCRS updated performance of the interim HCR and variants - SCRS produced consolidated report on MSE 1. COMM: PA2 considered possible approaches that could be useful in developing guidance on a range of appropriate management responses if exceptional circumstances occur, including those implemented by other RFMOs	- SCRS held three BFT MSE Technical Group meetings with significant progress but advised at least one additional year of work needed - SCRS continued to evaluate candidate MPs - At intersessional meeting, PA2 reviewed and developed initial operational management objectives and identified performance indicators - SCRS held December webinar to review OM progress	- SWO Species Group meeting - SCRS contracted with technical expert to develop initial MSE framework - Commission adopted conceptual management objectives at the Annual Meeting (Res. 19-14)	- SCRS conducted yellowfin tuna stock assessment - SCRS agreed on developing a western skipjack (W-SKJ) MSE and a multi-stock MSE (eastern skipjack, bigeye and yellowfin tuna) Commission updated MSE roadmap for the period 2019-2024[1] and requests that the SCRS "*refines the MSE process in line with the SCRS roadmap and continue testing the candidate management procedures. On this basis, the Commission shall*

[1] https://iccat.int/mse/en/COM_ROADMAP_ICCAT_MSE_PROCESS_ENG.pdf

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2019		COMM: PA2 reviewed MSE progress and advised the Commission on next steps, including the need for an update of the stock assessment to provide TAC advice for at least 2021		*review the candidate management procedures, including pre-agreed management actions to be taken under various stock conditions. These shall take into account the differential impacts of fishing operations (e.g. purse seine, longline and baitboat) on juvenile mortality and the yield at MSY."* (Rec. 19-02)
2020	1. COMM (PA2) developed guidance intersessionally on a range of appropriate management responses should exceptional circumstances be found to occur (5-6 March, PA2 intersessional)	1. SCRS conducted stock assessment update and developed TAC advice for 2021 and 2022	1. SCRS continued development of MSE framework, including the operating model conditioning and refinement of the uncertainty grid	COVID slowed progress on multi-stock MSE but SCRS developed a preliminary OM for W-SKJ MSE.
	2. SCRS conducted NALB stock assessment (in June)	2. COMM set TACs for at least 2021, based on stock assessment update, at the Annual Meeting (Rec. 20-06, Rec. 20-07).	2. SCRS developed example candidate MPs	
	3. SCRS evaluated existence of exceptional circumstances	3. SCRS continued development of MSE framework including the operating model conditioning and the uncertainty grid		
	4. COMM set new TAC for 2021 based on the HCR and 2020 assessment (Rec. 20-04)			

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2021	1. SCRS prepared inputs for a new MSE framework using the Stock Synthesis (SS) model	1. SCRS adopted reference (OM) grid and decided plausibility weighting	1. SCRS continued development and testing of candidate MPs. SCRS continued work on the reference (OM) grid, including diagnostics	1. COMM reviewed and proposed update of tropical tuna MSE roadmap
	2. SCRS evaluated existence of exceptional circumstances	2. SCRS initiated independent peer review of MSE code	2. SCRS continued work on criteria for determining exceptional circumstances, taking into account the exceptional circumstances protocol for NALB	2. SCRS agreed on major sources of uncertainty to be considered in the MSE and candidate performance indicators for tropical tuna MSEs
	3. COMM: a) reviewed and endorsed guidance developed intersessionally on management responses in the case of exceptional circumstances b) reviewed the interim HCR and adopt a long-term MP, including the TAC, at the Annual Meeting	3. SCRS continued development and testing of candidate MPs	3. SCRS initiated independent peer review of MSE code	3. SCRS conducted bigeye stock assessment
		4. SCRS/BFT SG initiated two additional subgroups on Indices and Modeling to address key issues. Subgroup on Growth in Farms continued its work	4. COMM (PA4) reviewed MSE progress, and began considering performance indicators and a limit reference point at the 1st Intersessional PA4 meeting. Additional dialogue in 2022 was proposed.	4. SCRS recommended modifying OM for W-SKJ to include the whole of the western Atlantic

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2021		5. COMM (PA2) – Intersessional Meetings held and updates on MSE progress provided by SCRS (March, September). Ambassadors workshops held in October.	5. The Group provided an update on the progress of the MSE to COMM/PA4 at the Annual Meeting	5. JCAP/ICCAT Training workshops on MSE and HCR held for Portuguese and Spanish speaking Scientists and Managers
		6. The SCRS presented an overview on the progress of the BFT MSE to the COMM (PA2) at the Annual Meeting (1-day prior), including conceptual illustrations on how candidate MPs would work and on the trade-offs in achieving different objectives. The workplan to complete the MSE was discussed, including the plan for future dialogue meetings. PA2 provided feedback to support next steps.		

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2022	1. SCRS to initiate independent peer review of MSE process			
	2. SCRS to work on developing a new MSE reference grid using the SS model for NALB	2. COMM (PA2) to meet intersessionally to: - recommend final operational management objectives and identify performance indicators - develop guidance on range of appropriate management responses should exceptional circumstances be found to occur	2. COMM (PA4) to recommend initial operational management objectives and identify performance indicators either intersessionally or during the Annual Meeting	2. SCRS to conduct SKJ stock assessments
	3. SCRS to evaluate existence of exceptional circumstances	3. SCRS to conduct data preparatory meeting for EBFT (based on work conducted by subgroups on models and indices)	3. SCRS to conduct stock assessment (North and South Atlantic)	3. SCRS dialogue with PA1 on management objectives and performance indicators to be used for tropical tunas MSE
		4. SCRS to complete MSE, incorporating feedback from COMM to be provided at dialogue meetings with PA2	4. SCRS to recondition OMs considering new information from the stock assessment and finalize OM grid	4. SCRS to recondition OMs for SKJ in W-SKJ MSE model and ESKJ in mixed species MSE model in light of new SKJ assessments
		5. COMM (PA2) and SCRS to meet intersessionally to consider final CMPs	5. SCRS to continue work on criteria for determining exceptional circumstances taking into account the exceptional circumstances protocol for NALB	5. SCRS to initiate development and testing of candidate Management procedures (CMP) for W-SKJ
		6. COMM to: a. consider SCRS guidance developed intersessionally on	6. SCRS dialogue with PA4 on CMPs, operational management	6. COMM (at Annual meeting or Panel 1 intersessional) to

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2022		management responses in the case of exceptional circumstances, and b. adopt an MP at the Annual Meeting, including TAC	objectives and performance indicators	provide feedback on evaluation criteria and W-SKJ CMPs to be evaluated further
		7. SCRS to continue work on criteria for determining exceptional circumstances for inclusion in the exceptional circumstances protocol for BFT to be developed by Panel 2, based on the exceptional circumstances protocol adopted for NALB	7. COMM (PA4) and the SCRS to: - refine CMP(s) - continue discussion on operational management objectives and identify performance indicators (2022 COMM meeting)	7. SCRS to contract independent review of tropical tuna MSE process and technical review of W-SKJ MSE
2023*	1. SCRS will continue to conduct assessments periodically to ensure that the conditions considered in MP testing are still applicable to the stock. The first such assessment is scheduled for 2023	1. Once an MP is adopted, SCRS to conduct assessments to ensure that the conditions considered in MP testing are still applicable to the stock	1. SCRS to continue MSE, incorporating feedback from COMM through PA4/SWGSM	1. SCRS to conduct yellowfin assessment
	2. SCRS will finalize a grid of reference and robustness OMs based on Stock Synthesis as part of a new MSE, after reconsidering the main axes of uncertainty.	2. SCRS to provide final advice to COMM on criteria for determining exceptional circumstances	2. PA4 to have 3 intersessional meetings to receive updates and provide feedback to the SCRS: a) 1st intersessional (early 2023): PA4 to recommend final operational management objectives, performance indicators, advice intervals; b) 2nd intersessional (mid 2023): provide feedback on CMPs format and construction; c) 3rd intersessional (before the	2. COMM to consider final evaluation of W-SKJ MPs and adopt an interim W-SKJ MP at the Annual Meeting

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2023*			annual meeting): discussion on the proposed CMPs. The SCRS should have approximately 2-3 candidate MPs and performance statistics values to show trade-offs [,,,]	
	3. SCRS to evaluate existence of exceptional circumstances	3. On the predetermined timescale for MP setting, SCRS to evaluate existence of exceptional circumstances	3: SCRS and PA4 to organize ambassador sessions before the PA4 meetings [...]	3. SCRS to initiate independent technical review of multi-stock MSE
	4. COMM to continue use of the MP to set TAC at the Annual Meeting, on the predetermined timescale for MP setting	4. COMM to continue use of the MP to set TAC based on the MP at the Annual Meeting, on the predetermined timescale for MP setting	4. COMM to (annual meeting) a) adopt an interim MP at the Annual Meeting, including the TAC b) review and finalize an exceptional circumstances protocol	
2024*	1. SCRS to improve Observation Error Model by incorporating statistical properties of CPUE residuals		1. COMM to review and finalize, as needed, guidance on a range of appropriate management responses should exceptional circumstances be found to occur.	1. SCRS to test final set of MP candidates for multi-stock MSE
	2. SCRS to test the available (i.e. production model) and alternative candidate MPs (e.g. based on Jabba, or empirical)			2. SCRS to provide advice on exceptional circumstances for the implementation of the MP
	3. SCRS to evaluate existence of			3. COMM to consider final

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
	exceptional circumstances			evaluation of MPs for multi-stock MSE
				4. SCRS to deliver multi- stock MSE, including fully conditioned operating models and candidate management procedures to COMM
				5. COMM to: a) review and endorse guidance on management responses in the case of exceptional circumstances, and b) considers adopting interim MP(s) for BET, YFT and eastern SKJ
2025 and beyond*	1. According to the frequency outlined in the exceptional circumstances protocol, SCRS to evaluate existence of exceptional circumstances	1. According to the frequency outlined in the exceptional circumstances protocol, SCRS to evaluate existence of exceptional circumstances	1. SCRS to conduct assessments as per the agreed-to assessment interval to ensure that the conditions considered in MP testing are still applicable to the stock	1. Once an MP is adopted, SCRS to conduct periodic assessments to ensure that the conditions considered in MP testing are still applicable to the stock
	2. COMM to continue use of the MP to set management measures on the predetermined timescale defined in the MP setting	2. COMM to continue use of the MP to set TAC based on the MP at the Annual Meeting, on the predetermined timescale for MP setting	2. On the predetermined timescale, SCRS to evaluate existence of exceptional circumstances	2. On the predetermined timescale for MP setting, SCRS to evaluate existence of exceptional circumstances
	3. SCRS to conduct periodic assessments to ensure that the conditions considered in MP testing are still applicable to the	3. Once an MP is adopted, SCRS to conduct assessments to ensure that the conditions considered in MP	3. COMM to continue setting TAC based on the MP at the Annual Meeting, on the predetermined	3. COMM to continue use of the MP to set management measures on the predetermined

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
	stock	testing are still applicable to the stock	timescale for MP setting	timescale defined in the MP setting

*Assumes that the workplan is accomplished as described.

LIST OF ACRONYMS:

BET = Bigeye tuna
BFT = Bluefin tuna
BFT SG = SCRS Bluefin Tuna Species Group
COMM=Commission
HCR = Harvest Control Rule
MP = Management Procedure
MSE = Management Strategy Evaluation
OM = Operating Model
SCRS = Standing Committee on Research and Statistics
SWGSM = Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers
TAC = Total Allowable Catch
TRO = Tropical tunas