Report of the 2024 Intersessional Meeting of the Swordfish Species Group (including MSE)
(hybrid/Madrid, Spain, 6–9 May 2024)

1. Opening, adoption of agenda and meeting arrangements and assignment of rapporteurs

The meeting was held online from 6–9 May 2024. The Swordfish Species Group Rapporteur, Dr. Kyle Gillespie, opened the meeting and welcomed participants (the Group). The Executive Secretary welcomed participants and wished them success in their meeting. The Chair proceeded to review the agenda, which was adopted with minor 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 documents and presentations presented at the meeting are included in **Appendix 4**.

The following participants served as Rapporteurs:

Sections	*Rapporteur*
Item 1	N.G. Taylor
Item 2	C. Mayor, J. Garcia
Item 3	N. Stewart
Item 4	K. Gillespie, R. Coelho, S. Miller
Item 5	N.G. Taylor, M. Ortiz
Item 6	K. Gillespie
Item 7	K. Gillespie
Item 8	M. Santos, C. Brown
Item 9	N.G. Taylor

2. Review of fishery statistics/indicators

The ICCAT Secretariat presented the Group with the latest fishery statistics and tagging data for swordfish (*Xiphias gladius*, SWO) in the North Atlantic, South Atlantic, and Mediterranean stocks, sourced from the ICCAT database system (ICCAT-DB). The datasets reviewed include Task 1 nominal catches (T1NC), Task 2 catch and effort (T2CE), Task 2 size frequencies (T2SZ), Task 2 catch-at-size reported (T2CS), and the most recent CATDIS estimations (T1NC catches of swordfish distributed by quarter and 5x5 degrees grids, between 1950 and 2022). Existing swordfish conventional and electronic tagging information was also presented and reviewed by the Group.

Two documents with swordfish fisheries statistics (SCRS/2024/064 and SCRS/2024/065) were presented to the Group in this section.

2.1 Task 1 catches and discards data and spatial distribution of catches

Updated swordfish T1NC statistics (landings plus dead discards) by stock and gear are presented in **Table 1** and **Figures 1, 2, 3,** and **4**. The updated swordfish SCRS catalogues (**Tables 2, 3** and **4**), showing both T1NC and Task 2 (existence or absence of datasets: T2CE, T2SZ, and T2CS) paired series for the last 30 years (1993-2022) ranked by order of importance (i.e., % of T1NC contributed by each CPC to the total T1NC in the last 30 years) were also presented to the Group. These SCRS catalogues allow the Group to identify potential data inconsistencies and/or data gaps in the stocks. The T1NC dashboard with all swordfish stocks for interactively querying T1NC information was also made available to the Group, in addition to the latest CATDIS estimations with swordfish, reflecting T1NC information available as of 31 January 2024. The swordfish CATDIS maps were also published on the ICCAT website (Statistical Bulletin Vol. 49).
The ICCAT Secretariat informed the Group about live discards (DL) and dead discards (DD) provided by the CPCs and summarized in **Table 5**. It was noted how, compared to the T1NC reports (landings and DD), reports of LD are still limited and not all CPCs provided estimates of LD and a description of the estimation methodology, which are mandatory reporting requirements of significant importance for determining total mortality.

The ICCAT Secretariat reminded the Group that information on both DD and LD reported in T1NC could be complemented using the existing scientific domestic observer data collected onboard longline vessels, i.e., data reported annually to ICCAT using form ST09-DomObPrg. The Group noted that these data might require further efforts to be extrapolated to T1NC total amounts. The Group also discussed how to best summarize the reporting status of all available scientific observer data, including elements such as CPC, gear, year, and others.

SCRS/2024/064 provided information on a new type of fishing gear (informally referred to as "trap line") associated with mesopelagic longline fleets used for catching swordfish in the Mediterranean Sea. This fishing gear uses a series of metal or nylon rings that entangle swordfish and other large pelagic fish and is apparently more efficient than traditional hooks. It was noted that, as no technical description or gear code has been assigned, CPCs continue reporting catches with this gear under the longline category (various types).

The Group further noted that, while this new gear has only recently (2021) been reported by CPCs operating in the Mediterranean, anecdotal evidence suggests that it might originate from Pacific Ocean fisheries. The Group noted that evaluating the efficiency of this gear compared to traditional longlines requires proper data and statistical analysis for the SCRS to report to the Commission.

The Group recommended that all information on this new gear be reported to the Sub-Committee on Statistics (SC-STATS) as it will likely affect several species and therefore called experts to provide a proper technical definition, potentially adopting it by assigning a new ICCAT code and including it in the obligatory data collection and reporting recommendations.

SCRS/2024/065 provided information on Mediterranean swordfish (SWO-M) catch statistics from Palestinian Gaza strip fisheries. The document indicates an average catch of 0.6 t per year, with sampled individuals ranging from 100 to 130 cm in lower-jaw fork length, mostly caught as by-catch in small-scale fisheries targeting other species (although swordfish fetches high market prices). In the past, catches from Palestine were reported together with catches from Israel. In recent years, it has not been possible to disaggregate them by flag.

The Group asked about the type of gear associated with these catches. The author responded that this information was not available and suggested assigning the gear type of these catches to unclassified gears.

2.2 Task 2 catch and effort

The T2CE detailed catalogue, with essential information (metadata and quantities) on swordfish by stock, was also prepared for the meeting. Its purpose is to serve as a tool for the ICCAT CPC scientists to revise their T2CE series in search of issues (missing datasets, errors, poor time-area resolution, inconsistencies, etc.) and to provide missing datasets or improved updates for the existing datasets. The swordfish standard SCRS catalogues (**Tables 2, 3** and **4**) summarize the T2CE data (DSet="t2", character "a") using only T2CE datasets that have sufficient temporal (by month) and spatial resolution (5x5 latitude-longitude squares or better for longline gears, and 1x1 latitude-longitude squares or better for the surface gears).

The ICCAT Secretariat reminded the Group that the CATDIS estimates are completely reliant on the availability and quality of T2CE information. The Group encouraged ICCAT CPC scientists to revise their T2CE statistics using the SCRS catalogues, as recommended by the SCRS.

2.3 Task 2 size data

The T2SZ and T2CS detailed catalogue was also prepared for the meeting, with information (metadata and quantities) on all swordfish stocks. This is intended as a tool for ICCAT CPC scientists to revise their series in the search for incompleteness (missing datasets) or potential series improvements (updates to existing datasets). The swordfish standard SCRS catalogues (**Tables 2, 3** and **4**) summarize the availability of T2SZ (character "b") and T2CS (character "c") data for fleets.

The ICCAT Secretariat presented T2CS estimated/reported by CPCs to ICCAT in the past. It has not been required to report catch-at-size for swordfish since the 2023 SCRS decision. The SCRS catalogues do not include T2SZ

datasets estimated as being of inferior quality (poor time-area detail, size/weight bins larger than 5 cm/kg) either.

2.4 Tagging

The ICCAT Secretariat presented a summary of updated conventional and electronic tagging data.

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 provide a geographic summary of swordfish conventional tagging available in ICCAT. The density of releases in 5x5 squares (**Figure 5**), the density of recoveries in 5x5 squares (**Figure 6**), and the apparent movement of swordfish (arrows from release to recovery locations) are shown in **Figure 7**.

Additionally, two dashboards were prepared to dynamically and interactively examine the tagging data. The first one (snapshot in **Figure 8**) for conventional tags shows a summary of released and recovered tags. The second one (**Figure 9**) for electronic tags shows a summary with data extracted from the meta-database held in ICCAT. The dashboards for conventional and electronic tagging metadata are published on the ICCAT website.

Improvements will continue to be made to all conventional tagging information and will run in parallel with maintenance and improvement of the conventional tagging database (CTAG), and the development of the new database on electronic tagging (ETAG). The ETAG project's main goal is to integrate all the information obtained from electronics tags and the associated metadata into a centralized relational database system (PostgreSQL).

2.5 Updates to USA tagging statistics

The ICCAT Secretariat informed the Group of the current difficulties incorporating conventional tagging data reported by the USA between 2009 and 2019 (all species including swordfish) due to a number of reasons. Aiming to solve this situation in the medium term, collaborative work has begun involving the ICCAT Secretariat and the USA tagging correspondents. The objective is to have full cross-validation of both conventional and electronic tagging databases to correct all discrepancies and missing information across all species. As a result, around 2,500 new conventional tags from the National Oceanic and Atmospheric Administration's (NOAA) Cooperative Tagging Program and The Billfish Foundation will be added to the ICCAT database.

3. Updates from the Swordfish Year Programme (SWOYP)

Documents SCRS/2024/073 and SCRS/2024/032 reviewed the history of the biological sampling programme (phases 1–5) while highlighting the challenges posed by spatial gaps in sampling coverage. Following the presentation on slides regarding phases 1–5, it was noted that sampling gaps should be identified and clearly communicated to the Group. The presenter noted that such an approach is currently underway, and efforts are being made to compare the swordfish database of biological samples against CPC fishing activity to develop a targeted list of sampling priorities where area, size class, and tissue requirements are clearly conveyed to contributors who could potentially fill those gaps.

Clarification was requested on whether sampling efforts are funded solely by SWOYP or by contributors as well. The presenter clarified that the biological sampling programme relies on "in-kind" contributions from national sampling programmes to provide biological samples, but that the SWOYP has funds available to pay for sampling materials and biological samples.

A request was made for an up-to-date copy of the biological sampling database, and the presenter confirmed that a spreadsheet last updated in April 2024 can be provided upon request.

Document SCRS/2024/033 provided an update on ageing and growth work for the SWOYP. The presenter described spatial representation and sampling gaps for the programme and detailed ongoing work. These efforts include working to standardize the ageing protocol, in part through developing a well-defined first

annulus and a yardstick to aid ageing protocols across labs. Some preliminary work on bomb radiocarbon analysis for validation of age assignments was provided and the presenter noted that a further update on the progress of this promising work will hopefully be provided during the Species Group meeting in September 2024.

In terms of the next steps for ageing and growth work, the presenter noted that the Group should aim for a more balanced and targeted sampling approach to address gaps in the size distribution and spatial representation of samples (e.g., otoliths and spines).

There was discussion on what kind of biological tissue is required for the epigenetic ageing protocol. The presenter described that the current use of both muscle and fin tissues are generating promising preliminary results. The Group member leading the epigenetic ageing project agreed on this point. It was noted that ensuring sample quality (i.e., minimizing time between sample collection and storage via freezing) is important.

Document SCRS/2024/034 provided a summary of existing electronic tagging data from ongoing tagging efforts through the SWOYP, combined with contribution of historical tagging data from NOAA (USA) and Fisheries and Oceans Canada (DFO) (CAN). The data demonstrated that a wide range of size classes of SWO are strongly represented in the current swordfish tagging dataset (91 – 390 LJFL). The existing dataset is being used to characterize both horizontal and vertical movements. It was noted that there are dedicated swordfish tagging trips planned for 2024 in both the northwest (Canadian waters) and northeast Atlantic (near the Canary Islands).

Following the presentation, the Group discussed issues with tag failures. There have been continued efforts to rectify these issues with input from Wildlife Computers; however, these efforts have not been successful in all cases. During the last SCRS workshop on swordfish tagging, it was noted that tag purchases would cease until these issues can be resolved, but that a focus should be placed on deploying all the tags that have been purchased to date. Contributors agreed that efforts should be made to designate a Chair for a group to discuss these concerns about tag failures. One of the multiple concerns on this issue is that some parties will be worried about supporting the purchase of tags with a history of unacceptable failure rates.

The Chair presented SCRS/P/2024/037 that summarized current efforts to characterize size-at-maturity and, subsequently, maturity ogives for swordfish in different areas. It was noted that some gonad tissue samples are still housed with the contributors, and it was strongly recommended that these be provided to the appropriate lab as soon as possible for processing. Upon completion of processing the samples, these additional data can contribute to re-analysis of the maturity ogives. The maturity-ogive analysis may also be subject to changes, depending on developments in the understanding of stock structure from tagging and genetic work.

Discussion followed concerning the potential explanations for the sex bias in the sample collection and the overall swordfish reproduction dataset (more females than males). Multiple suggestions were raised with relevance to this topic. The past emphasis on the greater relevance of female swordfish gonad samples to estimate fecundity and, therefore, productivity was mentioned as a contributing factor. The potential issue of different catchability between male and female swordfish was also raised, and it was noted that gear selectivity is an important issue. The importance of considering the ecology and behavior of swordfish was also emphasized. For example, anecdotes from harpoon fishers in the Strait of Messina indicate that multiple males will sometimes aggregate around a single female swordfish, which can affect the availability of particular fish to the harpoon fishery. In summary, multiple participants expressed interest in the issue of a skewed sex ratio in the SWOYP biological sampling database.

SCRS/P/2024/036 described two ongoing fields of genetic research with relevance to swordfish biology. First, stock discrimination methods were described using several methods, including ddRAD and machine learning models. Second, progress on the development of an epigenetic ageing tool was described, which is scheduled for completion during Phase 6.

The goals of the genetic population analysis based on ddRAD include identifying the minimum number of genetic variants for discriminating between swordfish stocks and subsequently using such a tool to identify

stock boundaries and key mixing areas. Several sets of genetic analysis demonstrated that the SWO-M stock is more clearly distinguished from the other two stocks than either Atlantic stock from one another However, several single-nucleotide polymorphisms (SNPs) on chromosome five highlight variation between the North Atlantic swordfish (SWO-N) and South Atlantic swordfish (SWO-S) stocks that can be used in aiding assignments. The presenter described how the ddRAD approach is used as a foundation for training machine learning models. The results of two machine learning models were presented: one that can discriminate between SWO-M and Atlantic swordfish stocks, and another that can distinguish between SWO-N and SWO-S stocks. The machine-learning approach is a less expensive tool for discriminating between stocks compared to applying the ddRAD approach to all samples. Following the presentation, the Group discussed how applying the machine-learning approach to a reduced number of SNPs can be used to reduce the cost of genetic stock assignments; however, the presenter noted that some ddRAD analysis will continue to be required to train the machine learning models.

The Chair credited the presenter for the incredible amount of high-quality work set forth in the presentation. Multiple participants expressed the promise of such genetic analysis for providing two of three key components of an effective biological sampling programme: stock of origin and age. The question was raised of whether sex (the third key component) could also be identified genetically. The presenter noted that a genetic tool for sex assignment in swordfish is currently being developed at l'Università Politecnica delle Marche.

Several questions were asked regarding plans for future sampling to support genetics work. The presenter highlighted several areas where additional sampling efforts should be made, including potential spawning areas on either side of the Atlantic, and samples from the eastern Mediterranean. The presenter re-emphasized the importance of both better defining spawning areas and collecting significant numbers of samples from the Atlantic areas to support stock-mixing analysis. The presenter noted that in the areas where genetic samples are lacking, samples for age and growth analysis are also required. Collecting samples from these underrepresented areas therefore represents an opportunity to benefit the entire biological sampling program for the SWOYP.

A participant inquired about whether there should be any concern about a year effect on the results of the genetics-based stock discrimination analysis. The presenter suggested that the results were likely robust on a 5–10-year scale at least, but did note that collecting samples on a year-to-year basis will be critical in order to continue monitoring swordfish stock mixing dynamics in key areas.

Regarding epigenetic ageing, the Chair inquired about the potential for the rates of epigenetic ageing to change over time, which could make it necessary to recalibrate the relationship of age assignments derived from otoliths versus epigenetic analysis. The presenter noted that this is currently unknown, but that climate change could represent a complicating factor in this potential relationship. It was noted that since these are new tools, it is not possible to know with any certainty whether the epigenetic ageing tool will need to be recalibrated in the future. The Chair closed the discussion noting that synthesizing the genetics data with the tagging data should help clarify the complexities of migration and mixing dynamics between swordfish stocks.

4. Management Strategy Evaluation (MSE)

SCRS/P/2024/031 described the current development status of the North Atlantic swordfish MSE process. It included a review of the operating models, candidate management procedures (CMPs), and key performance statistics. The presenter described SCRS-Panel 4 meetings that occurred in 2023, the decisions made during these meetings and the MSE workplan outlined in *Recommendation by ICCAT replacing Recommendation 22-03 extending and amending Recommendation 17-02 for the conservation of North Atlantic swordfish* (Rec. 23-04).

The Group acknowledged the presentation and requested information on how the workplan of the SWO-MSE technical team aligned with that provided by the Commission. The Chair noted that the early months of 2024 were spent re-developing and testing the combined index as this was the most important component for obtaining new results from the CMPs. Assuming the settings for the new combined index were adopted during this meeting, work on other elements of the MSE, as requested by the Commission, would begin soon.

4.1 Combined Index

The Chair provided an overview of the development of the combined index over time. The authors of the two papers (SCRS/2024/063 and SCRS/2024/075) on combined indices then provided the results from the models that were developed.

The Group noted that the models use catch per unit effort (CPUE) in biomass. For fleets that report catch and effort in numbers, the data are converted to biomass based on the size data.

The Group discussed the use of the size class cluster variable in the models, and what this represents in the models. The authors explained that the size-cluster variable mostly aims to address size selectivity in the fleets. Sensitivities without that variable were run to see the effects on the annual standardized index, and there are some changes, especially in a peak in the historical period that is much smoother when using that size variable; nonetheless, the changes are minimal in the most recent years. The Group agreed to use this size categorization variable.

The Group discussed which fleets to include in the model, noting that historically only the main seven fleets were used, but models using all the available fleets (15) were also built for exploratory purposes this year. It was noted that the main fleets account for more than 90% of catches, but that by adding the other fleets there would be the possibility of covering some additional spatial areas. However, by adding all those additional fleets there will be more missing data in some areas, years, seasons, etc., and that might be problematic. As the main fleets are what has been already used and more scrutinized overall in the past, the Group agreed to continue using those main core fleets for the final combined index.

The Group discussed the inclusion of the target variable. It is noted that it is derived from T2CE data, but in some cases, it was updated using descriptions from national scientists or literature. The Group noted that such a method might be a little more subjective and there is the need to make sure it can be updated in the future. The authors clarified that most of the categorization comes from Task 2 data, and it was only necessary to make such substitutions in a small number of very particular situations. It was mostly done when there was no catch information on other species, as this should have a smaller impact on recent years because data quality tends to be better overall for most fleets. The Group agreed to use the target variable.

There was a clarification on the Moroccan data used, with scientists confirming that the Moroccan data used between 2004 and 2022 only comes from longline fisheries.

The Group discussed the variable and model selection process. It was noted that the Akaike information criterion (AIC) is just one possible criterion for variable selection, but that it often results in over-parametrized models. The more complex models might be better in terms of goodness-of-fit, but there is also the need to evaluate the overall changes in the final yearly CPUE series that, in many cases for this combined index, seem to be minimal. It was also noted that in this case the combined index is used only for the future as an indicator for the management procedure (MP) runs, so a simpler model might be more adequate and less likely to fail in the future.

The Group discussed the model type to use, as there are options using a generalized linear model (GLM) and visual, agile, simple threat modeling (VAST) model. It is noted that the GLM includes area effects, but they are more limited and not as high resolution as the spatial structure built in VAST. It was also noted that the final results are similar, so there is some assurance that even the simpler GLM is using the current area stratification that has been defined and used before. Overall, the Group agreed to continue to use GLM models, while continuing to explore VAST or other models that could better explain and address spatial structure and auto-correlations in the data. The Group also agreed to include the two newer areas further North, to make sure that data from those northern regions is included and used in the combined index.

The Group discussed the data lag to be used in the CPUE index. It was noted that having a 1-year lag might be too risky, as the CPCs deadline to submit data is the 15 of July and they can then provide further revisions until September. So, to update the index yearly with a 1-year data lag, all the work would have to be done in a very

short period late in the year, which would be very risky. The Group agreed that having a 2-year data lag is more adequate and there was overall support for the default to be a 2-year data lag.

The final conclusions and decisions from the Group with regards to the model to use for the CPUE standardized index were:

1) use the simple effects GLM model with a Tweedie error distribution,
2) add the two northern region areas to the spatial structure,
3) use only the main core fleets,
4) use the target clusters,
5) use the size class clusters,
6) use as a default a 2-year data lag.

4.2 CMP results

The Group discussed whether it was possible to use different values of F_{Target} within the harvest control rule adapted to the different operating model (OM) life histories (M and steepness assumptions) in the SPSSFox model CMPs. The author stated that the structure of the MP cannot be changed based on the structure of the OM. Nevertheless, the F_{Target} used is very robust across the range of OMs but, in theory, an option could be to adapt the F_{Target} to the specific OM. However, this cannot be done in practice because the CMP does not know which OM is being used at any given time.

The Shiny app with new updated results of the CMPs with one of the VAST indexes was shown.

The Group discussed whether the step size used in mostly constant catch (MCC) CMPs should be changed based on the new results observed, that is, the step size in the CMP to respond to changes in abundance should be changed to make the CMP more responsive to changes in the indicator. Examples of the responsiveness of the CMPs were shown, both in the Robustness test set and the Reference set. It was pointed out that these CMPs were designed with the old, combined index values. Based on the new results with the new combined index there might be a chance that more steps are needed. This point is made clearer in the R3a and R3b scenarios of the Robustness test. The Group discussed that once the final combined index is chosen, there is a need to further experiment with the step size used in these CMPs.

The Group raised the issue that for the MCC CMPs, the historical period for the total allowable catch (TAC) calculation is fixed, which might cause the big differences observed in the TAC in CMPs in some very rare cases, because the TAC is always calculated based on the historical period TAC, not on the previous year TAC. The Group asked whether it makes sense, when reviewing the MSE, if this historical period should be changed based on new results and how the MSE is performing. This could be decided after analyzing new biological data when doing the stock assessment, in that case the historical period of the MCC CMP could be changed based on new data. The Group expressed concerns about having this fixed historical period in the MCC CMPs.

The SPSSFox2 CMP was also discussed by the Group. This CMP has no constraint to reduce TAC when biomass is below B_{MSY}. In addition, it includes a 25% cap increase in TAC. The 25% cap constraint on the increase in TAC might take the CMP too long to react when the biomass has been low and then recovers and there is a chance to increase the TAC. Some saw the reactionary speed of MCC as more desirable, but the TAC goes much lower in terms of the drop in the biomass. The SPSSSFox_b is slow at recovering the catch, and the SSPSFox2_b even slower, but the MCC5_c did not fully recover the stock during the same period. The Group advises adding a scenario where the TAC is not restrained so that, for instance, catch can be increased more quickly as the stock increases in size.

Regarding this delay in responsiveness of some of the CMPs the developers reminded the Group that the CMPs are reacting to variations in the combined index, not to the biomass resulting from the OMs (which might not be similar to the combined index), and with the 2-year lag. In addition, CMPs are applied for a 3-year cycle so this can decrease the reactiveness of the CMP.

A new “what if scenario” tool was shown to better understand how the different CMPs react in terms of setting a TAC to the variations in the combined index. A future index trend is assumed by the user and how the catch

would respond because of the various CMP is depicted. The Group felt that the new tool was extremely helpful to demonstrate and compare the operations/responses of the various CMPs.

The Group discussed whether it could be a problem that MCC5 is not reacting to simulated increases in the combined index in the "what if" tool. It was recalled that MCC CMPs were built with the old-combined index, so again, more steps might need to be included. One benefit of MCC CMPs is that they are very reactive in that they can move across multiple steps if needed, i.e., they do not have to go through each step to reach an objective of either reducing or increasing the TAC. They can move more than one step between management cycles. This is something that can be useful for managers to be aware of and is a benefit of these CMPs.

Regarding the "CMP Project" tool, it was brought to the Group's attention that a 0% change in the CPUE did not result in identical catches during the projection period from all CMPs, at least not at the end of the projection period. It was asked then if some CMPs might always result in higher (or lower) catches. It was difficult to address this question as the projection period within the tool was too short to determine if a similar equilibrium would be reached.

4.3 Robustness test development

The Group was informed that no additional work on robustness tests had been completed since the SCRS Species Group meeting in September 2023. The were several comments on the role of robustness testing in the broader MSE process and the need to tailor the tests to uncertainties specific to the stock, including linking to exceptional circumstance criteria - in the case of swordfish, uncertainties related to discard mortality. There was discussion on robustness tests 3a and 3b, which are currently identified as "climate change" tests. Several within the Group noted the complexity of future climate change effects and the difficulty in linking climate and oceanographic changes to swordfish life-history and fleet dynamics. The technical team indicated that the current climate change tests do not assume (or model) causal links between climate change processes life and history but rather assume future directional variation in recruitment as a proxy for climate driven impacts on the stock. It was suggested that the SCRS could examine a soon to be released swordfish climate vulnerability assessment as a basis for developing robustness test. The Chair welcomed specific robustness tests but suggested that more complex hypotheses (e.g., spatial shifts, changes in productivity, etc.) would require a multi-year workplan and likely fall outside of the scope of the technical work possible in 2024. It was noted that the Meeting of the Joint Experts Group on Climate Change with the Commission in July 2024 would be a good opportunity for the SCRS and the Commission to exchange ideas and define objectives and approaches to include within the SWO-N MSE process the potential impacts of climate change on the SCRS management advice.

4.4 Communication materials

The Group reviewed the list of communications materials produced in 2023 on the MSE. These included the trial specifications document (TSD), a custom Shiny app, and two summary documents – one shorter document focused on requested input from Panel 4 with the supporting content to inform those decisions, and one technical document aimed at a more scientific audience. There were also two ambassador sessions (June and October 2023), which included presentations and the brief summary documents.

The Group agreed to follow a similar communication approach this year in accordance with the meeting schedule. A Panel 4 meeting was scheduled for the 25 June 2024, although it was later rescheduled for October 2024. The meeting was reduced to 1 day per the PA4 Chair's request since a separate group requested to use the second day. The intention is to add an additional 1-day PA4 meeting in October (ideally the second week of October), with a single ambassador session in early October prior to that Panel 4 meeting. The SCRS Chair will follow up with the Panel 4 Chair and ICCAT Secretariat to ensure the meetings are scheduled.

The following communication materials will be produced this year:

- Trial Specifications Document

- Custom Shiny app: The Group noted that the app has primarily been used by scientists, including to walk managers and stakeholders through results based on requests for specific scenarios. The Group viewed it to be a very valuable tool and acknowledged that the app is complex in its design and functionality, and there may be value in using a second, more user-friendly version (e.g., Slick, which has been redesigned this year and includes many of the same features of the custom app) or an executive summary page of the custom app. There was a request to try to simplify some of the figures in the custom app to reduce the number of plots shown to managers, for example by combining reference and robustness OM results on one figure.

- Short summary document

  - The June version will provide a status update, including a review of PA4's decisions from last year, detailed descriptions of the remaining CMPs, and, as deemed appropriate by the technical team depending on progress, updated MSE results using the new combined index and any adjustments to the CMPs. The Group noted that there is no specific feedback needed from Panel 4 at this time. The summary should be submitted for translation by mid-June at the latest to allow Panel 4 members to review it in advance of the meeting.

  - The October version will present the final MSE results, noting that additional feedback from Panel 4 will not be sought since the SCRS will have already approved the final results.

The more technical document will be used by the SCRS only this year to simplify communications, but CPCs can access the document through their scientists. Full results are also available to Panel 4 members through the Shiny app.

The Group discussed whether to include both old and new results in communications with Panel 4 and decided to keep things as simple as possible. Only new results will be presented, and less time will be spent on introduction to MSE since this was covered multiple times last year. Panel 4 made a lot of decisions last year (e.g., regarding management cycle length, narrowing management objectives and CMPs), so that should also help to streamline communications this year.

4.5 Exceptional circumstances

The Chair presented a concise review of the basic structure of exceptional circumstance (EC) protocols currently in use at ICCAT. He noted that development of the protocol would be a collaborative process between Panel 4 and the SCRS and that the intended scope of the EC work in 2024 was not yet clear. The Group discussed some of the differences of SWO-MSE relative to other ICCAT MSE stocks and the implications of these differences for the indicators that are to be used to assess for changes in stock and fishery dynamics, etc. There were some suggestions on the types of analysis that could be developed to identify indicators of ECs (e.g., jackknife analysis on the combined index) or thresholds within indicators. It was noted that more thorough development of science components of the EC may be possible after an MP is adopted, but that decisions on an EC development workplan may be made at the upcoming October Panel 4 meeting. The Chair suggested the formation of a small team to take on this work should Panel 4 request it. The team was encouraged to limit the complexity of the protocol and to draw heavily upon protocols already in place for albacore and bluefin tuna.
The Group briefly discussed if for the EC the analysis should be done on the individual CPC indices that were used for the OM conditioning, or on the combined index. The Group agreed that this point needs to be clarified and fully described when the EC protocol is developed.

5. Closed-loop simulation study for South Atlantic swordfish

SCRS/2024/016 provided an overview of computing architecture of the closed-loop simulations for SWO-S. The main audience for this document was to provide a detailed overview of the source code for its review (SCRS/2024/067) that had mostly been described in other SCRS documents (Taylor *et al.*, 2022a; Taylor *et al.*,

2022b; and Taylor, 2023). The closed-loop simulation experiments are set up in a two-factor design. They are: 1) the choice of multivariate priors on steepness, natural mortality, and growth e.g. Taylor *et al.* (2022a); as well as 2) the choice of CPUE cluster (Taylor, 2023). Rather than "tuning" few MPs, the approach selects MPs from 42 candidate CMPs using user-specified criteria.

SCRS/2024/067 reviewed the code and analysis described in SCRS/2024/016. This review concluded that the approach developed in this analysis is well suited for closed-loop simulation testing and it would be of benefit to further develop and refine the methodology. Areas that require fixing and/or checking include: generating samples for the life-history parameters from a truncated log-normal distribution, sampling the von Bertalanffy t_0 from a uniform distribution, including L50/L∞ Ratio in the set of correlated parameters, consider bounding parameter ranges with empirical estimates, confirming the indices within each CPUE cluster, a better description of the clustering method, increasing the number of simulations for the final rapid conditioning model analysis and test for convergence, as well as identification of an index to use in the CMPs.

The Group discussed both SCRS/2024/067 and SCRS/2024/016. The author of SCRS/2024/016 concurred with the opinion of the reviewer and noted that many of the recommendations can be addressed quickly. The Group encouraged further exploring the approach(es) described in SCRS/2024/016. They also noted that the review highlighted the need to thoroughly revise the input CPUE series, i.e., there should be some minimum standards that define when an index can be included. In addition, they noted that while some of the MPs used considered those that are traditionally used at ICCAT in other situations (like data-poor ones), alternative MPs could be considered to illustrate potential MPs that had not previously been considered. The Group also noted that it would be useful to present this work as ongoing and might consider mentioning this work to Panel 4 to decide if it wants to embark on an MSE for SWO-S after an MP has been adopted for SWO-N.

6. Responses to the Commission

The Group reviewed items requiring SCRS response to the Commission in 2024. Items include continued development of the North Atlantic MSE and monitoring of catch levels in the South Atlantic. It was agreed that the SWO Species Group rapporteurs would draft responses in advance of the September Species Group meeting and, where necessary, solicit feedback on draft text from relevant sub-groups (e.g., the SWO-N MSE technical team).

7. Recommendations and workplan

The Group recommended that additional studies be completed on swordfish monofilament entanglement gear ("trap line gear"). These studies should examine the gear's configuration, how it is set, catch rates, and the location, timing, and scale of its use. The Group recommended that the issue be examined by the SC-STATS.

The Group recommended the development of a cost-benefit analysis on the suitability of genetic techniques for monitoring the stock for life history features.

The Group recommended noting to Panel 4 that the work on SWO-S closed-loop simulation is ongoing and ask if it wants to consider embarking on an MSE for SWO-S after an MP has been adopted for SWO-N.
The Group recommended that historical swordfish catch in the Palestinian area, documented in SCRS/2024/065, be reviewed by the SC-STATS, and following the Sub-Committee's approval, included in the ICCAT database.

It was noted that some by-catch of ICCAT species in the Gulf of Guinea is reported to the Fishery Committee for the Eastern Central Atlantic (CECAF) but not to ICCAT. Accordingly, ICCAT CPCs should be reminded that information reported to CECAF on swordfish and any other by-catch ICCAT species must be also reported to ICCAT as part of their obligatory ICCAT submission. Also, ICCAT may wish to engage with CECAF to get this information.

8. Other matters

8.1 Budget

The ICCAT Secretariat provided a brief overview of the ICCAT Science funding assigned to the Swordfish Species Group between 2018 and 2022, which was previously presented during the SCRS Workshop as SCRS/P/SCRS/009. The overview focused on the comparison of the available funds and their effective use by the Swordfish Species Group.

The ICCAT Secretariat also listed ways to overcome the underspending of the available science funds, as follows:

- Better assessment of funding needs.
- Enhance ability to make full use of funding, through:
    - Improve planning/coordination within Consortium/between teams.
- Enhance the number of teams involved.
- Enhance management skills related to project coordination.
- Enhance ICCAT Secretariat engagement on project administration & management.
- Fully comply with the budget.

Based on the above, the ICCAT Secretariat informed the Group that the Science budget for 2024 must be used strictly in line with the approved budget by the Commission, which is detailed in Table 1 of the document "SCRS research activities requiring funding for 2024 and 2025" [STF-208B/2023]. Accordingly, no extensions will be granted, nor will changes between budget line items be allowed. Moreover, the importance that the ICCAT Secretariat receive all the Terms of Reference related to the science activities that require funding for the following year soon after the Meeting of the Standing Committee on Research and Statistics was emphasized. As such, the ICCAT Secretariat would be able to conduct and conclude the administrative processes very early in the year, allowing more time for the development of the activities that are dependent on issuing contracts.

The SCRS Chair pointed out that these guidelines, and particularly the deadline for developing Terms of Reference, was consistent with and supported by the development of longer-term research plans (approximately six years) and detailed budget requests covering the next two years. Considering these research plans, the objective would be to prepare the draft Terms of Reference for the Species Group meeting in September 2024 for review and approval by the Group. This will also facilitate the discussion of the proposed science budget requests for submission to the Meeting of the Standing Committee on Research and Statistics.

The SCRS Chair recognized the possibility that the identification of new science activity needs might be developed at the Species Group meeting in September. In such cases, the Terms of Reference should be developed in advance of the annual Commission meeting. Having all Terms of Reference prepared before the annual Commission meeting should aid the Commission in considering the science funding requests, as well as facilitate a more rapid initiation of projects funded by the Commission, which is critical given the new guidelines on the use of funds.

9. Adoption of the report and closure

The meeting agenda was completed, and the report was adopted during the meeting. The meeting was adjourned.

References

Taylor N.G., Sharma R., Arocha F. 2022a. A Stochastic Prior on Steepness for Atlantic Swordfish Derived from Life History. Collect. Vol. Sci. Pap. ICCAT, 79(2): 693-704

Taylor N.G., Mourato, B., Parker D. 2022b. Preliminary Closed-loop Simulations of Management Procedure Performance for Southern Swordfish. Collect. Vol. Sci. Pap. ICCAT, 79(2): 705-714

Taylor N.G. 2023. A Hierarchical Cluster Analysis of Southern Swordfish CPUE Series. Collect. Vol. Sci. Pap. ICCAT, 80(1): 168-175

Table 1. Swordfish (*Xiphias gladius*) estimated catches (landings + DD, t) by stock, gear, and year.

SWO Stocks — SWO-N

	Longline	Other surf.												
Year	LL	BB	GN	HL	HP	HS	PS	RR	TN	TP	TR	TW	UN	Total
1950	1445				2201					0				3646
1951	966				1615					0				2581
1952	966			0	2027					0		0		2993
1953	1203				2100					0		0		3303
1954	305				2729					0				3034
1955	619				2883					0				3502
1956	374				2984					0				3358
1957	1010				3467					0		1	100	4578
1958	875				3929					0			100	4904
1959	1428				4704					0		0	100	6232
1960	1042				2786					0		0		3828
1961	2060				2321							0		4381
1962	3202				2140									5342
1963	9193				997							0		10190
1964	10833	9			316					100		0		11258
1965	7759	6		179	622					86		0		8652
1966	8503	15			782					49				9349
1967	8679	11			394					23				9107
1968	8985	12		0	145					30				9172
1969	9003	11		0	185					4		0		9203
1970	9484	8		0	83					3				9578
1971	5243	11		0	0					12				5266
1972	4717	21		0	0					28				4766
1973	5929	37		0	0					8			100	6074
1974	6267	92		0	0					3				6362
1975	8778	58	3	0	0									8839
1976	6663	32	1	0	0									6696
1977	6370	38		0	0					1				6409
1978	11125	17	8	0	656		2			11		2	6	11827
1979	11177		16	29	715									11937
1980	12831		30	15	676								6	13558
1981	10583		50	8	551					1			4	11197
1982	13023		37	7	148									13215
1983	14062		70	6	421					4				14563
1984	12664		65	7	94					2			1	12833
1985	14240	1	50	7	76					5			4	14383
1986	18283	0	68	7	104		15			5		0	4	18486
1987	20029	1	85	10	107					6		0		20238
1988	19126	4	333	5	55		0	0		2				19525
1989	15554	1	1510	8	182		1			5			0	17261
1990	14215	0	1209	10	100		16			38		9	75	15672
1991	14491	0	217	21	75		5			8		42	75	14934
1992	14739	2	415	51	61		3			24		24	75	15394
1993	16212	3	324	49	28		8			3		16	95	16738
1994	15073	5	322	21	24		5			14		37		15501
1995	16390	4	400	23	190		8	1		13		38	38	17105
1996	14384	7	479	0	94		99	7		8	1	117	26	15222
1997	12643	4	67	1	90		11	16		8	0	172	12	13025
1998	11538	5	472		241		41	10		2	1	10	9	12329
1999	11242	3	248	5	18		40	21		13	2	26	4	11622
2000	11058	13	158	9	95		23	16		6	2	72	1	11453
2001	9574	1	266	9	129		17	2		7		6	2	10011
2002	9406	3	73	12	41		1	22		4		83	8	9654
2003	10952	1	114	23	147		1	6		7	0	156	37	11444
2004	11723	3	83	24	88		1	25		3	2	112	7	12071
2005	11854	10	16	40	193			62		5	3	187	11	12380
2006	11111	2	7	38	204			53		8	0	97	8	11528
2007	11751	0	11	129	267		0	68		8	7	54	9	12306
2008	10628	0	6	97	258			76	0	2	2	24	9	11102
2009	11654	1	34	128	248		0	32	0	4	1	36	9	12146
2010	11225	0	19	129	177		1	52		5	0	55	8	11672
2011	12189	1	86	121	208		0	54		5	0	36	9	12709
2012	13367	0	63	231	98		0	71		2	1	45	12	13890
2013	11565	1	4	168	275	0	0	22	0	1	0	40	2	12078
2014	10245	0	9	151	233		0	35		0	0	33	0	10708
2015	10361	0	37	128	98		0	46		0	1	81		10752
2016	10018	0	33	228	85			27		1	0	108	0	10501
2017	9611		114	266	175		1	34	0		1	93	0	10295
2018	8553	0	30	262	34		0	36	0	0	2	107	1	9025
2019	9644	34	28	348	33		0	64		0	0	90	3	10244
2020	9859	1	25	306	50		1	53	2	0	2	144	3	10445
2021	9266	0	16	251	18		1	40	0	0	1	135	56	9785
2022	9878		1	212	31		1	51	0	0	0	147	18	10340
2023	617													617

SWO Stocks — SWO-S

	Longline	Other surf.									
Year	LL	BB	GN	HL	HS	PS	RR	TR	TW	UN	Total
1950			0							100	100
1951			0							200	200
1952			0							200	200
1953			0							200	200
1954			0							100	100
1955			0							100	100
1956	1	0	0								1
1957	124		0							100	224
1958	92	0	0								92
1959	71		0							100	171
1960	359		0							100	459
1961	816		0							200	1016
1962	769	0	0								769
1963	1418	0	0								1418
1964	2030		0								2030
1965	2578		0								2578
1966	1952		0								1952
1967	1577		0								1577
1968	2348		100								2448
1969	4281		200								4481
1970	5426										5426
1971	2164	2									2166
1972	2580										2580
1973	3078										3078
1974	2753										2753
1975	3062										3062
1976	2812										2812
1977	2840		12							3	2855
1978	2829		5			12					2846
1979	3374		1						28		3403
1980	5287		113						31		5431
1981	4039		24			4			9		4076
1982	6364		80						3		6447
1983	5383		102						7		5492
1984	8986		180		1	12			23	26	9227
1985	9224		131						3	228	9586
1986	4982	0	95						2	815	5894
1987	5797		147						2	84	6030
1988	12602		266					216	4	84	13172
1989	16573		191					207	0	84	17055
1990	16705		189					181	230		17305
1991	13496		124					179	93		13893
1992	13422	1	116					177	97		13813
1993	15739		172				2	202	16		16130
1994	17839	0	110				1	190	24	794	18958
1995	21584		165				1	178	2		21931
1996	17860	0	263					166	1		18289
1997	18320		73					148	1		18542
1998	13758		131	3				135			14027
1999	14829	356	150					129	38		15502
2000	15450	18	137			4		120	0		15728
2001	14302	144	550	7				120	5	0	15128
2002	13577	7	391					120	10		14104
2003	11714	4	777	3				120	16		12634
2004	12558	0	395					126	2		13082
2005	12915		96	5				147	1		13163
2006	13984		73	1				138			14196
2007	15408		82	1				138			15629
2008	11986		201	11		0		172			12370
2009	12301		178					188	2		12668
2010	12234	9	158					193	1		12596
2011	10928	49	164	4		0		60	0	0	11205
2012	10395	63	120	1		23		84		0	10686
2013	8958		168	16		1		60			9204
2014	9781		94			0		94	0		9970
2015	10090		104	5		0		145			10345
2016	10463		67	4				77			10611
2017	10392		74	4		3		65			10537
2018	10349		17	6		5			1	0	10378
2019	10025		49	4		12					10090
2020	8871	15	42	5		4					8938
2021	9440		33			14					9487
2022	8667		40	1		11					8719
2023	473										473

SWO Stocks — SWO-M, and TOTAL

	Longline	Other surf.												
Year	LL	BB	GN	HL	HP	PS	RR	TN	TP	TR	TW	UN	Total	TOTAL
1950	586												586	4332
1951	580												580	3361
1952	337												337	3530
1953	501												501	4004
1954	452												452	3586
1955	340												340	3942
1956	393												393	3752
1957	395		250										645	5447
1958	414		500										914	5910
1959	401		200										601	7004
1960	403		112										515	4802
1961	500		112										612	6009
1962	591		112										703	6814
1963	498		224										722	12330
1964	686		112										798	14086
1965	1423		112						1			224	1760	12990
1966	1192		336									224	1752	13053
1967	869		111						1			336	1317	12001
1968	2570		115		194				1			560	3440	15060
1969	3313		133		277								3723	17407
1970	2993		99		249								3341	18345
1971	4496		76		402				1				4975	12407
1972	5399		5247		513				1				11160	18506
1973	4362		3985		388								8735	17887
1974	4564		4684		462				3				9713	18828
1975	3888		4219		416								8522	20423
1976	4318		4914		312								9544	19052
1977	4838		4791		417								10046	19310
1978	5186		5377		756						8		11327	26001
1979	5200		4980		475								10655	25995
1980	6230		5216		501								11947	30937
1981	6450		4873		461								11784	27056
1982	6112		3730		356								10198	29860
1983	6313		4016		366				1				10696	30751
1984	6709		6658		294				5				13666	35726
1985	7169		7816	1	298				5		1	3	15294	39263
1986	8166		8130		469								16765	41145
1987	8776		9219		325								18320	44589
1988	10250		9645		468				2				20365	53062
1989	7875		9542		345								17762	52078
1990	7346		8280		379				12				16018	48994
1991	7365		7971		397	0			12				15746	44573
1992	7631		7076		0	0			2				14709	43917
1993	7377		5819		0	0			4			65	13265	46133
1994	8985		6978						18			101	16082	50542
1995	6319		6648		11	0			11			26	13015	52051
1996	5884		5998		10				4			157	12053	45564
1997	5389		9195		12				5			92	14693	46260
1998	6674		7577		12				4		57	45	14369	40725
1999	6223		7372		0				3		52	49	13699	40823
2000	7129		8335		11				3		51	39	15569	42750
2001	7498		7420			4			6			78	15006	40145
2002	8042		4695						2			75	12814	36572
2003	10748		4870		7	2	2		6		0	58	15694	39771
2004	10886		3332	112	5	45	2		2			20	14405	39558
2005	11067		3265	175	6	56	2		5			46	14622	40166
2006	11339		3400	72		47			1			56	14915	40639
2007	11132		3023	1		22			1			48	14227	42162
2008	13025		587	0	27	12			2			30	13683	37155
2009	12416		477	0		2		0	3		4	333	13235	38050
2010	13407		411	1		3		1	2		3	926	14754	39021
2011	11478		388	1		3		0	3	0	24	744	12640	36555
2012	10264		0	2		34		0	3		15	727	11046	35622
2013	10020		2	4		13		1	1		24	5	10070	31352
2014	10886	0	3	3	2	7	0	3	1	0	10	53	10969	31646
2015	11905		1	5	32	19			1		20	0	11983	33080
2016	12247		0	4	7	17		3	1	2	17	1	12300	33412
2017	10333			4	35	11		2	0		4	0	10390	31223
2018	8620		0	2	29	17		1	0		12	0	8681	28084
2019	8130		0	3	28	1		0	1		5	8	8176	28510
2020	7604		1	3	44	1		0	8		2	1	7664	27047
2021	7446		1	3	51	0			3	0	8	1	7512	26784
2022	7036		0	5	70	12			1	0	7	37	7169	26228
2023	0												0	1090

Table 2. 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 (1993 to 2022). 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 presented against its equivalent Task 2 availability (DSet= "t2") scheme. The Task 2 color scheme has a concatenation of characters ("a"=T2CE exists; "b"= T2SZ exists; "c"= T2CS exists) that represents Task 2 data availability in the ICCAT-DB.

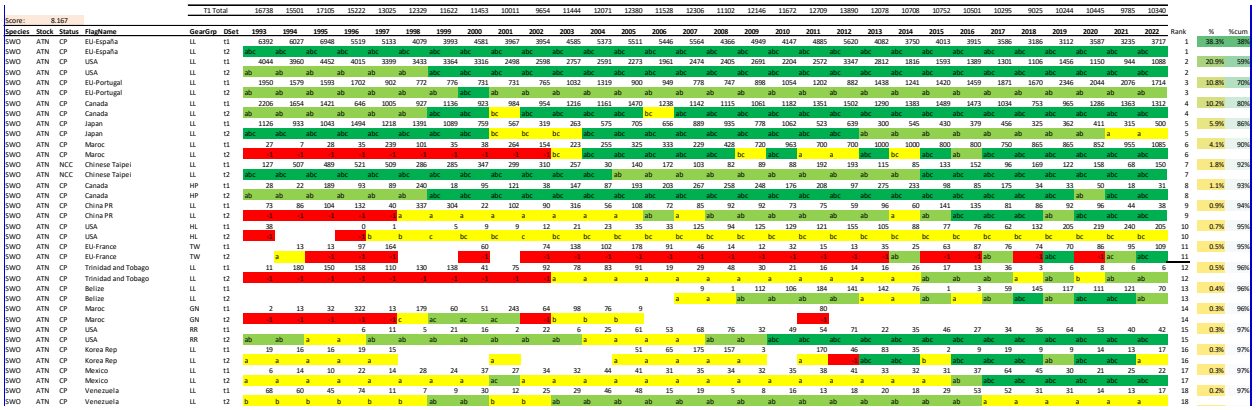

Table 3. SWO-S standard SCRS catalogue on statistics (Task 1 and Task 2) by stock, major fishery (flag/gear combinations ranked by order of importance), and year (1993 to 2022). Only the most important fisheries (representing ±97.5% of Task 1 total catch) are shown. For each data series, Task 1 (DSet="t1", in t) is visualized against its equivalent Task 2 availability (DSet= "t2") scheme. The Task 2 color scheme has a concatenation of characters ("a"=T2CE exists; "b"= T2SZ exists; "c"= T2CS exists) that represents Task 2 data availability in the ICCAT-DB.

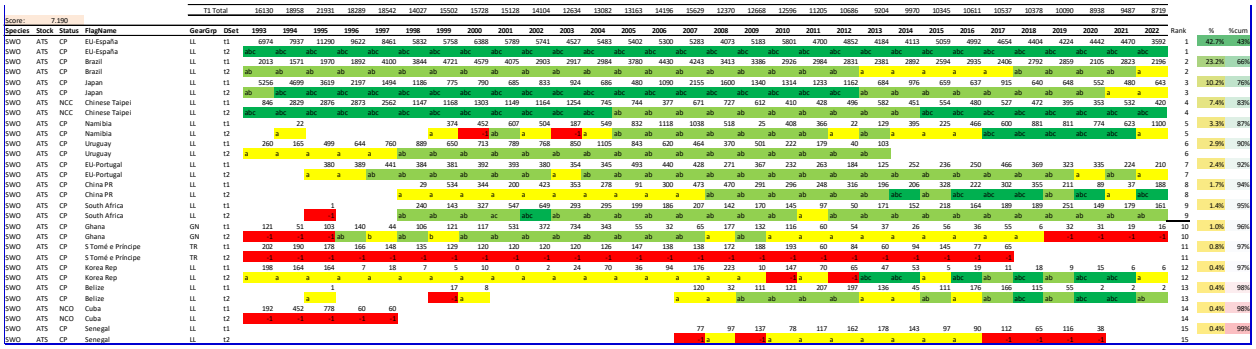

Table 4. SWO-M standard SCRS catalogue on statistics (Task 1 and Task 2) by stock, major fishery (flag/gear combinations ranked by order of importance), and year (1993 to 2022). Only the most important fisheries (representing ±97.5% of Task 1 total catch) are shown. For each data series, Task 1 (DSet="t1", in t) is visualized against its equivalent Task 2 availability (DSet= "t2") scheme. The Task 2 color scheme has a concatenation of characters ("a"=T2CE exists; "b"= T2SZ exists; "c"= T2CS exists) that represents Task 2 data availability in the ICCAT-DB.

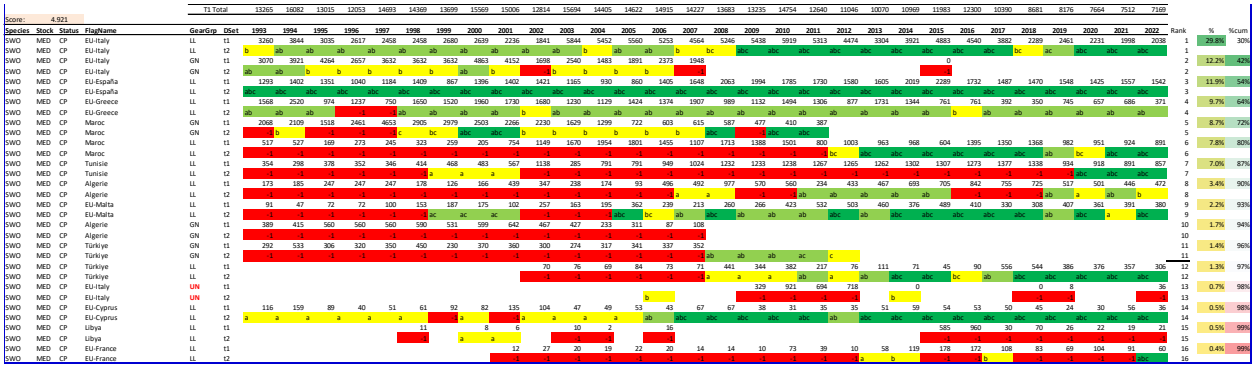

Table 5. Reported swordfish DD and DL by stock, major gears, and year.

	DD (Discarded dead)									DL (Discarded live)								
Year	SWO-N			SWO-S			SWO-M			SWO-N			SWO-S			SWO-M		
	Longline	Other surf.	Total	Longline	Other surf.	Total	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	9		9	339		339						
2005	323	10	333				113		113	123		123						
2006	215	8	223				16		16	1		1						
2007	273	8	281	91		91	19		19	0		0	54		54			
2008	235	9	244	6		6	1546		1546	0		0	3		3			
2009	151	7	157				1396		1396	0		0						
2010	148	5	153	147		147	1488		1488	1		1	10		10			
2011	392	9	402	74		74	1191	0	1191	0		0				0		0
2012	391	10	402	140		140	1133		1133	0		0						
2013	199	0	199	0		0	973		973	0	0	0	0		0	0		0
2014	156	0	156	46		46	1168	0	1168	0	0	0	0		0	0	0	0
2015	167	0	167	43	0	43	1230		1230	29	0	29						
2016	105	0	105	2		2	1369		1369	47	0	47	0		0	3		3
2017	149	0	150	111	0	111	1988		1988	64	0	64	0	0	0	0		0
2018	152	0	152	26	1	27	1682	0	1682	84	0	84				15		15
2019	304	0	304	50		50	89		89	31		31						
2020	113	0	113	57	0	57	0	0	0	45	0	45						
2021	99	1	101	128		128	188	0	188	63	0	63	0		0	0		0
2022	70	3	73	85		85	90	0	90	20	0	20	0		0	0	0	0
2023	0		0	0		0	0		0									

Table 6. Summary of swordfish conventional tagging data available in ICCAT. Number of swordfish releases by year and associated recoveries by year. The number of recoveries without recovery dates (unk) is also shown.

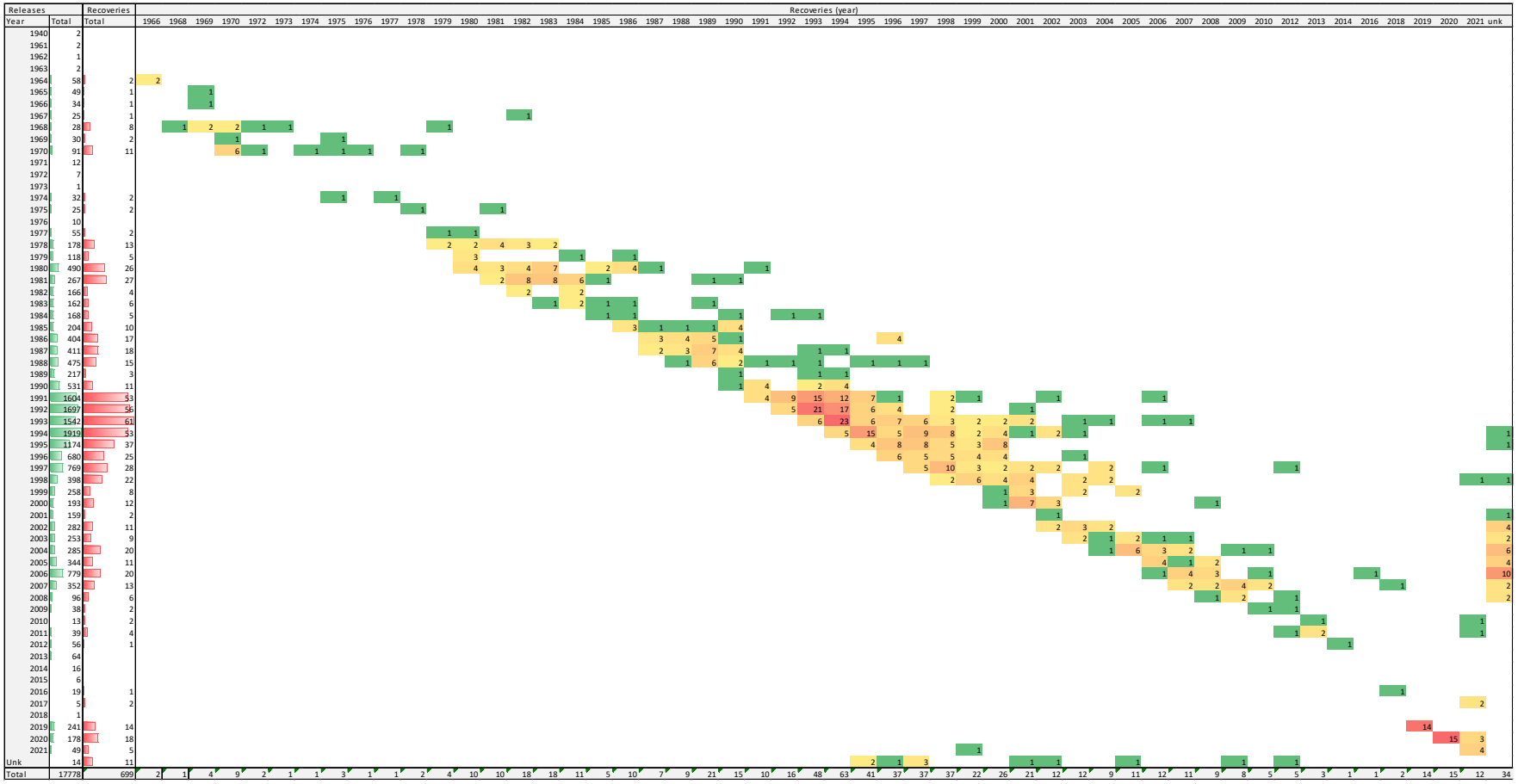

Table 7. Summary of swordfish conventional tagging data: number of recoveries grouped by number of years at liberty in each release year. The last column shows the recovery rate (%) in each release year.

Number of tag Swordfish (*Xiphias gladius*)													
			Years at liberty										
Year	Releases	Recaptures	< 1	1 - 2	2 - 3	3 - 4	4 - 5	5 - 10	10+	15+	Unk	Error	% recapt*
1940	2	0											
1961	2	0											
1962	1	0											
1963	2	0											
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	0											
1972	7	0											
1973	1	0											
1974	32	2		1		1							6%
1975	25	2			1			1					8%
1976	10	0											
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	398	22	6	4	5	1	2	2			1	1	6%
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	285	20	5	2	3	1		2			6	1	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	13	2			1				1				15%
2011	39	4	1	2					1				10%
2012	56	1			1								2%
2013	64	0											
2014	16	0											
2015	6	0											
2016	19	1			1								5%
2017	5	2					2						40%
2018	1	0											
2019	241	14	14										6%
2020	178	18	17	1									10%
2021	56	5	3									2	9%
2022	28	1							1				4%
?	14	11									11		79%
Grand Total	17813	700	205	146	115	58	46	68	12	1	45	4	3.9%

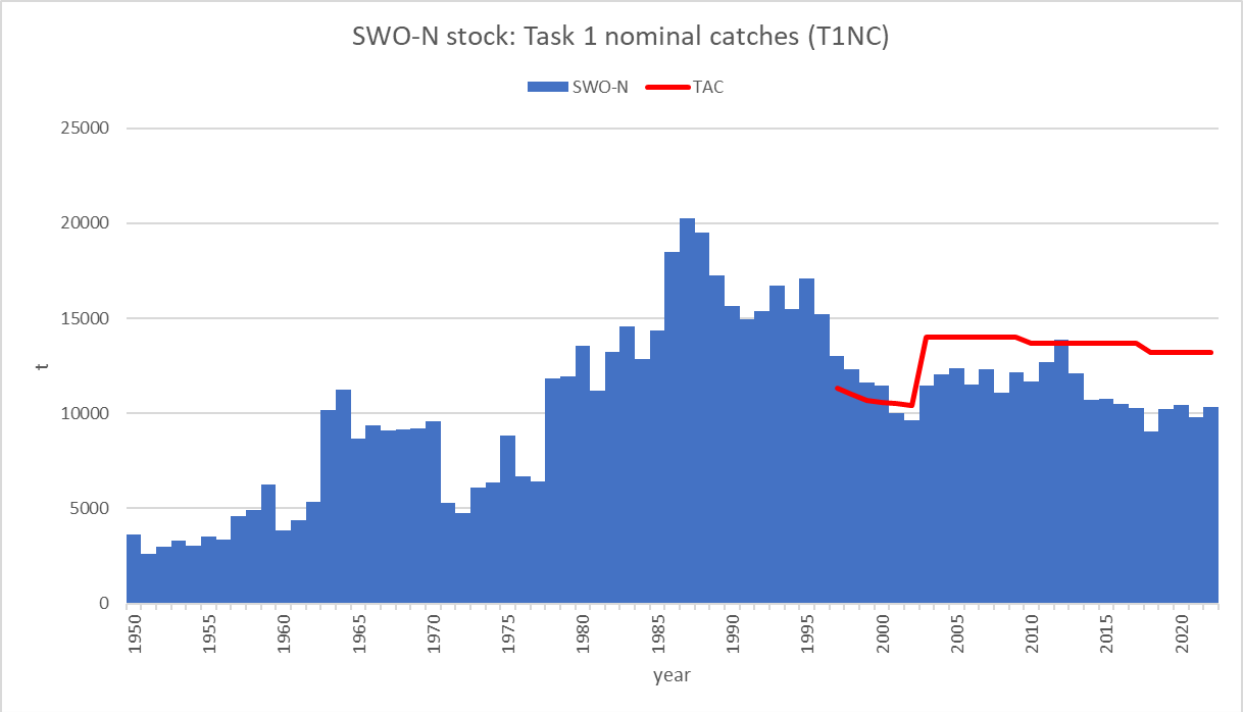

Figure 1. Total SWO-N catches (t, landings, and dead discards) by major gear between 1950 and 2022.

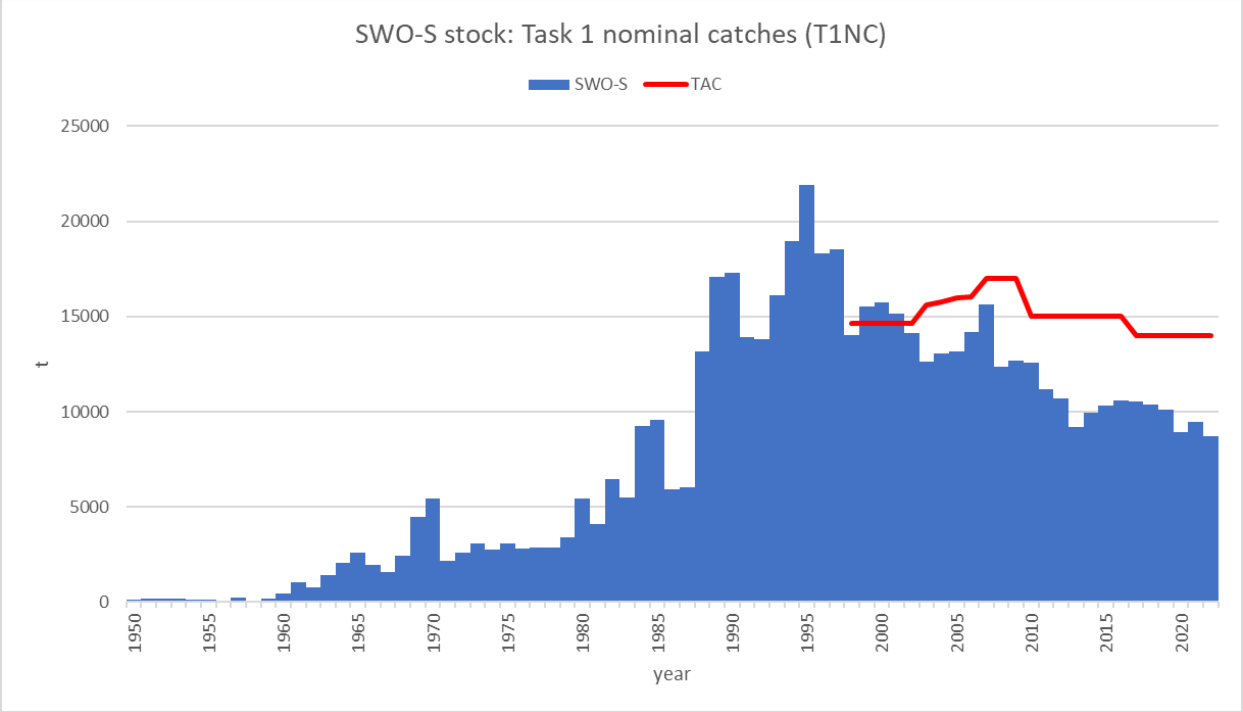

Figure 2. Total SWO-S catches (t, landings, and dead discards) by major gear between 1950 and 2022.

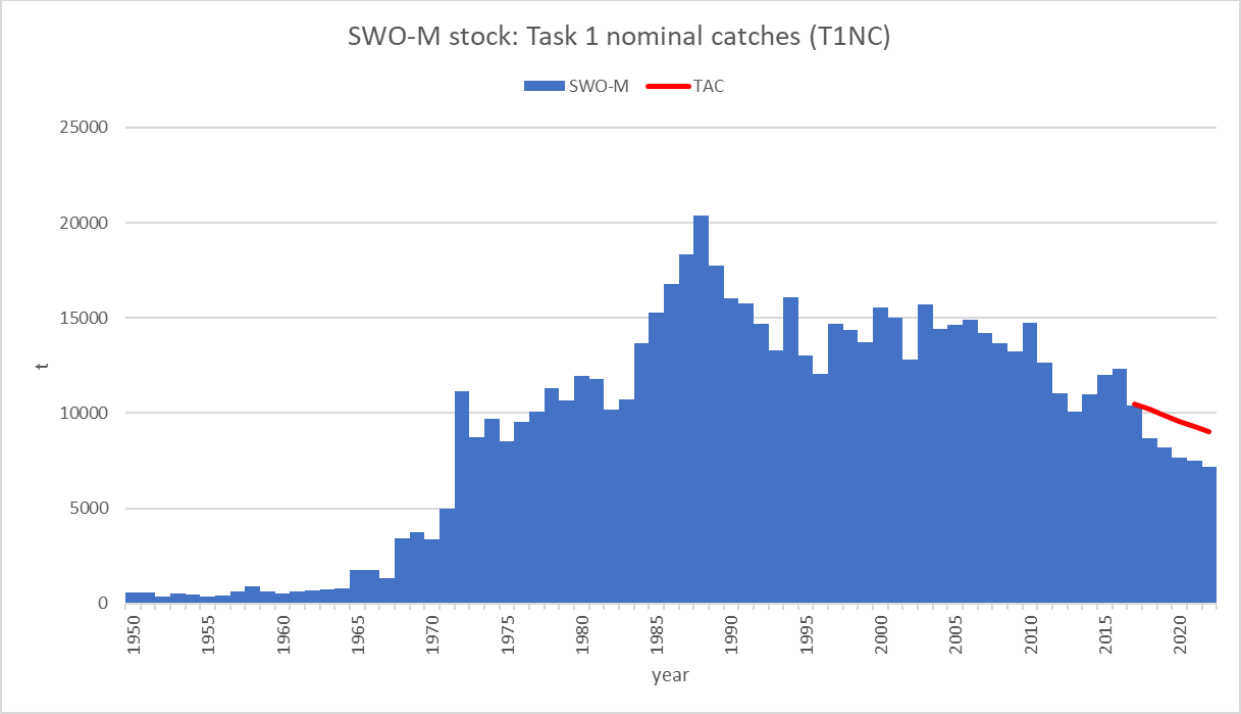

Figure 3. Total Mediterranean swordfish (SWO-M) catches (t, landings, and dead discards) by major gear between 1950 and 2022.

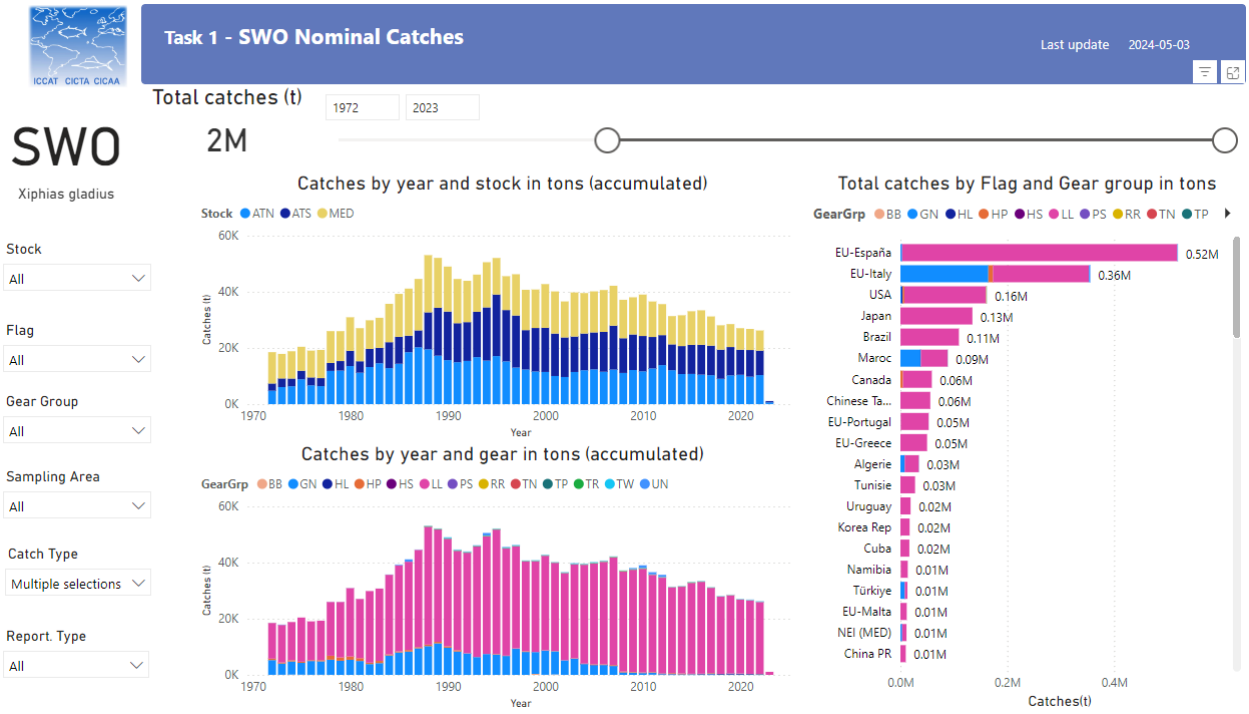

Figure 4. Screenshot of the dashboard developed for T1NC with swordfish and the three stocks.

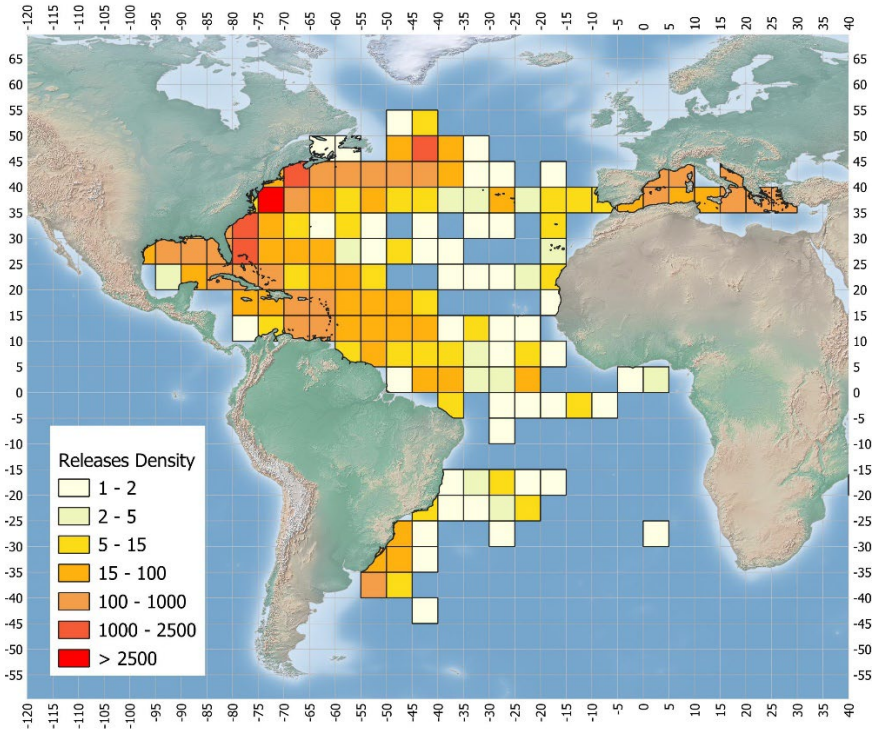

Figure 5. Density of swordfish conventional tags released in the ICCAT area in a 5x5 square grid.

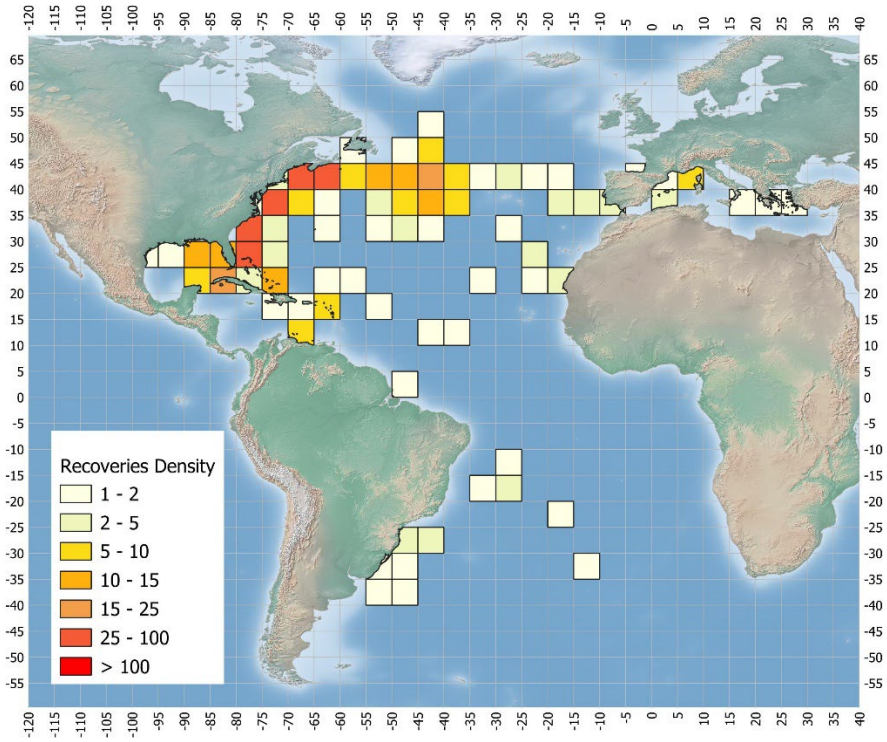

Figure 6. Density of swordfish conventional tags recovered in the ICCAT area in a 5x5 square grid.

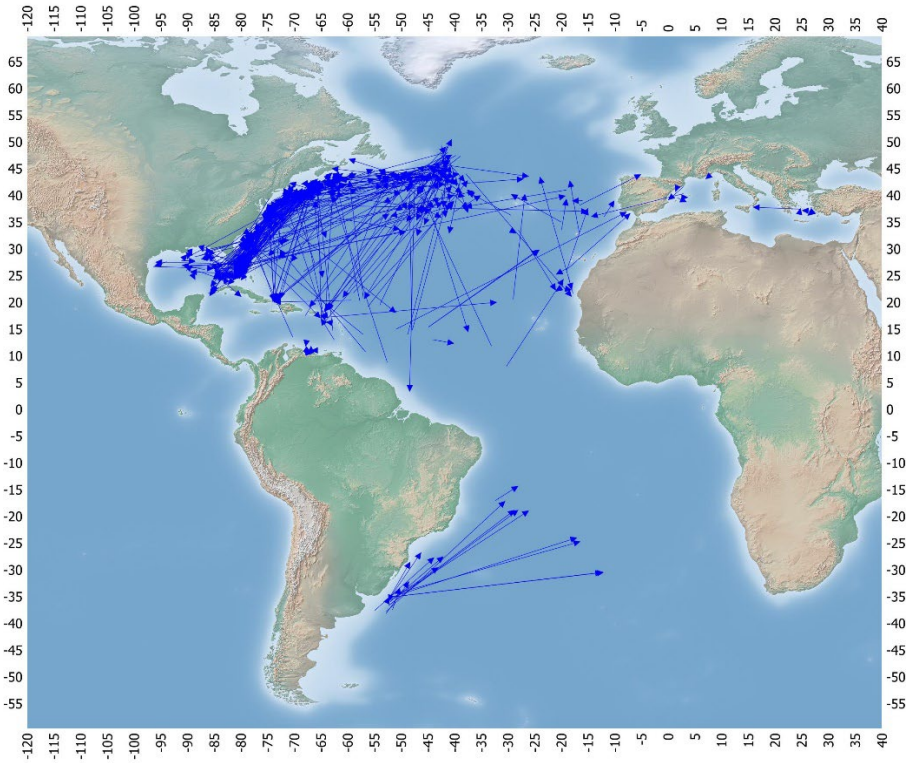

Figure 7. Apparent movement (arrows: release to recovery location) of swordfish conventional tagging.

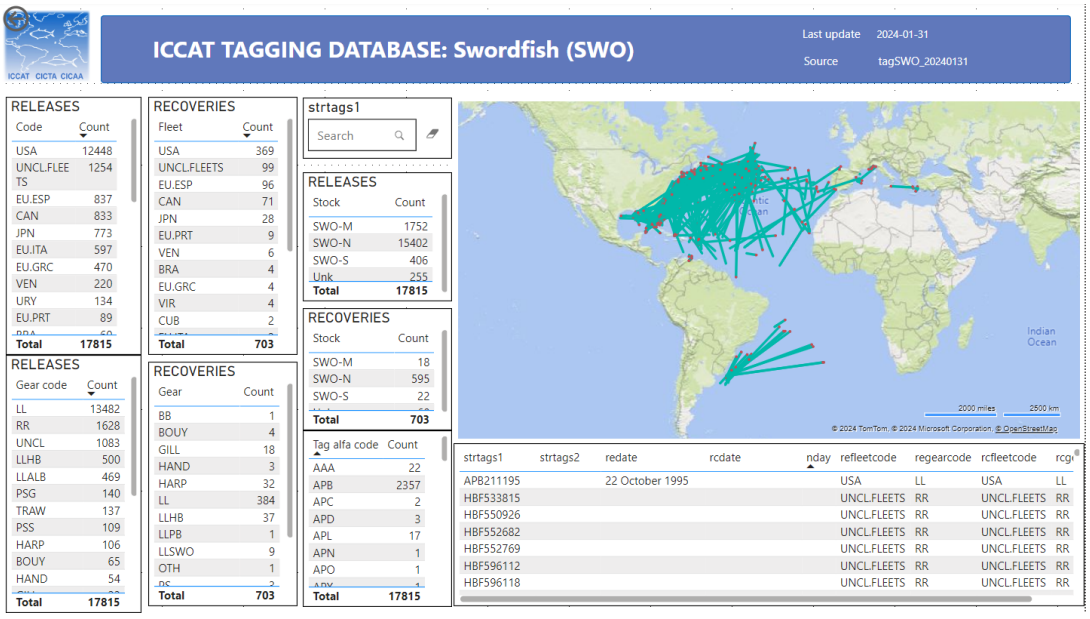

Figure 8. Snapshot of the conventional tagging (swordfish) dashboard.

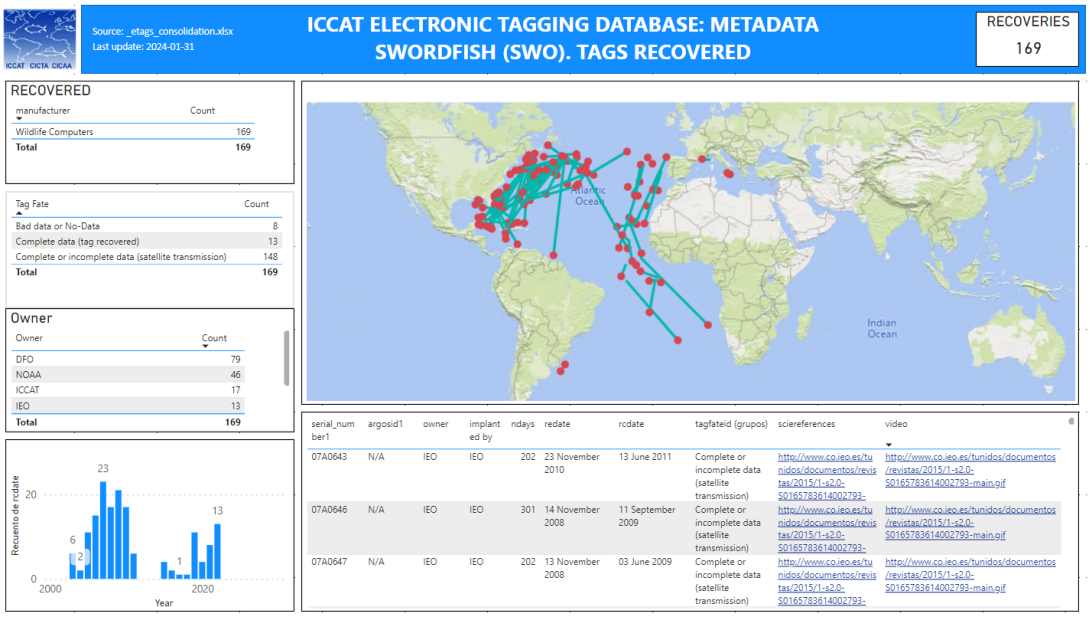

Figure 9. Snapshot of the electronic tagging dashboard (swordfish).

Appendix 1

Agenda

1. Opening, adoption of agenda and meeting arrangements

2. Review of fishery statistics/indicators

3. Updates from the Swordfish Year Programme (SWOYP)

4. Management Strategy Evaluation (MSE)

    i) Updates to the combined index of abundance and related robustness testing for data lags
    ii) CMP results
    iii) Robustness test development
    iv) Communication materials
    v) Exceptional circumstances protocol

5. Closed-loop simulation study for South Atlantic swordfish

6. Responses to the Commission

7. Recommendations and workplan

8. Other matters

9. Adoption of the report and closure

Appendix 2

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Appendix 3

List of papers and presentation

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SCRS/2024/016	An Overview of the Southern Swordfish Closed-Loop Simulation Approach	Taylor N.G.
SCRS/2024/063	An Index of Atlantic Swordfish Relative Abundance Developed from Multilateral Fisheries Data	Sosthene A., Hanke A., and Gillespie K.
SCRS/2024/064	A New Challenge for Assessing the Swordfish Fishery: the Use of an Innovative Fishing Gear	Garibaldi F., Di Natale A., and Zava B.
SCRS/2024/065	Swordfish (*Xiphias gladius* L.) Catches in the Palestinian Area (Southeastern Mediterranean Sea)	Salah J., Aboutair M., Zava B., and Di Natale A.
SCRS/2024/067	Review of Code and Simulation Framework for Southern Swordfish Closed Loop Simulations	Hordyk A.
SCRS/2024/073	Final report for phase five of the ICCAT short-term contract for continuation of the swordfish growth, reproduction, and genetics studies: biological samples collection and analysis	Gillespie K., Hanke A., Coelho R., Rosa D., Carnevali O., Gioacchini G., and Macías D.
SCRS/2024/074	Workshop on the Swordfish Year Program	Anonymous
SCRS/2024/075	Updated combined biomass index of abundance for the North Atlantic swordfish stock 1963-2022	Gilespie K, Akia S., Hanke A., Coelho R., Su N., and Ikkiss A.
SCRS/P/2024/031	North Atlantic Swordfish MSE development status and work planning for 2024	Anonymous
SCRS/P/2024/032	Phases 6 and 7 of the Swordfish Year Program	Gilespie K, Hanke A., Coelho R., Rosa D., Carnevali O., Gioacchini G., and Macias D.
SCRS/P/2024/033	Update on the age and growth component of the Swordfish Year Program	Rosa D.
SCRS/P/2024/034	Update on the satellite tagging of swordfish under the Swordfish Year program	Rosa D., Gillespie K., and Garibaldi F.
SCRS/P/2024/036	ddRAD, WGS and RRBS as innovative tools to assess genetic population structure and distribution and aging of Atlantic and Mediterranean swordfish stocks	Gioacchini G.
SCRS/P/2024/037	Results on swordfish reproduction under the Short-term contract for ICCAT swordfish growth, reproduction and Genetics studies	Macías, D, Puerto M.A., Gómez-Vives M.J., Rodríguez E., and Ortiz de Urbina J.M.
SCRS/P/2024/038	Preliminary Results for the North Atlantic Swordfish MSE based on an Updated Index of Abundance	Hordyk A.

Appendix 4

SCRS document and presentation abstracts as provided by the authors

SCRS/2024/016 - Here I summarize the approach for swordfish close-loop simulations and progress to date. The approach uses two methods to characterize uncertainties in operating models. The first of these is to use multivariate priors to characterize uncertainty in life-history parameters and productivity. The second of these approaches is to capture the uncertainty in the indices by clustering the indices by trend; this allows for sets of different relative abundance series to be treated as separate operating models. For Management Procedures, I choose a large set of candidate Management Procedures from among those for which there is a history of using data and/or modeling choices for ICCAT Swordfish stocks, i.e., those using Catch Per Unit Effort Data and/or simple production models. For selecting among Management Procedures, I first apply minimum satisficing criteria then visually inspect future stock trajectories for instability and other long-term undesirable behavior.

SCRS/2024/063 - Combined data from 15 longline fleets, either directing for or catching swordfish in the North Atlantic as bycatch, was fit using a VAST model.

SCRS/2024/064 - In recent decades, fishers have been very innovative, often proposing technologically advanced fishing gear that could only be scientifically evaluated 'a posteriori'. In swordfish fishing, this has perhaps happened most frequently. Recently, a new fishing gear, which does not fit into any previously known category, has been identified: it is called a 'trapline' and it is supposed to be in use since at least 2022. This gear poses a number of new challenges to researchers, including how to define the CPUE of the last three years. The data collection, management and regulation of this new gear should pose also new challenges.

SCRS/2024/065 - The presence of the swordfish (*Xiphias gladius*) in the Palestinian area is known since 1935, but detailed fishery data for the past are not available. Considering the importance of this species at the Mediterranean level and for the local communities, this short paper presents the few available data until the first part 2023, before the almost complete destruction of the fishing sector in the Gaza Strip.

SCRS/2024/067 - A closed-loop simulation framework has been developed for the South Atlantic swordfish fishery. This approach uses several new methods that have not previously been used in other ICCAT MSE processes. The Standing Committee on Research and Statistics (SCRS) requested a review of the code and closed-loop simulation framework. This paper reports the findings of the review.

SCRS/2024/073 - This report details the fifth phase of biological sampling and associated analysis undertaken as part of an international swordfish biology research program (the Swordfish Year Program – SWOYP). The program was established in 2018 and sampling was conducted for swordfish in the North and South Atlantic and Mediterranean. Fish were sampled for size, sex, and maturity. In phase 5, the primary focus has been on processing and analysis of samples collected during previous project phases. In particular there were important advancements in ageing techniques, age validation, epigenetic ageing, stock differentiation, and processing of gonads. Data from these analyses will be used to enhance advice that ICCAT's SCRS provides to the Commission. In this report we identify gaps in sampling and next steps required examine sampling representativeness relative to spatial and temporal patterns in recent catch data. Samples were obtained from a broad temporal and spatial range, however, some improvements are required in spatial-temporal coverage. ICCAT CPC engagement in sampling and analysis for this program is urgently needed.

SCRS/2024/074 - *Summary not provided by the author*.

SCRS/P/2024/031 - This presentation provided an update on North Atlantic Swordfish MSE development status and work planning as of May, 2024. A review of the MSE structure and key performance metrics was presented. Among the work items for the technical team in 2024 is review of the combined index of abundance work on this was completed May, 2024. Following guidance from Rec. 23-04, the technical team is revising the management procedures in light of the recent trends in the combined index. Further, this presentation reviewed possible paths forward on technical elements of an exceptional circumstances document.

SCRS/2024/075 - The standardized biomass index of abundance developed since 2006 for North Atlantic swordfish was revised and updated with data through 2022. The index is to be used as an indicator of abundance for management procedures in the North-Atlantic swordfish management strategy evaluation. Generalized Linear Models were used to standardize swordfish catch (biomass) and effort (number of hooks) data from the major longline fleets operating in the North Atlantic. Unlike past analyses where the primary data source was CPC submitted data, the primary data source for this standardization was ICCAT Task 2 Catch & Effort with supplements from some CPCs to fill temporal gaps. Main effects included: year, area, quarter, a nation-operation variable accounting for gear and operational differences thought to influence swordfish catchability. A target variable to account for trips where fishing operations varied according to the main target species was not included as these data are not available in T2C&E and for some CPCs.

SCRS/P/2024/032 - This presentation reviewed research plans for addressing key uncertainties in swordfish biology with relevance providing scientific advice to the Commission. Plans for studies span four research areas: ageing and growth, reproduction, genetics, and movement. The SWO biology program has identified new analyses for phases 6 and 7 which include validation of growth curves, epigenetic ageing, definition of stock boundaries and mixing, and identification of spawning areas. A planning workshop in early 2024 has led to development of a research plan that will define the next 6 years of work for the biology program - themes from which were presented here.

SCRS/P/2024/033 - An update on the age and growth component of the biology program for swordfish is provided. For this component, both spines and otoliths are being collected and processed for comparison of age readings between both structures. Currently, 2255 spines and 902 otoliths have been processed and funds are available to continue processing both structures. Developments under this task have been focused on the standardization of age readings amongst readers for both spines and otoliths through the development of reading protocols, location of first annulus formation with daily readings and development of yardstick for the first three years. Validation work through bomb radiocarbon dating in otoliths is ongoing. Sampling for this component should continue, with special emphasis on the collection of spines and otolith pairs of under-sampled areas and sizes as specified in the most recent project phases.

SCRS/P/2024/034 - This presentation provides an update of the study on habitat use for swordfish, developed within the Swordfish Year Program (SWOYP) of ICCAT. A total of 52 tags have been acquired by ICCAT (46 Wildlife Mini-PAT and 6 Microwave X-Tag), of these 29 tags have been deployed so far. Additionally, tags funded by NOAA (n=35) and DFO (n=89) are also included in the analysis, resulting in 153 deployments. Most of the deployments occurred in the North Atlantic, with nine tagging events in the equatorial region, four in the Southwest Atlantic and four in the Mediterranean. Data compilation and analysis of the horizontal and vertical habitat use of swordfish is ongoing. During 2024, dedicated trips for swordfish tagging are planned and budget exists for opportunistic tagging. Priority areas of tagging include the potential stock mixing areas and areas with low satellite tagging coverage.

SCRS/P/2024/036 - The use of advanced genetic tools in fisheries management has proven to be effective to define not only the genetic structure and diversity of fisheries stocks but also for better understanding the stock status and its capacity to face changing environmental conditions. As such, conservation genetics is being more readily applied in fisheries management for improving a science-based decision-making process to create practical management measures for highly migratory species, such as the swordfish (Xiphias gladius). This paper presents most of the results obtained during all the phases of SWOYP project. The analysis of 635 samples using Single Nucleotide Variants (evaluated by Double digest restriction-site associated DNA (ddRADseq)) and of 30samples using structural variants (evaluated by Whole Genome Sequencing (WGS)) let: 1) determine stock differentiation (in terms of genetic structure and diversity, fitness and evolutionary potential), 2) identify a minimum set of variants to discriminate different stocks, 3) identify stock boundaries and 4) genetic admixing among North-, South-Atlantic and Mediterranean stocks. In addition, this paper presents an update of the work still in progress on the aging assessment of 40 samples by Reduced representation bisulfite sequencing (RRBS) approach.

SCRS/P/2024/037 - This presentation summarized the results of the short-term contract for ICCAT swordfish growth, reproduction, and genetics studies. In general, it showed that Mediterranean swordfish become mature earlier than Atlantic stocks, and that the southern Atlantic stock matures earlier than the north Atlantic stock.

SCRS/P/2024/038 - This presentation summarized the updated results of the northern swordfish MSE based on the new updated index of abundance. Operating Models are unchanged, they are conditioned using SS3, based on 2022 assessment, data up to 2020. The OM Projection period starts in 2021 with fixed catch/TAC for 2021 – 2024. Performance Metrics were updated to correspond with new projection years. The updated combined index was used. A 2-year data lag was implemented for all CMPs. In addition, the presentation provided a summary of the CMPs that have so far been short-listed: constant exploitation (CE), Mostly Constant Catch 5 (MCC5), Mostly Constant Catch 7 (MCC7), state-space surplus production fox model (SPSSFox), and SPSSFox2. CMPs were tuned to achieve PGK – probability of green Kobe. The NSWO App was updated here: SWOMSE – Default.