REPORT OF THE 2019 ICCAT INTERSESSIONAL MEETING OF THE SWORDFISH SPECIES GROUP

(Madrid, Spain, 25-28 February 2019)

"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 at the ICCAT Secretariat in Madrid, from 25-28 February 2019. Dr. Rui Coelho (EU-Portugal), the Swrodfish Species Group ("the Group") coordinator and meeting Chairman, opened the meeting and welcomed participants. Mr. Camille Jean Pierre Manel (ICCAT Executive Secretary) welcomed the participants and highlighted the importance of the issues to be discussed by the Group, referring the requests made by the Commission regarding swordfish for the current and upcoming years. The Chair proceeded to review the Agenda, which was adopted with some changes (**Appendix 1**).

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

Sections	Rapporteur
Items 1, 10	M. Neves dos Santos
Item 2	C. Palma
Item 3, 4	M. Schirripa. H. Honda, A. Kimoto
Item 5, 6	K. Gillespie, D. Rosa, F. Garibaldi
Item 7	G. Tserpes, J.M. Ortiz de Urbina
Item 8	R. Coelho
Item 9	R. Coelho, M. Neves dos Santos

2. Review of fishery statistics

The Group revised the most up-to-date swordfish (SWO) fishery statistics (T1NC: Task I nominal catches; T2CE: Task II catch & effort; T2SZ: Task II size frequencies; T2CS: Task II catch-at-size reported) and conventional tagging data, available in the ICCAT database system (ICCAT-DB). The three swordfish stocks (SWO-N: North Atlantic; SWO-S: South Atlantic; SWO-M: Mediterranean) were individually addressed. **Tables 1A, 1B**, and **1C**, presents the respective SCRS catalogues on fisheries data availability for the period 1988 to 2017.

2.1 Task I (nominal catches) data

No major revisions were made to the two swordfish Atlantic stocks (SWO-N and SWO-S), when compared to the corresponding SWO statistics adopted at the 2018 SCRS annual meeting. However, for the SWO-M stock the Group revised entirely the T1NC dataset (1950-2017) aiming to identify missing catches, and, to improve the gear discrimination by flag across the entire catch series.

The Group observed that a large portion of the SWO-M historical catches have no gear associated (UNCL gear for 48% of the total catches in the 60's, 44% in the 70's, and, 35% in the 80's). The gear discrimination for SWO-M has greatly improved in the last three decades (UNCL gears for 7% of the total catches in the 90's, 10% in the 2000's, and, 2% in the 2010's). With the collaboration of the National scientists, the Group was able to revise the majority of the catch series without gear, by reallocating and/or splitting in one or more gears those UNCL catches. All the corrections were adopted and registered in ICCAT-DB. The major revisions involved EU-Malta (1970-82, UNCL reclassified as LL by National scientists), Turkey (1957-84 HARP/UNCL reclassified as GILL, and, 2003-2007 GILL split into LL and GILL by National scientists), EU-Italy (1968-75 UNCL split into HARP [12%] and LL [88%] using the average ratios of 1977-79, 2001-05 UNCL reclassified as LL), Algeria (1998-00 UNCL reclassified as LL, 2001-02 and 2004 with UNCL merged in LL, 2003 UNCL split into GILL [64%] and LL [36%] using the average ratios of 2000-02), Morocco (2016 HAND merged with LL), and EU-France (2001-08 UNCL reclassified as LL).

In addition, to complete some gaps identified in some important catch series, the Group adopted preliminary estimations (carry overs obtained as the average of the three previous years) for EU-España (LL in 1953, 1957, 1959-64), Morroco (LL in 1979-82), Tunisia (LL in 1977-79) and EU-France (LL in 2003, 2005-2006). In the future all the carry overs have to be replaced by official estimations.

Overall, this revision significantly improved the SWO-M Task I nominal catches in terms of gear discrimination and catch series completeness. There are however, some important catch series for which the Group could not find a proper solution:

- EU-Italy UNCL catch series between 1984 and 1991 could have some level of duplication (some part of those catches already included in LL and/or GILL). It requires further investigation by National scientists.
- EU-Italy GILL catches between 1950 and 1984 are missing (part could be included in HARP and/or LL catches series of 1968-84) and the LL and HARP catches between 1950 and 1967 are missing. It requires further investigation by National scientists.
- Algeria UNCL catches between 1990 and 1997 need to be properly reclassified into gears GILL/LL/TRAW. Algeria scientists committed to solve this gear discrimination problem.
- EU-España UNCL catches between 1992 and 2007 could contain GILL (a fraction only). Spanish scientists committed to study and reallocate part of those catches to GILL.
- NEI (MED) catch series for GILL (1984 to 1992) and LL (1980 to 1992) have no flag association (both series estimated at the 1992 GFCM-ICCAT joint meeting). This could lead in the future (after a full recovery of all the GILL and LL catch series) to double counting those catches. This Group should address this problem before the next assessment.

Table 2 presents the final SWO T1NC estimations by stock/gear group and year. **Table 3** shows the level of UNCL gear reduction (before and after the revision) by decade. With the exception of the 80's (highly dependent on the EU-Italy 1984-91 UNCL catch series) all the remainder decades have improved substantially having now ratios below 10% of catches without gear. **Figure 1** presents the T1NC estimations by gear group and year for the three swordfish stocks.

Document SCRS/2019/031 presented a revised catch series (1984-2012) for the artisanal gillnet fishery of Côte d'Ivoire. The biomass was obtained by converting the swordfish specimens measured at three main landing ports of Côte d'Ivoire (Abidjan, San Pedro and Sassandra). This revised series has yet to be included in the T1NC dataset, replacing the existing one (affects SWO-S). Further discussion on this document are included in section 5.4.

2.2 Task II (catch-effort and size samples) data

As shown in the swordfish SCRS catalogues (**Tables 1A, B, C**) both Atlantic stocks are reasonably well covered in the last 30 years (1988-2017), being the SWO-N (score = 7.6) in a slight better shape than SWO-S (score = 6.5). The Mediterranean stock (SWO-M) has a low Task II coverage with a score of 3.9 (scores below 5 are considered poor) with important gaps in both T2CE and T2SZ. As for other ICCAT species, the Secretariat has in place since 2014, a long-term project aiming to (a) recover missing Task II datasets, and to, (b) improve the level of Task II resolution and harmonization (replacing year/trimester by month, replacing 20x20/10x20/10x10 grids by 1x1 and 5x5, harmonise efforts by gear, harmonise/improve size/weight classes, etc). This work, supported by the SCRS (committed to a long-term improvement of ICCAT statistics) requires the participation and full commitment of the ICCAT CPC scientists. The Secretariat is using the SCRS catalogues as one of the important instruments used to request revisions to ICCAT CPCs.

Document SCRS/2019/023 presented a summary of the available size and catch-at-size information for Mediterranean swordfish. Size sampling data is available since 1975, however the number of measured fishes was low until the 1990's. Preliminary analysis of size sample data indicated that since 1990 there are adequate size frequency information for the main gears (gillnet and longline) catches. Although, size sampling is unbalanced particularly for fleets in the eastern Mediterranean. Unfortunately for the 1980's when the largest catches of Mediterranean swordfish were taken, there is very limited size information. Reported size sampling is mainly in 5 cm bin size intervals, thus the size frequencies should be aggregate to 5 cm LJFL.

Size frequencies show a left skewed distribution with a 95% quantile of fish size from 70 to 180 cm LJFL mainly, a mode at about 110 cm and mean of 140 cm. The size range extends from 35 cm to 290 cm LJFL. Longline size samples show two different strategies; the Japan and Chinese-Taipei longliners targeting bluefin tuna primarily that catch larger swordfish (170-190 LJFL), and the swordfish longliners of the Mediterranean catch medium size fish (150-160 LJFL). There is however larger variation of mean size between years. Overall, the longline catches show a declining trend of the swordfish mean size caught. For the other main fishing gear gillnets, the catches of swordfish size distribution show also a wide range, with average size catch of 120 cm fish. However, over the period of size sampling, 1990 to 2011 there is relatively low variation on annual mean size.

The Group commented on the size distribution reported, indicating that most sampling is done with precision of 1 cm, however it is later aggregated in 5 cm bin size for data submission. It was recommended, that size sampling data be submitted in the original precision of the measure. It was recognized that there are at least two types of Mediterranean longline operations, home base (LLHB), which is now recoded as Surface longline (LL-surf/LLSWO) versus semi-pelagic operations (LLSP) which represents recent changes in fishing strategies and operations, including using a different type of bait, artificial lures with light sticks.

For the assessment models, size information will be aggregated by the fleet-gear and season combinations following the Group recommendations. In the interim analyses of sample size will be performed to determine the appropriate size frequency samples. An effort to reclassify size samples from unknown gear type has also been done.

2.3 Tagging data

The Secretariat informed the Group that the swordfish conventional tagging information presented is basically the same one as the information presented in the 2018 SCRS annual meeting.

3. Review of work done to date on Swordfish MSE

3.1 Revision of the work conducted in 2018 by the contracted expert team

The Chair presented the summary of the work done by the contractors and the Group acknowledged the work and discussed the final report of the contract (Kell and Levontin, 2019: SCRS/2019/032). The Group felt that there was not enough time to closely review of the report. It was decided to make a small study group to provide the more detailed review and attach it as **Appendix 5** to this report. The study group will provide their review within one week after this meeting (8 March 2019), and circulate it among the swordfish species group (all participants in this meeting) with one week for final comments and adoption (15 March 2019). This review will be sent to the contractors for their consideration.

The Group emphasized the need to have all documents posted on the owncloud at least one week prior to the species groups meetings even if preliminary.

It was commented that the MSE process including its generic concepts and frameworks needs to be transparent and understandable for managers and stakeholders as well as scientists in order to provide useful information and perspectives on the fisheries management. It was also suggested to comprehensively evaluate this MSE work by the contractor, using guidelines suggested by Punt *et al.* (2016).

The Group particularly acknowledged the method of validating OMs in their work that is very useful generally. However, the Group felt there is still more work to do with the OM to incorporate various uncertainties of the parameter values which were agreed in the 2018 intersessional meeting (Anon., 2018). It was noted that the SS model set up, fitting and results in the OMs need to be reviewed thoroughly. Therefore, the Group will also make an initial brief check if the SS model set up in the OMs as expected.

The Group briefly discussed the importance of having a clearly organized GitHub code in order for other users to reproduce the same results. For example, all the input files for the SS3 model should be easily accessible. The Group agreed to maintain the GitHub site for the work done by the contractors as private; any SCRS scientists can request access to the Secretariat. It was clarified that ICCAT owns the work, thus any SCRS scientists can work on the codes.

3.2 Revision of any other work done in relation with North Atlantic SWO MSE

There was no discussion on this item.

4. Revision and further development of the MSE workplan and roadmap for ICCAT North Atlantic Swordfish MSE process

4.1 Discussion on the process to finalize the reference set of OM and their conditioning

It was noted that four MSE efforts going on at the same time in 2018 and the Commission requested SCRS to slow down the process but not to stop completely and devote more effort to fewer MSEs, especially on Atlantic bluefin tuna. Given the decision by the Commission and the current available budget for swordfish MSE, which is less than in 2018, the current MSE roadmap relative to swordfish needs to be adjusted.

The Group discussed how to proceed the North Atlantic SWO MSE work in 2019. It was discussed if reference set of OMs will be limited to a small number, like the bluefin Species Group currently does (e.g. 24 OMs), or will be expanded to complex grid design, like IOTC does (e.g. 2,500 for SWO in the Indian Ocean; Rosa *et al*., 2018). It was suggested starting with a smaller grid design as it is difficult to check all diagnostics of all OMs run on a large grid (Anon., 2018). It was also suggested to take a similar approach to that of the BFT Species Group work, making a list for "redface test" to judge the acceptability of OMs. The importance of examining several diagnostic plots and taking a careful examination of results and diagnostics was highlighted.

The Group further discussed the work for 2019 contract under a limited budget. Several options were considered: continue to develop OM; review of code that brings in Stock Synthesis and outputs the desired variation(s) intended (i.e. did it change M as intended); which diagnostics can we use to check each model run. It was agreed that the Group will make one call 1) to continue development of the OMs considering the wide range of the uncertainties as discussed at the 2018 intersessional meeting (Anon., 2018), and 2) more and automated diagnostics. The Group recognized the importance of close involvement of actual stock assessment scientists in the development of OMs and MPs when dealing with contractors.

4.2 Discussion on start testing of candidate management procedures

There was no discussion on this item.

5. Progress on the Atlantic and Mediterranean Swordfish Project and other work related to the workplans

5.1 Stock structure project, including biology and satellite tagging

Document SCRS/2019/027 presented several methods to assess the reproductive status of swordfish: histological assay; FTIR microspectroscopy and transcriptomic analysis. Histological analysis was used to classify the ovary maturation, the use of the FTIR microspectroscopy provided a chemical map of the macromolecular composition of the oocytes at different developmental stages to assess oocyte quality. With the de-novo transcriptome assembly approach, the molecular dynamics governing ovarian maturation were elucidated and molecular biomarkers of swordfish reproduction were identified. Also, a protocol for sample collection was optimized and adapted for on-board sampling procedures.

It was noted that the document provided to the Group did not fully reflect the contents of the presentation. The Group encourages the authors to provide an updated paper version for publication in ICCAT Collective Volumes of Scientific Papers.

Results presented were aggregated by area and it was explained that this was a preliminary analysis, more focused on the methods used, and that further results will be presented in the future. The importance of a rigorous and consistent sampling protocol between laboratories was emphasized. Determination of maturity stage from histology, for example, is influenced by which of the two gonads is sampled and location within the gonad where a tissue sample is obtained (i.e. apex, middle or distal end). For results to be comparable between laboratories, the protocol standardization is required.

It was noted that in the presented results there were females with the gonad index below 1.5 and that were still able to reproduce. It was clarified that histological based gonad index (GI) can have lower values that macroscopic assessments of maturity, and that the Hinton index was used. It was noted by the Group that Hinton index can underestimate the GI.

The Group encouraged the authors to continue this work, especially for answering specific questions, e.g. to have a better correspondence between macroscopic and histological assessment of the maturity stages; defining spawning areas and seasons; investigating the relationship between egg quality and recruitment. There was a further recommendation that the author compare these results to all reproductive work that has been completed in the Mediterranean in the past.

Document SCRS/P/2019/004 presented results from a peer-review paper on reproductive biology of swordfish in the Strait of Gibraltar. Females attained larger sizes than males and mature at larger size, at 170 cm, opposed to 95 cm LJFL for males. Comparing this study with previous studies from both the Atlantic and the Mediterranean, it was found that L_{50} for males is close to the males L_{50} of Mediterranean swordfish, whereas L_{50} for females was closer to Atlantic estimates. The authors concluded that the Strait of Gibraltar is a migratory route for pre-spawners swordfish that would spawn from June to September, probably in the Mediterranean. Moreover, taking into account the LJFL distributions of the catches by sex, it was therefore hypothesized that this area could be a mixing site for stocks from the Mediterranean and the Atlantic.

The Group acknowledged the work, stressing the importance to collect more samples for genetics and improve tagging activities from this area, in order to better define mixing rate and stock boundaries.

Presentation SCRS/P/2019/006 provided a species distribution model (SDM) for swordfish using a habitat suitability framework. Currently, the model integrates ocean depth, annual average estimated total chlorophyll by latitude and longitude, and temperature and oxygen by latitude, longitude, depth, month and year. Model predictions and general distributions of North Atlantic swordfish catches are used as criteria for the inclusion and treatment of variables. The current formulation predicts the north-south seasonal migration in the North Atlantic but also predicts high abundance in areas of low swordfish catch. The author noted the potential use of this model for habitat suitability based CPUE standardization.

The Group acknowledged the effort for the development of this model. It was noted that using the catch to validate the habitat model might lead to predicting more the feeding grounds rather than the preferred habitat, noting that feeding and reproduction habitats might be different. It was suggested to use preferred prey distribution instead of catch, however this might not be straightforward to obtain that is why the model is using chlorophyll and zooplankton.

It was suggested that as swordfish are tolerant to a large range of temperatures, perhaps food availability could be more important than temperature. It was clarified that this could be altered in the model by changing the weights of the components, and even a weighted model by month could be attempted, to capture the forage/reproduction balance between months. There was discussion about the differences in habitat preference between adult and juvenile life stages as well as difference between males and females. The author noted that modeling habitat suitability by life stage and sex was the ideal approach, however, this is very analytically demanding and beyond the scope of model development at this point.

Presentation SCRS/P/2019/008 provided a brief overview of the highly migratory species tagging efforts under the Cooperative Tagging program (CTP) administered by the United States NOAA Fisheries at the Southeast Fisheries Science Center (SEFSC) in Miami, Florida, with focus on swordfish release and recapture of locations conventional tags. The presentation provided some detailed results from SEFSC electronic tagging of swordfish and ongoing collaborations. Through the CTP, 11,305 SWO have been tagged, with 459 reported recaptures. The SEFSC tagged 20 swordfish with Pop-up Satellite Archival Tags (PSATs) from 2003 to 2008 off the southeastern Florida Coast and between Cuba and Hispaniola. These data showed that this fish tended to spend most of the time at night within 120 m of the surface, in waters that tended to be

between 20 and 30°C, while occasionally diving to deeper depths (300m or more). During the day, although the fish still spent limited time at or very near the surface (presumably basking), most of the time the fish was at depths of around 300-600m, at temperatures between 6 (or lower) and 9°C. Depth profile information showed vertical movements consistent with a hypothesis that the fish spent nighttime hours near the surface (where it was potentially available to the local fishery), then followed the slope contour off the shelf break down to deeper waters during the day (with excursions to the surface), before returning with a similar vertical migration profile to shallower waters during the transition from evening to nighttime. In addition, some initial results were presented for a USA-Portugal collaboration for tags deployed around 5°N and the Equator. Also shown were the deployment locations for electronic tags which provided data for a U.S./Canada/EU-Spain/EU-Portugal collaboration to parameterize a longline fishery simulation model, intend to reflect the spatio-temporal interactions of the gear with highly migratory species, taking into account the depth-temperature habitat preferences of the species.

The Group acknowledged the importance of understanding habitat use and vertical migration patterns of swordfish and how this may relate to fishing patterns, and general life history. It was suggested that the author examine variation in light transparency across depths as this may help with interpretation of data relating to horizontal movement patterns.

Presentation SCRS/P/2019/007 provided an overview of biological data collected in the Atlantic and Mediterranean swordfish sampling program. The program was initiated in 2018 by the Swordfish Species Working Group with the aim of collecting data critical for addressing unknowns in the growth and reproductive biology of ICCAT's three swordfish stocks as well as the stock boundaries and their mixing rates. An initial analysis of size structure, sex composition, and spatial and temporal sample coverage indicates potential differences between stocks but the authors note that sampling gaps in several ocean areas and Mediterranean require increased sampling participation from ICCAT members. The presentation also suggested next steps for biological sampling and sample analysis, particularly for aging, reproductive and genetics studies.

The Group acknowledged the work done by the project coordinators. The Group was informed by the Secretariat that this project will be funded for another year and encouraged the continuation of such biological studies. The price per sample was discussed, as for some countries it was not possible to participate in the project because it would be necessary to buy the whole fish, or it was not possible to collect all samples necessary to be considered into this sampling program. Given the budget, to increase the price per sample then it would be necessary to collect less samples, it was noted that another type of partial sample could be considered for samplers that can only get genetic samples. It was encouraged that laboratories that have samples, even if it is not a complete sample, to participate in this study.

5.2 Size/sex distribution

No new information was presented, however the Group stressed the importance of continuing this revision. As new data becomes available the Group will continue developing size/sex distribution models for swordfish, especially in time for the next assessments.

5.3 Length/weight relationships

Document SCRS/2019/025 and document SCRS/2019/026 presented length-weight relationships and the monthly size distributions of length and weight classes for swordfish caught by Italian longline fishery in the Mediterranean Sea. The length-weight relationships parameters were obtained from the Lower Jaw Fork Length (LJFL) and Round Weight (RWT).

The Group acknowledged the importance of this data for the Mediterranean swordfish, especially because there it presented length to round weight relationships, for which there are not much data available. As Mediterranean Length-Weight (L-W) relationships are being revised these data could be useful to add to the collated data so far to produce a L-RW Mediterranean equation. It was questioned if the separation in two different documents was based on any biological reason. The author clarified that there was no biological reason, but only related to different geographical sampling coverage. It was suggested that results for the monthly size and weight distributions should be presented separately by gear/longline to reflect differences in catchability. There was a further recommendation for the author to compare these results to work that has been completed in the Mediterranean in the past.

5.4 Fisheries indicators

Document SCRS/2019/030 presented an update of the biological data and fishery indicators for the swordfish targeted by the Moroccan longline fleet in the south Moroccan Atlantic waters for the period 2003-2018.

The Group noted that both the CPUE (calculated in biomass) and the mean sizes are increasing, and requested if in the future the authors could explore producing CPUEs in numbers (N), for comparative purposes. This would allow checking if there has really been an increase in number of fish in the area, or if the CPUE trend is mostly related with the increase in the mean fish size/weight.

It was also noted that the increases in size can be related either with the actual specimens distribution in the area, but also correlated with other factors as for example fishing regulations (e.g., minimum landing sizes) or changes in fishing strategy. The authors clarified that there are no discards in this fishery and that it has been consistently operated since the beginning of the series. However, as the fishery started in 2002, there have also been possible improvements in factors more difficult to model, as for example improvements in the skills of the skippers and knowledge about the fishing grounds. The authors will try to explore those, and also other factors as for example introduction and use of light sticks.

Document SCRS/2019/031 updated data on swordfish fishery statistics collected in the main ports of Côte d'Ivoire.

The author clarified that the data comes from artisanal gillnets and are catches from the main landing sites in Côte d'Ivoire. It was noted that the current ICCAT T1 statistics for Côte d'Ivoire are different from those now reported in this paper. The authors clarified that in some years the sampling and reporting was based on catches from Abidjan only, as the main port, while this work now compiles and presents data from all the main ports. The authors will now coordinate with the ICCAT Secretariat to update the Task I nominal catch database with this new information.

6. Plan for the ongoing and future activities of the Atlantic and Mediterranean Swordfish Project

The Group revised the 2019 work plan based on the overall budget available for this year. The table below summarizes the activities to be conducted during 2019 and related decisions taken by the Group.

Activity	Amount (€)	Needs	Action to be taken
Reproductive biology study	20,000	To collect gonads samples and provide preliminary analysis results	Continuation of the project to collect samples for reproduction, genetics and ageing studies, and provide preliminary analysis results.
Age and Growth	35,000	To collect and process hard structures for age and growth study.	
Genetics study for stock differentiation	80,000	To collect tissue samples and provide preliminary analysis results	
Sampling collection and shipping	75,000	Additional collection and shipping of samples.	
e-tagging	45,000	Purchase PSAT tags and satellite transmission. Deploying PSAT.	Secretariat to proceed with acquisition. Around 11 tags to be split between the North/South Atlantic and North/Mediterranean stocks. Reserve 5,000 for released fish payments and 500 for tagging equipment (poles, applicators, etc.).

Workshop on age and reproduction	14,000	To standardize sampling and processing protocols between laboratories	Organize a workshop to establish sampling and processing protocols. Preliminary age reading between laboratories (including attendance of experts). Revise and update maturity scale protocols.
Total	**269,000**		

The Group reiterated that it would be beneficial that the studies listed in the table above should be a collaborative process, increasingly involving more scientists from all nations with major Atlantic and Mediterranean swordfish fisheries. Any additional CPCs that are interested in participating and can provide relevant samples/data and/or expertise in the projects are welcome.

The Group was also informed that there is a specific budget line for the ongoing northern swordfish MSE process.

What follows is a draft version of the swordfish species group work plan for 2020 that will be finalized at the Species Working Group in September 2019. The table below provides summarized information regarding the Group decisions on research activities to be carried out during 2020.

Activity	Amount (€)	Needs
Reproductive biology study	20,000	Ongoing consortium work for continuing collection and shipping of samples. Process hard structures for age and growth and workshop organization to establish reference set for SWO aging (including attendance of experts). Process reproduction and genetic samples and provide results.
Genetics study for stock differentiation	80,000	
Age and growth	40,000	
Workshop on Ageing Reference Set	25,000	
Sampling collection, shipping and consumables	80,000	
e-tagging	50,000	Purchase PSAT tags and satellite transmission. Deploying PSAT. Reserve 5,000 for released fish payments and 500 for tagging equipment (poles, applicators, etc.)
N-SWO MSE process	30,000	Continue the N-SWO MSE process.
Total	**325,000**	

7. Data available for update of fisheries indicators for Mediterranean Swordfish

7.1 Standardized CPUE

Document SCRS/2019/19 reported standardized relative abundance indices for swordfish caught by the Spanish surface longline fisheries in the western Mediterranean Sea for the period 1988-2017. The standardized index showed notable annual fluctuations without any definite trend for the period under study. Based on the shape of the residuals and the trend of the nominal CPUE for the last years in the time series. The Group agreed that it would be worth, if the necessary information exists, to also explore the effect of fishing gear modifications, such as the use of light-sticks and artificial bait. The authors will also explore separating data from home-based versus semi-pelagic longlines.

The Group was notified that updated standardized indices for other Mediterranean fisheries will be also presented in the Species Group meeting on September 2019. This would at least include the standardized CPUEs used in the 2016 stock assessment (Anon. 2017) (EU-Greece, Morocco and EU-Spain (preliminary EU-Spain CPUE was presented in this meeting). Additional CPUEs from other fleets in the Mediterranean are strongly encouraged.

7.2 Size structure

Document SCRS/2019/23 reviewed the time series of swordfish size data that CPCs have provided to the ICCAT Secretariat under the Task II requirements. The data were revised, standardized and aggregated to size frequencies samples by main gear type, year and quarter. For the Mediterranean stock, size sampling for the major fishing gears is consistent with the proportion of the catch since 1990; in general longline fisheries are better sampled than the other fisheries. The number of fish measured has increased substantially in the last decades for the Mediterranean fisheries; however the resolution of the reported measurements has been low (e.g., collect data at 1cm and report at 5cm intervals), which may substantially impair the conversion of CAS to CAA.

Document SCRS/2019/024 presented information on the size composition of swordfish catches along the Algerian coast of the Mediterranean by the artisanal longliner fleet. In 2018 it was observed higher occurrence of relatively large individuals in the landing ports, compared to the previous recent years.

Presentation SCRS/P/2019/005 provided information on the effects of the Mediterranean swordfish minimum size regulations (Rec. [16-05]) on the discard rate of the Spanish longline fishery by gear type and quarter of the year. After the implementation of Rec. [16-05], discards have increased to values up to 30% in the case of the traditional home-based longline gear (LLHB), compared to values of around 6% prior to the adoption of the Recommendation. For the semi-pelagic LL, the discards increased from around 1% to 9%. The Group further noted that discard misreporting can highly affect assessment estimates.

The Group discussed that in the Mediterranean, due to the characteristics of the distribution of swordfish and the fishing fleets, those catches of undersized swordfish are very difficult to avoid. Further, the hooking mortality of those undersized fish is likely very high and the post-release mortality is unknown. Specific values for the Mediterranean hooking mortality are unknown, but for the Atlantic hooking mortality on undersized swordfish (119-125 cm LJFL in the Atlantic) have been reported to be around 88%, noting that those values increase with decreasing swordfish sizes (Coelho and Muñoz-Lechuga, 2018). As such, the current regulation on minimum catch sizes likely does not reduce juvenile mortality for Mediterranean swordfish.

The Group noted that currently no information on Mediterranean swordfish discards is available on ICCAT T1 database and emphasized the need for CPCs to collect and submit the relevant information to the ICCAT Secretariat, according to the ICCAT Rec. 16-05.

8. Other matters

No other matters were discussed during the meting.

9. Recommendations

Recommendations with financial implications

- Given the high success on the start of the swordfish biological project that will now expand from a sampling program to a full research project with continued sampling and analysis, and that this project is addressing many sources of uncertainty still related with swordfish biological parameters for the three stocks (Mediterranean, North and South Atlantic), the Group recommended that the Commission gives a high priority to this project and that, if possible, it starts to be managed and budgeted in a continuous multi-year approach, rather than depend on yearly requests and funds that can hinder longer term plans and analysis.

- Under the swordfish biological project that started in 2018, sampling started both in the Atlantic and Mediterranean seas, including hard parts for ageing and tissue for genetics. The Group recommended that for the population genetics analysis, priority is given to the mixing areas between the Mediterranean and North Atlantic, followed by the mixing areas between the North and South Atlantic.

- Data recovery plan (adopted as a Recommendation from the 2018 SCRS plenary): The Group noted that the catch and CPUEs time series currently in use in the stock assessment models start in 1985. Therefore, the early period of the fisheries, which accounted to increasing catches is not being accounted in the model. As such, the Committee recommended conducting a recovery of historical data, so that the entire history of the fishery is taken into account in the stock assessment models. Particular effort should be dedicated to collecting available information from the major fisheries of the early years, especially EU-Italy fisheries. Such a project could be accomplished within one year and its cost is estimated to be up to €10,000.

Recommendations related to statistics

- Given that sometimes size data are reported at relatively low resolution (e.g., 5cm size classes) even when it is collected at higher resolution (e.g., 1cm), which may substantially impair the conversion of CAS to CAA, the Group recommended that size measurements are reported at the highest resolution available.

Other Recommendations for the Swordfish Species Group

- The Group recommended that preliminary work on the 2020 Mediterranean swordfish stock assessment is carried out in the September 2019 Species Group meeting. For example, a comparison between the previous XSA model used for advice and alternative models (e.g., production models, SS3) could be prepared as SCRS papers to be shown to the swordfish species group.

10. Adoption of the report and closure

The report was adopted during the meeting with the exception of **Appendix 5**, which was adopted by correspondence. The meeting was adjourned.

References

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Table 1[A/B/C]. Standard SCRS catalogues on statistics (Task-I and Task-II) of SWO by stock, major fishery (flag/gear combinations ranked by order of importance) and year (1988 to 2017). Only the most important fisheries (representing ±97.5% of Task-I total catch) are shown. For each data series, Task I (DSet= "t1", in t) is visualized against its equivalent Task II availability (DSet= "t2") scheme. The Task-II colour scheme, has a concatenation of characters ("a"= T2CE exists; "b"= T2SZ exists; "c"= T2CS exists) that represents the Task-II data availability in the ICCAT-DB. Scores obtained still preliminary.

Table #	Fishery	SCORE	Score type
A	SWO-N stock	7.62	score3
B	SWO-S stock	6.52	score3
C	SWO-M stock	3.85	score3

		Quartile
bad:	[0, 2.5[	1
poor:	[2.5, 5[	2
rasonable:	[5, 7.5[	3
good:	[7.5, 10[	4

LEGEND and color schemes used to show Task II (t2) availability

character	represents
a	t2ce
b	t2sz
c	t2cs

color scheme	t2 availability score

Table A. SWO-N stock

						T1 Total	19513	17250	15672	14934	15394	16738	15501	16872	15222	13025	12223	11622	11453	10011	9654	11442	12068	12373	11470	12302	11050	12081	11553	12523	13868	12069	10678	10673	10376	10142			
Species	Stock	Status	FlagName	GearGrp	DSet	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Rank	%	%cum
SWO	ATN	CP	EU.España	LL	t1	9600	5696	5736	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	1	39.6%	40%
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	ac	ac	1		
SWO	ATN	CP	U.S.A.	LL	t1	6020	5855	4967	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	1276	2	24.3%	64%
SWO	ATN	CP	U.S.A.	LL	t2	ab	ab	ab	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	2		
SWO	ATN	CP	Canada	LL	t1	874	1097	819	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	3	9.3%	73%
SWO	ATN	CP	Canada	LL	t2	ab	ab	ab	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	3		
SWO	ATN	CP	EU.Portugal	LL	t1	612	292	463	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	1171	1751	4	7.9%	81%
SWO	ATN	CP	EU.Portugal	LL	t2	ab	ab	ab	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	4		
SWO	ATN	CP	Japan	LL	t1	621	1572	1051	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	455	5	6.3%	87%
SWO	ATN	CP	Japan	LL	t2	abc	abc	abc	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	5		
SWO	ATN	CP	Maroc	LL	t1	195	219	24	92	41	27	7	28	35	239		35	38	264	154	223	255	325	333	229	428	720	963	700	700	1000	1000	800	800	750	6	2.7%	90%
SWO	ATN	CP	Maroc	LL	t2	-1	-1	-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	6		
SWO	ATN	NCC	Chinese Taipei	LL	t1	23	17	269	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	7	1.8%	92%
SWO	ATN	NCC	Chinese Taipei	LL	t2	ac	abc	abc	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	7		
SWO	ATN	CP	Canada	HP	t1	24	150	92	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	8	1.0%	93%
SWO	ATN	CP	Canada	HP	t2	ab	ab	ab	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	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	9	0.7%	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	9		
SWO	ATN	CP	EU.España	GN	t1	194	949	646	124	316	202	150		20																						10	0.7%	94%
SWO	ATN	CP	EU.España	GN	t2	ac	ac	ac	ab	-1	-1	-1		-1																						10		
SWO	ATN	CP	Trinidad and Tobago	LL	t1	42	79	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	11	0.6%	95%
SWO	ATN	CP	Trinidad and Tobago	LL	t2	-1	-1	-1	-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	11		

Table B. SWO-S stock

						1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Rank	%	%cum
			T1 Total			13172	17055	17304	13893	13813	16130	18958	21930	18289	18542	14027	15502	15728	15128	14104	12634	13081	13163	14245	15630	12546	12848	12698	11455	10686	9169	9956	10337	10658	10543			
SWO	ATS	CP	EU.España	LL	t1	4393	7725	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	1	41.8%	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	ac	ac	1		
SWO	ATS	CP	Brazil	LL	t1	1162	1168	1696	1312	2609	2013	1571	1970	1892	4100	3844	4721	4579	4075	2903	2917	2914	3780	4120	3892	3152	3132	2657	2800	2831	2381	2892	2594	2935	2406	2	20.1%	62%
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	ab	ab	ab	a	a	a	a	a	2		
SWO	ATS	CP	Japan	LL	t1	4453	4019	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	657	637	902	3	14.1%	76%
SWO	ATS	CP	Japan	LL	t2	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	ab	ab	ab	ab	ab	3		
SWO	ATS	NCC	Chinese Taipei	LL	t1	798	610	896	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	4	7.7%	84%
SWO	ATS	NCC	Chinese Taipei	LL	t2	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	ab	ab	ab	ab	ab	ab	ab	ab	ab	abc	abc	abc		4		
SWO	ATS	CP	Uruguay	LL	t1	427	414	302	156	210	260	165	499	644	760	889	650	713	789	768	850	1105	843	620	464	370	501	222	179	40	103					5	3.1%	87%
SWO	ATS	CP	Uruguay	LL	t2	a	a	a	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	6	2.1%	89%
SWO	ATS	CP	Namibia	LL	t2							a					a	-1	ab	a	-1	a	ab	ab	ab	ab	ab	ab	a	ab	a	a	a	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	7	1.9%	91%
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	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	8	1.4%	92%
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	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	9	1.1%	93%
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	9		
SWO	ATS	CP	Ghana	GN	t1	235	156	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	10	1.0%	94%
SWO	ATS	CP	Ghana	GN	t2	-1	-1	-1	-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	10		
SWO	ATS	CP	S. Tomé e Príncipe	TR	t1	216	207	181	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	1.0%	95%
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	-1	-1	-1	11		

Table C. SWO-M stock

						1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Rank	%	%cum
			T1 Total			20365	17762	16018	15746	14709	13265	16082	13015	12053	14693	14369	13699	15569	15006	12814	15694	14405	14622	14915	14227	12164	11840	13265	11450	9913	9096	9801	10751	10921	8402			
SWO	MED	CP	EU.Italy	LL	t1	2989	2989	2454	2470	3518	3260	3844	3035	2617	2458	2458	2680	2639	2236	1841	5844	5452	5560	5253	4564	4521	4687	5101	4579	3856	2848	3384	4213	3917	2974	1	26.6%	27%
SWO	MED	CP	EU.Italy	LL	t2	a	-1	b	ab	ab	b	ab	b	b	b	ab	b	ab	b	b	b	b	b	b	b	bc	abc	abc	abc	abc	abc	abc	abc	abc	abc	abc	1		
SWO	MED	CP	EU.Italy	GN	t1	1846	2542	4353	3142	4077	3070	3921	4264	2657	3632	3632	3632	4863	4152	1698	2540	1483	1891	2373	1948								0			2	15.2%	42%
SWO	MED	CP	EU.Italy	GN	t2	-1	-1	ab	ab	ab	ab	ab	b	b	b	b	b	ab	b	-1	b	b	b	b	-1								-1			2		
SWO	MED	CP	EU.España	LL	t1	1760	1250	1438	1132	790	1293	1402	1351	1040	1184	1409	867	1396	1402	1421	1165	930	860	1405	1648	2063	1994	1785	1730	1580	1605	2019	2289	1732	1487	3	10.7%	52%
SWO	MED	CP	EU.España	LL	t2	ac	ac	ac	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	3		
SWO	MED	CP	EU.Greece	LL	t1	1008	1120	1344	1904	1456	1568	2520	974	1237	750	1650	1520	1960	1730	1680	1230	1129	1424	1374	1907	989	1132	1494	1306	877	1731	1344	761	761	392	4	9.9%	62%
SWO	MED	CP	EU.Greece	LL	t2	ab	-1	ab	ab	ab	ab	ab	ab	-1	-1	ab	ab	ab	ab	b	a	a	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	ab	-1	ab	4		
SWO	MED	CP	Maroc	GN	t1			866	1186	1883	2068	2109	1518	2461	4653	2905	2979	2503	2266	2230	1629	1299	722	603	615	587	477	410	387							5	8.9%	71%
SWO	MED	CP	Maroc	GN	t2			-1	-1	-1	-1	b	-1	-1	-1	c	bc	abc	abc	b	b	b	b	b	b	abc	-1	abc	abc							5		
SWO	MED	CP	Maroc	LL	t1	62	97	371	508	807	517	527	169	273	245	323	259	205	754	1149	1670	1954	1801	1455	1107	1370	1110	1200	640	802	770	770	480	1110	1000	6	5.8%	77%
SWO	MED	CP	Maroc	LL	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	bc	abc	abc	abc	abc	abc	6		
SWO	MED	CP	EU.Italy	UN	t1	8175	7478	2294	2926				11					3								5	329		694	718		3	32			7	5.6%	83%
SWO	MED	CP	EU.Italy	UN	t2	-1	-1	-1	-1				-1					-1			b		b	b			-1	-1		-1	-1		bc	-1			7		
SWO	MED	CP	Tunisie	LL	t1	80	159	176	181	178	354	298	378	352	346	414	468	483	567	1138	285	791	791	949	1024	1011	1012	1016	1040	1038	1036	1030	1034	1007	1003	8	4.8%	88%
SWO	MED	CP	Tunisie	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	a	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	8		
SWO	MED	CP	Algerie	LL	t1	2621	590	173	173	6	173	185	247	247	247	178	126	166	439	347	238	174	93	496	492	802	468	459	192	356	384	549	558	666	550	9	3.0%	91%
SWO	MED	CP	Algerie	LL	t2	-1	-1	b		-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	a	a	-1	-1	ab	ab	ab	ab	ab	-1	-1	9		
SWO	MED	CP	EU.Malta	LL	t1	233	122	135	129	85	91	47	72	72	100	153	187	175	102	257	163	195	362	239	213	260	266	423	532	503	460	376	489	410	330	10	1.8%	92%
SWO	MED	CP	EU.Malta	LL	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	ac	ac	ac	-1	-1	-1	abc	bc	ab	abc	ab	ab	ab	abc	ab	abc	abc	abc	abc	10		
SWO	MED	CP	Turkey	GN	t1	589	209	243	100	136	292	533	306	320	350	450	230	370	360	300	274	317	341	337	352											11	1.6%	94%
SWO	MED	CP	Turkey	GN	t2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	ac	ac	ac	ac	c						11		
SWO	MED	CP	Algerie	GN	t1											590	531	599	642	467	427	233	311	87	108											12	1.0%	95%
SWO	MED	CP	Algerie	GN	t2											-1	-1	-1	-1	-1	-1	-1	-1	-1	-1											12		

Table 2. Swordfish final Task I nominal catches (t, landings and dead discards) by stock, major gear and year.

	SWO-N														SWO-S												SWO-M										
Year	BB	GN	HL	HP	LL	PS	RR	TL	TN	TP	TR	TW	UN	Total	BB	GN	HL	HS	LL	PS	RR	TR	TW	UN	Total	BB	GN	HL	HP	LL	PS	RR	TN	TP	TR	TW	UN	Total
1950				2201	1445									3646										100	100					586								586
1951				1615	966									2581										200	200					580								580
1952				2027	966									2993										200	200					337								337
1953				2100	1203									3303										200	200					501								501
1954				2729	305									3034										100	100					452								452
1955				2883	619									3502										100	100					340								340
1956				2984	374									3358					1						1					393								393
1957				3467	1010							1	100	4578					124					100	224					395								645
1958				3929	875								100	4904					92						92					414								914
1959				4704	1428								100	6232					71					100	171					401								601
1960				2786	1042									3828					359					100	459					403								515
1961				2321	2060									4381					816					200	1016					500								612
1962				2140	3202									5342					769						769					591								703
1963				997	9193									10190					1418						1418					498								722
1964	9			316	10833					100				11258					2030						2030					686								798
1965	6		179	622	7759					86				8652					2578						2578					1423				1			224	1760
1966	15			782	8503					49				9349					1952						1952					1192							224	1752
1967	11			394	8679					23				9107					1577						1577					869				1			336	1317
1968	12			145	8985					30				9172		100			2348						2448		115		194	2570				1			560	3440
1969	11			185	9003					4				9203		200			4281						4481		133		277	3313								3723
1970	8			83	9484					3				9578					5426						5426		99		249	2993								3341
1971	11				5243					12				5266	2				2164						2166		76		402	4496				1				4975
1972	21				4717					28				4766					2580						2580		60		513	5399				1				5973
1973	37				5929					8			100	6074					3078						3078		59		388	4362								4809
1974	92				6267					3				6362					2753						2753		15		462	4564				3				5043
1975	58				8778								3	8839					3062						3062		10		416	3888								4314
1976	32				6663								1	6696					2812						2812		7		312	4318								4637
1977	38				6370					1				6409		12			2840					3	2855		34		417	4838								5289
1978	17	8		656	11125	2						13	6	11827		5			2749	12					2766		20		756	5186						8		5970
1979		16	29	715	11177									11937		1			3265				28		3294		44		475	5200								5719
1980	15	25		676	12831								11	13558		113			5179				31		5323		13		501	6226								6740
1981	8	12		551	10549					1			59	11180		24			3938				9	4	3975		70		461	6450								6981
1982	7	3		148	13019								38	13215		80			6364				3		6447		40		356	6112								6508
1983	6	17		421	14023					4			56	14527		5			5307				7	83	5402		216		366	6313				1				6896
1984	7	23		94	12664					2			1	12791		111		1	8920				23	107	9162		1773			6749				5			5139	13666
1985	2	26	6	76	14240					5			28	14383		125			9224				3	234	9586		1961	1		6493				3		1	6833	15292
1986	0	52	7	104	18269	15				5			34	18486		63			4982				2	847	5894		2089			7505							7171	16765
1987	1	55	10	107	20026					6			33	20238		146			5797				2	85	6030		2568			8007							7745	18320
1988	4	314	5	55	18907	0				2			226	19513		266			12602			216	4	84	13172		2712			9476				2			8175	20365
1989	1	1475	8	182	15315	1				5			263	17250		189			16573			207	0	86	17055		3219			7065							7478	17762
1990	0	1206	10	100	14027	16				38		9	266	15672		186			16705			181		233	17304		5989			7184				12			2833	16018
1991	0	217	21	75	14448	5				8		42	118	14934		119			13496			179	5	93	13893		5026			7393				12			3315	15746
1992	2	408	51	61	14701	3				24		24	120	15394	1	108			13422			177	9	96	13813		6655			7631				2			421	14709
1993	3	310	49	28	16078	8				3		16	243	16738		163			15739		2	202	2	22	16130		5430			7377				4			454	13265
1994	5	296	21	24	15073	5				14		37	26	15501	0	96			17839		1	190		832	18958		6563			8985				18			516	16082
1995	4	149	23	190	16376	8	1			13		38	70	16872		151			21584		1	178	2	14	21930		6088			6319	0			11			597	13015
1996	7	451	0	94	14381	99	7			8	1	20	154	15222		190			17860			166	1	73	18289		5438		10	5884				4			717	12053
1997	4	39	1	90	12642	11	16			8	0	8	205	13025		73			18320			148	1		18542		8635		12	5389				5			652	14693
1998		444		241	11437	41	10			2	1	10	37	12223		131			13758			135		3	14027		7577		12	6674				4		57	45	14369
1999	3	220	5	18	11240	40	21			13	2	26	33	11622	356	150			14829			129	38		15502		7372			6223				3		52	49	13699
2000	13	158	9	95	11058	23	16			6	2	72	2	11453	18	137			15450	4		120	0		15728		8335		8	7129				3		51	42	15569
2001	1	266	9	129	9572	17	2			7		6	3	10011	144	550			14302			120	5	7	15128		7420			7498	4			6			78	15006
2002	3	73	12	41	9406	1	22			4		83	8	9654	7	391			13577			120	10		14104		4695			8042				2			75	12814
2003	1	114	23	147	10951	1	6	0		7	0	155	37	11442	4	777	3		11714			120	16		12634		4870		7	10748	2	2		6		0	58	15694
2004	3	83	24	88	11719	1	25			3	2	10	109	12068		395			12488			126	2	70	13081		3332	112	5	10886	45	2		2			20	14405
2005	10	16	40	193	11851		62				3	9	189	12373		96			12915			147	1	5	13163		3265	175	6	11067	56	2		5			46	14622
2006	2	7	38	204	11053		53			8	0	97	9	11470		73	1		13723			138		310	14245		3400	72		11339	47			1			56	14915
2007	0	11	129	267	11748	0	68			8	7	8	55	12302		82	1		15058			138		351	15630		3023	1		11132	22			1			48	14227
2008	0	6	97	258	10576		76		0	2	2	10	23	11050		336	11		11767			172		260	12546		587	0	23	11506	12			2			34	12164
2009	1	34	128	248	11590	0	32		0	4	1	36	9	12081		299			12106			188	2	253	12848		477	0		11020	2		0	3		4	333	11840
2010	0	19	129	177	11112	1	52			0	0	55	8	11553	9	158			12068			193	1	269	12698		411	1	921	11918	3		1	2		3	5	13265
2011	1	86	121	208	12003		54			5	0	36	9	12523	49	251	4		10908	0		60	0	184	11455		388	1		10288	3		0	3	0	24	744	11450
2012	0	63	231	98	13346		71			2	1	45	12	13868	63	120	1		10395	23		84		0	10686		0	2		9131	34		0	3		15	727	9913
2013	1	4	168	275	11543	0	22		0	1	0	40	15	12069		146	3		8958	1		60			9169		2	4		9047	13		1	1		24	5	9096
2014	0	9	151	233	10215	0	35				0	33	0	10678		81			9781	0		94	0		9956	0	3	3		9718	7		3	1	0	10	56	9801
2015	0	31	128	98	10288	0	46				1	81		10673		98			10089			145		5	10337		1	5		10673	19			1	8	12	32	10751
2016	0	19	228	85	9618		27			1	0	108	289	10376		61			10519			77			10658		0	4	7	10868	17		3	1	2	17	1	10921
2017		95	264	175	9356	3	34		0		1	92	120	10142		71	1		10406	1		65			10543			4	35	8345	11		2	0		4	0	8402

Table 3. SWO-M Task I catches (t) by decade and major gear, showing the ratio (%) of unclassified gear (UN) before and after the Group revision.

		Catch (t)												
T1NC data	Decade	BB	GN	HL	HP	LL	PS	RR	TL	TN	TP	TR	TW	UN	UN ratio(%)
before the revision	1950				950	3102									0%
	1960				224	6688						3		6407	48%
	1970				1960	25982						5	8	21935	44%
	1980		14227	1	1684	67912						11	1	44966	35%
	1990		64773		34	68755	0		109			75		9903	7%
	2000		27587	360	48	98768	190	6	51	0		31	4	14149	10%
	2010	0	805	235	963	79777	106			10		12	10	109	1571	2%
after the revision	1950		950			4399									0%
	1960		1479		471	12046						3		1344	8%
	1970		424		4390	45243						5	8		0%
	1980		14661	1	1684	70396						11	1	42541	32%
	1990		64773		34	69059	0					75	109	9599	7%
	2000		39404	360	48	100307	190	6		0		31	55	853	1%
	2010	0	805	25	963	79987	106			10		12	10	109	1571	2%

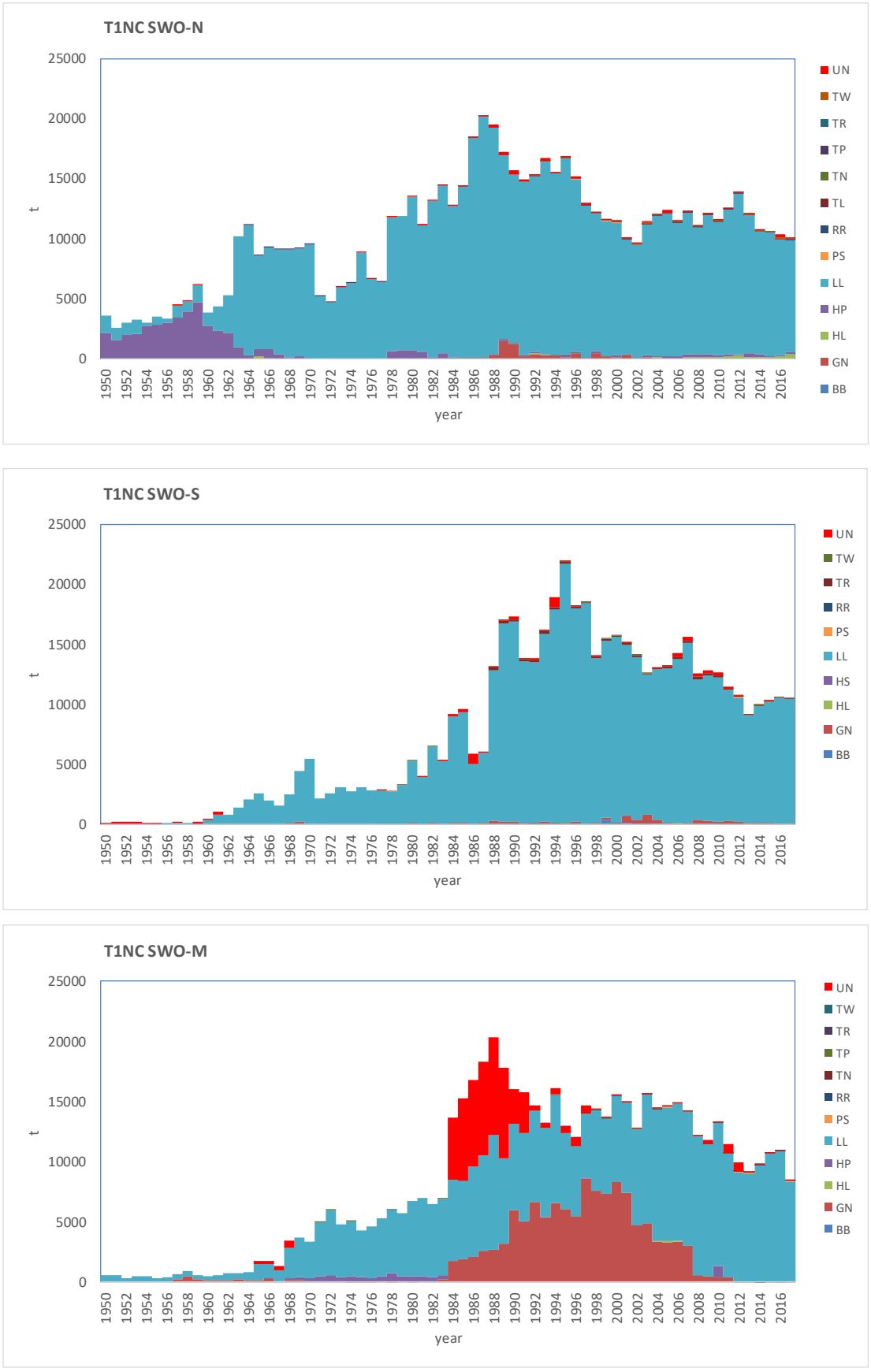

Figure 1. Swordfish Task I nominal catches (t) of each stock (SWO-N top, SWO-S centre, SWO-M bottom) by gear group and year. Unclassified gear series (UN, containing gears UNCL and SURF) are shown in "red".

Appendix 1

Agenda

1. Opening, adoption of agenda and meeting arrangements
2. Review of fishery statistics
   - 2.1. Task I (catches) data
   - 2.2. Task II (catch-effort and size samples) data
   - 2.3. Tagging data
3. Review of work done to date on Swordfish MSE
   - 3.1 Revision of the work conducted in 2018 by the contracted expert team
   - 3.2 Revision of any other work done in relation with North Atlantic SWO MSE
4. Further development of the MSE workplan and roadmap for ICCAT North Atlantic Swordfish MSE process
   - 4.1 Discussion on the process to finalize the reference set of OM and their conditioning
   - 4.2 Discussion on start testing of candidate management procedures
5. Progress on the Atlantic and Mediterranean Swordfish Project and other work related to the workplans
   - 5.1 Stock structure project, including biology and satellite tagging
   - 5.2 Size/sex distribution
   - 5.3 Length/weight relationships
   - 5.4 Fisheries indicators
6. Plan for the ongoing and future activities of the Atlantic and Mediterranean Swordfish Project
7. Data available for update of fisheries indicators for Mediterranean Swordfish
   - 7.1 Standardized CPUE
   - 7.2 Size structure
8. Other matters
9. Recommendations
10. Adoption of Report and Closure

Appendix 2

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Appendix 3

List of Papers and Presentations

Number	Title	Authors
SCRS/2019/019	Standardized catch rates for Mediterranean Swordfish (*Xiphias gladius*) from the Spanish longline fishery: 1988-2017	Saber S., Macías D., García S., Rioja P., Gómez-Vives M.J., and de Urbina J.O.
SCRS/2019/023	Review and preliminary analysis of size samples of Mediterranean swordfish (*Xiphias gladius*)	Ortiz M., and Palma C.
SCRS/2019/024	Nouvelles données de distribution de fréquence de taille de l'espadon *Xiphias gladius* obtenues le long de la côte Algérienne	Kouadri Krim A., and Bouhadja A.
SCRS/2019/025	Length-weight relationship, monthly size distributions of length and weight for swordfish (*Xiphias gladius* L.) caught by longliners in the Tyrrhenian Sea	Pignalosa P., Pappalardo L., Gioacchini G., and Carnevali O.
SCRS/2019/026	Length-weight relationships and size distributions of Mediterranean swordfish (*Xiphias gladius* L.) caught by longliners in the Mediterranean Sea	Pignalosa P., Pappalardo L., Gioacchini G., and Carnevali O.
SCRS/2019/027	Females reproductive biology of Mediterranean swordfish (*Xiphias gladius L.*): New insights from a multidisciplinary study	Gioacchini G., Pappalardo L., Pignalosa P., and Carnevali O.
SCRS/2019/030	An update of the Moroccan longline fishery targeting swordfish (*Xiphias gladius*) in the southern Atlantic coasts	Ikkiss A., Baibbat S.A., and Abid N.
SCRS/2019/031	Updated Swordfish (*Xiphias gladius*) fishery statistics collected from artisanal fishers in Côte d'Ivoire (1984 - 2012)	Bahou L., Amandé M.J., Konan K.J., and Diaha N.C.
SCRS/2019/032	Final report of the ICCAT short-term contract: Modelling approaches: support to ICCAT north Atlantic swordfish MSE process	Kell L., and Levontin P.

SCRS/P/2019/004	New information on the reproductive biology of swordfish in the Strait of Gibraltar	Abid N., Laglaoui A., Arakrak A. and Bakkali M.
SCRS/P/2019/005	Effects of Mediterranean swordfish size regulations on discards of Spanish longline fishery	García-Barcelona S., Ortiz de Urbina J.M., and Macías D.
SCRS/P/2019/006	Progress Towards a Swordfish Species Distribution Model Based on Habitat: A Work in Progress	Schirripa M. J., Forrestal, F., and Goodyear, C. P.
SCRS/P/2019/007	Update on biological sampling of Atlantic and Mediterranean swordfish	Gillespie K., and Hanke A.
SCRS/P/2019/008	Swordfish depth and temperature utilization and summary of Cooperative Tagging Center data	Orbesen E.

Appendix 4

SCRS Document and Presentations Abstracts as provided by the authors

SCRS/2019/019 - Standardized relative abundance indices for swordfish (*Xiphias gladius* Linnaeus, 1758) caught by the Spanish surface longline in the western Mediterranean Sea were estimated for the period 1988-2017. Standardized CPUEs were estimated through a General Linear Mixed Modelling (GLMM) approach under a negative binomial (NB) error distribution assumption. The main factors in the standardization analysis were fishing area and time of the year (quarter). The standardized index showed notable annual fluctuations without any definite trend for the period under study.

SCRS/2019/023 – Size sampling data of Mediterranean swordfish was reviewed, and preliminary analyses performed for its use within the stock evaluation models. Size data is normally submitted to the Secretariat by CPCs under the Task II requirements; optionally CPCs can submit Catch at Size, size samples or both for the major fisheries. The size samples data was revised, standardized and aggregated to size frequencies samples by main gear type, year and quarter. Preliminary analyses indicated a minimum number of XX fish measured per size frequency sample. For the Mediterranean stock, the size sampling proportion among the major fishing gears is consistent with the proportion of the catch since 1990; in general longline fisheries are well sampled compared to other fisheries. The number of fish measured has increased substantially in the last decades for the Mediterranean fisheries; however precision of measurements reported has been low which may substantially impaired the conversion of CAS to CAA.

SCRS/2019/024 – L'Algérie faisant face aux nouvelles mesures de gestion a renforcé le suivi des activités de pêche de la flottille palangrière artisanale ciblant l'espadon le dispositif d'échantillonnage de collecte de données de taille (LJFL) et de poids (We) mis en place permet d'avoir des informations quotidiennes qui sont compilées et transmises aux fins de traitement et d'analyse. L'instauration de quota, et d'une nouvelle période de fermeture de la pêche à l'espadon permettra de nous renseigner sur l'évolution ou la composition des captures en terme de taille et de poids. Le nombre d'individus échantillonné est de 476 individus , dont la taille LJFL oscille entre 85cm et 250cm, capturés débarqués dans les ports désignés à cet effet . Ce travail donne une nouvelle distribution de fréquence de taille et une relation taille poids actualisant les résultats obtenus avant l'évaluation de 2016.

SCRS/2019/025 – The current study presents length-weight relationship and the monthly size distributions of length and weight classes for Mediterranean swordfish caught by Italian longline fishery operating in the Tyrrhenian Sea. The measurements collected on length and weight were obtained from 3.162 specimens sampled during the period from April to December 2018. This study, intended as pilot project, was carried out in the port of Porticello (Palermo-Santa Flavia), as part of the National Observation and Monitoring Programme 2018. The length-weight relationship parameters were obtained from the Lower Jaw Fork Length (LJFL) and Round Weight (RWT). The length-weight equation obtained in this study is as follow and shows a good-quality correlation index of the estimates: $WT=9E\text{-}06*LJFL^{3,0853}$ (R^2 = 0,9012). The authors intend to show that a wide range of swordfish catches is included between 100-140 cm indicating that the fishing effort has a significant impact on juvenile specimens. These results provide accurate information on swordfish catches in order to improve the data available for stock assessment studies and sustainable management of resources.

SCRS/2019/026 – A total of 2.134 swordfish were collected from Mediterranean Sea during the sampling activity concerning the National Observation and Monitoring Programme 2018. This work presents a lenght-weight relationships and the monthly size distributions of length and weight classes for the swordfish caught by Italian longline fishery. The length-weight relationships parameters were obtained from the Lower Jaw Fork Length (LJFL) and Round Weight (RWT). In this study a new equation obtained from data collected during the fishing season 2018 was determined (1) and a last combined L-W equation applicable to the Mediterranean swordfish is also provided (2). The equations obtained in this study are as follow: 1) $RWT = 5E\text{-}06*LJF^{3,2024}$ (R^2 = 0,9477) and 29 $RWT = 7E\text{-}06*LJF^{3,1213}$ (R^2 = 0,9152). The authors intend to show that a wide range of swordfish (juveniles) catches is included between 100-140 cm. In addition, a better statistics value of the swordfish catches was obtained when comparing the data observed in the present study with the results obtained in the similar study carried out in Porticello for the 2018.

SCRS/2019/027 – A multidisciplinary approach which include histological, macromolecular and molecular assays, is of great importance to fully understand a complex process such as the reproductive biology of swordfish (*Xiphias gladius* L.). Accordingly, the optimization of reliable protocols for the collection of biological samples, intended for the different analytical tools, is a mandatory step considering the logistic constraints associated with on board sampling procedures. In this study have been optimized three analytical tools to assess reproductive status of Mediterranean swordfish: histological assay; FTIR microspectroscopy and transcriptomic analysis. The histological approach, based on the presence of specific characteristic structures, let us classify the ovary maturation in the following developmental stages: "immature","developing","spawning","regressing" and "regenerating". The use of the FTIR microspectros-copy provided information about the macromolecular composition of the oocytes at different developmental stages, providing specific chemical map for each class of oocyte. Finally, by the de-novo transcriptome assembly approach, the molecular dynamics governing ovarian maturation were elucidated and molecular biomarkers of swordfish reproduction were identified. For each analytical tool, the protocol for samples collection was optimized and adapted to difficulties of on-board sampling procedures.

SCRS/2019/030 – This document presents an update of the biological data and fishery's indicators for the Swordfish targeted by the Moroccan longline fleet in the south of the Moroccan Atlantic waters for the period 2003-2018. In total, 1557 trips were carried out by this fleet during the same period. The annual mean size for swordfish ranged between 59 and 277 cm LJ-FL, with an average size of 137 cm. The mean size of fish and the CPUE have shown an increasing trend from 2003 to 2018.

SCRS/2019/031 – The multispecies artisanal fishery operating with canoes in continental shelf waters of Côte d'Ivoire has been fishing for years for various target fishes. Here, updated information is presented on this gillnet fishery concerning the data on swordfish caught from 1984 to 2012. The data are about the swordfish specimens that were thus counted and measured at three main landing sites in Côte d'Ivoire. These sites are located in Abidjan, San Pédro and Sassandra. The statistics from these sites have been combined to meet accuracy and for national fishery statistics purposes. Evolution on catches and fish size for these years is included. Overall, yields vary from 12 t to 60 t, and the specimens caught range in size from 40 to 320 cm. Results show that the yield obtained from 1994 to 2003 remains higher as a result of heavy catches of swordfish within this decade. This decade cumulated approximately 48% of the total number of swordfish caught from 1984 to 2012. In addition, the 1994-2003 decade cumulated 44% of the total yield obtained from 1984 to 2012. Although no clear trends are observed, evidence is given of the yearly variation in yield.

SCRS/2019/032 – Management Strategy Evaluation was conducted for North Atlantic swordfish using an Operating Model (OM) conditioned using Stock Synthesis. A generic procedure for model validation and a shiny-app to visualise risk and uncertainty were developed. Residual runs test showed that the indices of abundance were in conflict, which may be due to model misspecification. Problems with the residuals from the fits to the indices also mean that it will be difficult to simulate psuedo data in the Observation Error Model to evaluate alternative Management Procedure. A hindcast (a forecast made retrospectively) identified that the assessment used to condition the OM has poor prediction skill. Although the OM itself does not have to predict the future state of the stock it should be representative of the main uncertainties in resource dynamics. A potential problem was that although the implied values of r and K were within plausible ranges the OM production function was highly skewed and hence BMSY could be below the limit reference point (Blim). This behaviour is mainly determined by parameters that are fixed (i.e. M and steepness), and has major implications for the assessment of the risk posed to the stock by harvesting.

SCRS/P/2019/004 – During the period from April to September for the years 2014–2016, 998 swordfishes caught by the Moroccan artisanal longline fishery in the Strait of Gibraltar were sampled to study the reproduction of this species in this mixing area between the Mediterranean Sea and the North Atlantic. The results showed that the sex ratio is slightly in favour of males for sizes smaller than 130 cm LJFL (Lower jaw-fork length), whereas females are more numerous in sizes larger than 140 cm LJFL. Fifty per cent (50%) of females were estimated to be mature at 170 cm LJFL, while for males, the size at first maturity was estimated to be 95 cm LJFL. The swordfish spawn from June to September, probably in the Mediterranean Sea. The findings of this study suggest that in general the reproductive characteristics of swordfish caught in the Strait of Gibraltar are similar to those of the Mediterranean swordfish, and a high mixing rate between the Mediterranean and the North Atlantic stocks occurs in the study area.

SCRS/P/2019/005 – Spanish Mediterranean fishery targeting swordfish consist of mainly two gears: The traditional longline (LLHB) and the mesopelagic longline (LLSP). In addition, lesser amount of swordfish is bycaught by other longlines targeting other tuna species. In 2017 a recovery plan for Mediterranean swordfish was implemented and, among other management measures, increased the minimum catch size from 90 to 100 cm LJFL. The main aim of this presentation is to analyse the effect of this change of minimum catch size in the discard and yield of the fishery. Swordfish caught by LLHB has a mean size of 95 cm LJFL without important differences among quarters. Swordfish caught by LLSP has an average size of 120 cm LJFL and the sizes decrease importantly after summer. Regarding discards, LLHB increased its discards rates in weight from 6% to 30% and LLSP from 1.3 to 9.1% after the change of regulation. Yields drop from 169 kg.10-3 in 2105 to 107 kg. 10-3 in 2017. This decrement could be attributed partially to the increase of discards, but also to the quotas not fully spent. In summary, the change of minimum catch size from 90 to 100 cm LJFL produce a high percentage of fish likely die that are discarded at sea not becoming part of the quota. The effort applied is higher than in the previous years and the fishing season extends to reach the quota. The increase in fishing effort and season affect to the profitability of the fishery without benefits on fish mortality. Finally, underreporting of discards affects importantly to the abundance indices used in assessments.

SCRS/P/2019/006 – This study develops a species distribution model (SDM) for swordfish using a habitat suitability framework. When suitably parameterized, the model is intended to estimate the time-varying, three dimensional (3D) distribution of swordfish habitat that would be useful for many aspects of stock assessment, including visualizing stock boundaries and estimating abundance from catch per unit effort (CPUE) data. Currently, the model integrates ocean depth, annual average estimated total chlorophyll by latitude and longitude, and temperature and oxygen by latitude, longitude, depth, month and year. Model predictions and general distributions of North Atlantic swordfish catches are used as criteria for the inclusion and treatment of variables. Initial trials demonstrated that the habitat cannot be predicted using temperature and oxygen alone. The inclusion of the spatial annual average productivity via chlorophyll markedly improved distribution predictions. The current formulation predicts the north-south seasonal migration in the North Atlantic but also predicts high abundance in areas of low swordfish catch. Better, time- varying data for ecosystem productivity relevant to swordfish might resolve this problem, but important habitat features may also be missing.

SCRS/P/2019/007 – This presentation provided an overview of biological data collected in an Atlantic and Mediterranean swordfish sampling program. The program was initiated in 2018 by Swordfish Species Working Group with the aim of collecting data critical for addressing unknowns in the growth and reproductive biology of ICCAT's three swordfish stocks as well as the stock boundaries and their mixing rates. An initial analysis of size structure, sex composition, and spatial and temporal sample coverage indicates some differences between stocks but the authors note that sampling gaps in several ocean areas require increased sampling participation from ICCAT members. The presentation also suggested next steps for sampling and sample analysis, particularly for aging, reproduction and genetics studies.

SCRS/P/2019/008 – This presentation provided a brief overview of the highly migratory species tagging efforts under the Cooperative Tagging program (CTP) administered by the United States NOAA Fisheries at the Southeast Fisheries Science Center (SEFSC) in Miami, Florida, with focus on SWO release and recapture locations, as well as providing some detailed results from SEFSC electronic tagging of SWO and ongoing collaborations. Through the CTP, 11,305 SWO have been tagged, with 459 reported recaptures. The SEFSC tagged 20 SWO with Pop-up Satellite Archival Tags (PSATs) during 2013-2018 of the South-eastern Florida Coast and between Cuba and Hispaniola. Detailed results are provided for one of these tags, recovered after 120 days at large, for which the depth, temperature, and light level observations collected every 10 seconds were available. These data showed that this fish tended to spend most of the time at night within 120 m of the surface, in waters that tended to be between 20o and 30o C, while occasionally diving to deeper depths (300m or more). During the day, although the fish still spent some time at or very near the surface (presumably basking), most of the time the fish was at depths of around 300-600m, with temperatures between 6o (or lower) and 9^{0}C. Depth profile information presented showed vertical movements consistent with a hypothesis that the fish spent night-time hours near the surface (where it was potentially available to the local fishery), then followed the slope contour off the shelf break down to deeper waters during the day (with excursions to the surface), before returning with a similar depth profile to shallower waters as the day turned into night. Some initial results were presented for a U.S.-Portugal collaboration for tags deployed around 5o N and the Equator. Also shown were the deployment locations for electronic tags which provided data for a U.S./Canada/Spain/Portugal

collaboration to parameterize a longline fishery simulation model, intend to reflect the spatio-temporal interactions of the gear with highly migratory species, taking into account the depth-temperature habitat preferences of the species.

Appendix 5

The Group Review of the North Atlantic swordfish MSE Process: SCRS/2019/032

After the presentation of the work done by the contractors (Kell and Levontin, 2019: SCRS/2019/032), the Swordfish Species Group (referred to as Group for now on) acknowledged that there was not enough time to closely review of the report. It was decided to create a small study group to provide a more detailed review, which will be attached as an Appendix to the 2019 SWO intersessional meeting report.

1. Timeline of the progress of Swordfish MSE work
   i) The Group noted that the outline to start developing the North Atlantic Swordfish MSE was addressed during the intersessional meeting of the Group in April 2018. The contractor was not present due to the delay of the process for the contract.
   ii) The Secretariat consulted with the SCRS Chair, the Group Chair and some members of the Group, and a Contract was awarded to Sea Plus Plus (Dr. Kell).
   iii) The Group met in September 2018 at the Species Group meeting and received two SCRS documents provided by the Contractor (SCRS/2018/166 and SCRS/2018/167). The Group acknowledged the contractor's efforts to initiate the work and observed that the progress and tentative outcomes by the Contractor were insufficient to justify the direction and concrete contents of the progress report by the contractor at that time. For example, generic concepts and components of the MSE were taken into consideration, but species, area, and stock specific information and specifications, as defined in the Group 2018 April meeting (see point 1 above), were not adequately incorporated.
   iv) The Group had to reschedule the original plan developed in April 2018. It was decided to reduce the number of models by considering only some example sources of uncertainties in order to ensure the outcomes of the MSE work by the Contractor in 3 months, by the end of the contract in December 2018.
   v) The draft report of the contract was submitted as scheduled, on 30 November 2018. A final report was also submitted on time on 15 December 2018. However, this final report was considered to still have many errors that need to be corrected for the actual final version (e.g., figures and tables not reference in the text, etc), and was therefore subject to further requests for revisions by the previous SCRS Chair, the Group Chair and the Secretariat. There were several requests for revision, made during January and February 2019.
   vi) A version close to the final and already including some corrections was circulated by e-mail in early February 2019 to the participants of the 2018 SWO Group meeting. As there is not a generic and comprehensive "SWO Species mailing list", the participants in the 2018 meeting (e-mails in the participants list) was the strategy chosen to circulate the document to what was believed to reflect the participants in the SWO Group.
   vii) A final report was then provided by the contractor on the 23 February 2019.
   viii) This final report, further revised as mentioned above, was shared with the participants of the 2019 Swordfish intersessional meeting at the beginning of the meeting, specifically on the 25 February 2019.
   ix) The Group tried to review the final report and the associated outcomes during the intersessional meeting in February 2019 (25 to 28 February). However, time was limited, and it was not possible to complete that task during the meeting. As such, the Group decided to give an opportunity to a small study group to review the overall outcomes because of the limited time during the meeting.

2. Review of the process of communicating the Final Report to the Species Group (Group)

2.1. Was the report provided on time, of professional quality and free from major errors?

The final report was submitted on time before the end of the contract. However, given the consideration of the time spent for the logical check and improvement of the materials submitted by the Contractor, it was explicitly needed to have an enough room to accomplish the final report and check the associated materials before the end of the contract. Based on the time spent for checking and clearing all the materials informed, it was suggested that the quality of the outcomes by the contractor did not reach to the full professional level and the qualitative and quantitative level of errors were significantly high. These issues were caused by the delay of work progress directly, and the delay of work progress might invite a negative spiral of delay, which might be caused by the lack of well-communication among the people involved. It is necessary to have a well-communicated structure particularly to ensure the achievement of the contracted subjects.

2.2. Did the overall work adhere the agreed upon design?

The final report for the contract generally suits the design requested by the Group in September 2018, modified from the initial design developed in April 2018 for the practical purpose to accomplish the Contractor's work by the end of the contract, typically in the combination of uncertainties incorporated into OM conditionings. However, the Group was not well-informed whether the work done by the Contractor for the time being performs well or not because a kind of negative chain reaction of delay occurred due to the delay of work progress and consequently overall work did not entirely adhere the agreed upon design which was initially decided at the Group meeting for MSE work in April 2018. Namely, a poor communication among the people involved forced the Group into making modification to reduce item numbers, for example the specifications for OM conditionings, and simplification of the whole work design from the initial design, and the diminution of the final outcomes from the work expected initially was concluded. This indicates the first milestone of the work was completed, but more works will be needed to complete the project.

2.3. Was all work made easily accessible on a common website, transparent and easy to reproduce?

All work did not fully make easily accessible on common website, and the extents of the transparent and well-understandable framework on the MSE provided by the contractor were quite limited. The structure of the final report by the Contractor did not illustrate the clear work flow and it seemed to be unclear for outside readers. For example, the structure of the input files was complex and not easy to understand that might be caused by the way of concrete construction, and the "GitHub" private website was known only to a few professionals, not common to the outside people, and it has an access limitation with complex structure. Even if we use these systems with the above prerequisite conditions, specific instructions will be necessary for users to access and understand easily. However, for example, the "readme" text as an instruction manual was too simplistic and not user-friendly. These situations make it extremely difficult to reproduce the materials by users.

2.4. Where all deliverables delivered?

All deliverables were not fully delivered to the Group properly on time. The report for the contract was submitted on time before the end of the contract, but it took nearly 3 months to finalize the report. The semi-final report was shared through emails which did not cover whole participants at the 2019 February meeting, as it was sent to the participants of the 2018 SWO meeting, using the participants contact information available from the 2018 SWO report. The final report was only available to all members at the 2019 February meeting just after the meeting started. This fact made difficult for the Group to check whether all deliverables were properly delivered to the Group or not. In addition to the above, a summary report only was provided to the Group and it is difficult to evaluate including the nine OMs test run for the Group during the meeting.

3. Review of the technical (OM) aspects of the Final Report and Deliverables

The Contractor work used the 2017 stock assessment model base case Stock Synthesis (SS) configuration to create an additional eight operating models. The work presents model fitting diagnostics in order to evaluate the reliability of the OMs for their use in the NSWO MSE. The work focuses mostly on model diagnostics of the OMs rather than subsequent MSE evaluation. Much of the text is general and background to MSE and is at times quite brief on the details of interpreting the results of the actual work completed.

The Contractor noted that the lack-of-fit to the data is mostly attributable to model misspecification with little to no mention of the contribution from data observation error. This is not necessarily consistent with the fact that both the SS (fully integrated) and the JABBA (Bayesian surplus production) models used for the 2017 assessment arrived at very similar estimates of stock status and yield at MSY in 2016, as well as those estimates from past assessments using the ASPIC (stock production) model. Assessment models not fitting the available data well is a feature common to all ICCAT assessment effort and should be considered as part of the overall uncertainty of the MSE process. The author seems to be concluding that since the OMs do not fit the data as well as we would like, these cannot be used for a reliable MSE. But both process and observation are part of the overall uncertainty of the assessment process.

1) For this work to be reproducible, the nine SS input files should be made available on the Git-hub site. If there are specific issues related with data storage limitations at github (e.g., limits in file sizes) then those files should alternatively be stored by the Secretariat. Additionally, a road map, containing which folders/files is in use for each analysis, should be available, so that any can reproduce the analysis with the same steps as the authors.
2) The Final Report did not contain enough detail to be able to independently reproduce several of the OMs. For instance, although steepness was one of the major axis of uncertainty, the values used were not explicitly reported. Exactly how selectivity domed-shaped or logistic was achieved was also not explained (i.e. parameterization).
3) The rounding of the values related to Virgin and BMSY (Table 6) to the nearest 1000 made for very imprecise interpretations and comparisons and validations, more precise numbers should be reported
4) Examination of the control file for OM 9 ("down weighted length compositions (0.1)") shows that, rather than down weighting the lengths via the effective sample size (as was agreed in the Species Group meeting in September 2018), they were down weighted by decreasing the lambda on the length compositions from 1.0 to 0.1. This could have been an alternative to variance re-weighting shortcut; however these are two entirely different methods that give entirely different results. Furthermore, at the same time the length lambdas were decreased to 0.1, the author also decreased all abundance indices lambdas and parameter priors were also decreased from 1.0 to 0.1. Therefore, both the lambdas on length composition and the abundance indices were down-weighted. Any data component not specified in the list remained at the default lambda of 1.0. The data sources utilized and remaining at the default lambda of 1.0 included mean weights, catch, initial equilibrium catch, and recruitment deviations. In summary, this OM is in error, the configuration needs to be corrected and the OM re-run before any conclusions can be made.
5) The final report by the Contractor claims that the OM performed poorly with regard to a retrospective analysis (page 20). However, the OM used to exemplify this performance was OM 9 (Table 7). This is the OM that was improperly configured as mentioned above. Contrary to this report finding, a presentation from the 2017 SWO assessment meeting (SCRS/P/2017/023, slide 32) showed the lack of any retrospective pattern for the base model even when dropping the last 8 years. As this is a basis of concern in the report this contrast should be investigated.

6) Despite the user defined value of "final convergence criteria" standard of 0.0001, the use of this value as a strict cutoff for "good" versus "poor" convergence is not appropriate (Table 8). To suggest that 1.4E-04 is "poor" while 1.0E-04 is "good" over emphasizes a trivial difference. In fact, it is easily argued that all gradient values in Table 3 are very satisfactory. The inversion of Hessian is a far better indicator of satisfactory convergence.
7) The final conclusion of the abstract is confusing:
A potential problem was that although the implied values of r and K were within plausible ranges the OM production function was highly skewed and hence BMSY could be below the limit reference point (Blim). This behaviour is mainly determined by parameters that are fixed (i.e. M and steepness) and has major implications for the assessment of the risk posed to the stock by harvesting.
The way the first sentence reads it is not at all clear what it is intended to convey. If the limit reference point (Blim) is at B/BMSY = 0.40 then it is nonsensical to suggest that it can be less than BMSY. Given the suggested importance of this conclusion, the author should be much clearer as to the intended consequences of this statement. Regarding the values of BMSY /B0 being low, the range of values in Table 6 are not so different from those from the swordfish assessments in the western Pacific (0.16) and those in the Indian Ocean (0.238).

Overall the technical aspects have one major error (OM 9), one important conclusion that needs clarification or justification, and more details concerning the methods so that it can be duplicated by reading the report.

4. Shiny app evaluation

Shiny Application aim

To explore the results from simulation testing of alternative Management Procedures for a range of Operating Models that represents uncertainty about resource dynamics with particular emphasis in communicating the MSE process in a succinct and visual form.

Technical

- Hosted at \verb|shinyapps.io| (www.shinyapps.io), RStudio hosting service for Shiny apps.
- The application is hosted at its own \verb|URL|:
- https://pl202.shinyapps.io/Swordfish_MSE_Vis/, users can visit the app.
- Comprehensive information (including the R code necessary to turn the raw MSE results into the graphs and tables shown in the app.) at:
http://rpubs.com/pl202/Documentation_NATL_Swordfish_app.

Application content

The application is structured in four main panels:

- UNCERTAINTY: By means of an infographic approach, it is depicted the general context of uncertainty out of which various scenarios for testing management procedures are usually constructed. The modelled sources of uncertainty (five in the current version) are highlighted by solid colours in the image and by bold text in the key.
- RELIABILITY: Shows a visual key that qualitatively addresses main concerns such as model inputs in terms of data and knowledge, as well as a qualitative key for model validation results.
- RESULTS: Summary of simulation results by means of a table giving an overview of the performance of all management procedures according to several performance metrics (four in the current version) under all the operating models. The comparison between the base case OM and a selected scenario is also implemented.
- TRAJECTORIES: In order to communicate volatility over time, shows dynamic realizations of individual trajectories of catches and biomass for the base case OM and a given Management Procedure.

Performance metrics currently implemented in the app.

- Kobe Green: probability that in the future the stock will be in the green Kobe quadrant (SSB is above SSB_MSY and F is below F_MSY).
- Catch: probability that catch is above 80\% of $Catch_{MSY}$.
- Safety: probability that the stock is above the LRP (>20 % SSB_Virgin).
- Stability: which is represented by proximity to a 100 % or by [100\% - coefficient of variation (CV)], to make all measures comparable (ideally all measures should be close to a 100 %).

Evaluation

- Overall, the application fits the purpose for which it is designed. It is informative, accessible and user-friendly.
- The content and expected results are properly documented in the app. (In addition, more detailed information is provided in an external link).
- From the point of view of functionality, all links work as expected (no broken links).
- From the point of view of usability, the site is easy to navigate, instructions provided are clear and satisfy its purpose.

Further development

- Inclusion of more detailed information on the tested sources of uncertainty implemented in the MSE process. An additional panel with the definition of the tested scenarios including the actual values of the parameters.

- Without prejudice to the simplicity in communicating the results, inclusion of alternative performance metrics as well as graphics for comparison between scenarios.