

REPORT OF THE 2021 ICCAT INTERSESSIONAL MEETING OF THE SWORDFISH SPECIES GROUP

(Online, 31 May - 7 June 2021)

“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

Due to the outbreak of Coronavirus (COVID-19) the meeting was held online from 31 May to 7 June 2021. Dr. Rui Coelho (EU-Portugal), the Swordfish Species Group (“the Group”) coordinator and Dr. Kyle Gillespie (Canada) northern Atlantic Swordfish rapporteur Chaired the meeting. Dr. Gillespie opened the meeting and welcomed participants. Mr. Camille Manel (ICCAT Executive Secretary) welcomed the participants and thanked the efforts made to remotely attend the meeting.

The Secretariat provided information on how to use the on-line ZOOM platform for the meeting. The Chairs reviewed the Agenda, which was adopted with minor changes (**Appendix 1**).

The List of Participants is included in **Appendix 2**. The List of Documents and Presentations provided to 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, 9	M. Neves dos Santos
Item 2	C. Palma, C. Mayor, J. Garcia
Item 3	A. Hordyk, K. Gillespie
Item 4.1	R. Coelho, K. Gillespie
Item 4.2	A. Hordyk
Item 4.3	M. Schirripa, D. Rosa
Item 4.4	N. Taylor
Item 4.5	A. Hordyk, A. Hanke
Item 4.6	C. Brown
Item 5.1, 5.6, 5.7	K. Gillespie
Item 5.2	D. Rosa
Item 5.3	N. Bezerra, F. Arocha
Item 5.4	G. Gioacchini, O. Carnevali
Item 5.5	A. Hanke, D. Rosa
Item 5.8	R. Coelho
Item 6	R. Coelho, K. Gillespie
Item 7	R. Coelho, K. Gillespie, M. Neves dos Santos
Item 8	D. Parker, M. Neves dos Santos

2. Review of fishery statistics

The Group reviewed the most up-to-date swordfish (SWO) fishery statistics (T1NC: Task 1 nominal catches; T2CE: Task 2 catch & effort; T2SZ: Task 2 size frequencies; T2CS: Task 2 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 presented individually. **Tables 1 A/B/C**, are the corresponding SCRS catalogues on fisheries data availability for the period 1990-2019 (2020 statistics still preliminary).

2.1 Task 1 (nominal catches) data

For the three swordfish stocks (SWO-N, SWO-S, and SWO-M) only minor revisions were made to the most recent years when compared to the corresponding SWO statistics adopted at the 2020 SCRS annual meeting. In line with the work done with other ICCAT species, the Secretariat continues its progressive work aiming to eliminate the SWO catches with unclassified gears (UNCL and SURF) by reclassifying them with the correct gear, and also with the elimination of historical LL gear codes discontinued by the SCRS (LLHB, LLFB, LLMB) by reclassifying them into the new LL codes (LLSWO, LL-surf, etc.). No gap completion analyses has been made this time to the current T1NC on the three stocks. The Group adopted the SWO Task 1 catches presented by the Secretariat and discussed the need for future dissemination of T1NC information with both the positive catches and the “0” catches (whenever available discriminated by catch type: landings, dead discards, live releases) reported by ICCAT CPCs and recorded in the ICCAT database system (ICCAT-DB; see recommendations in section 7 of this report).

The Group observed again that the SWO discards (both dead and alive) reported by the ICCAT CPCs are still very incomplete despite being mandatory. The lack of reported discards underestimates the total removals of each SWO stock per year, which may have negative impacts on the stock assessment process (e.g.: wrong perception of stock status). Despite this outcome, the Group strongly recommends that both dead and live discards be estimated by each CPC and reported to ICCAT for new and historical catch records.

Table 2 presents the final SWO T1NC estimations by stock/gear group and year. **Figure 1** presents the T1NC estimations by gear group and year for the three swordfish stocks.

SWO-N (North Atlantic swordfish stock)

After the large reclassification made by this Group in 2020 (Anon, 2020) the unclassified gear group (gears “UNCL”, “SURF”) for SWO-N only represents about 0.1% of the total catches between 1950 and 2019 (**Table 2**), where longline accounts for more than 90% of the total catches.

SWO-S (South Atlantic swordfish stock)

The situation is similar the SWO-S stock in terms of unclassified gears, with gears “UNCL” and “SURF” being less than 0.6% of the total catches between 1950 and 2019 (**Table 2**). The longline catches represent more than 95% of the total catches.

SWO-M (Mediterranean Sea swordfish stock)

After the large revision made during 2020 (Anon, 2020) by this Group, the unclassified gears (“UNCL”, “SURF”) has been reduced to less than 1% of the total catches between 1950 and 2019 (**Table 2**). The total catches are mostly attributed to longlines (64% of the total) and gillnets (34% of the total). The gillnet catch series are residual since 2011.

Some important SWO-M catch series for which the Group could not find a proper solution (requests pending from 2020), and no progress was made over this year, are:

- EU-Spain UNCL catches between 1992 and 2007 could contain GILL (a fraction only). This gear reallocation requires the participation of Spanish scientists.
- 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 continue to make efforts to address and solve these problems in the future.

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

As shown in the swordfish SCRS catalogues (**Tables 1A, B and C**) both Atlantic stocks are reasonably well covered in the last 30 years (1990-2019) in terms of Task 2 coverage, with the SWO-N (score = 7.9) in a slight better shape than SWO-S (score = 7.0). The Mediterranean stock (SWO-M) is in a comparable worst shape (score = 4.4). The ICCAT standard scorecard adopted by the SCRS in 2019 with all the species and stocks (**Table 3**) allows to compare three-time scales (10, 20 and 30 years) among all ICCAT managed species/stocks.

Important gaps in both T2CE and T2SZ still exists. As for other ICCAT species, the Secretariat has in place since 2014, a long-term project aiming to (a) recover missing Task 2 datasets, and to, (b) improve the level of Task 2 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.

Three documents were presented on fisheries statistics:

SCRS/2021/017 presents the problem created by the collection of curved LJFL in SWO by some observers' groups, in contrast with the standard straight LJFL measurements. This issue, in the absence of a published ICCAT code for the curved LJFL (CLJFL exists but it is not published in the SCRS forms), induced a mixing of different measures in ICCAT Task 2 database, created possible biases in the assessments after 2016, and made the results of several scientific papers that used these measurements difficult to be compared with previous papers. The paper also reviews the main regulations on the minimum size, detecting those where the type of measurement is not well defined, and considers the legal implication. Therefore, the authors propose several recommendations which the Group reviewed, and the conclusions are reflected in the Recommendation section.

The Secretariat pointed out that, independently from the type of measurement, it should be useful to have a precision range associated with each type. Also raised was the problem of taking measures in difficult conditions on board. The Group expresses its interest in the issue and its will to take into account the recommendations. It was also recommended that, due to difference in condition between male and females, sex specific conversion factors be examined. The importance of standard and correctly reported measurements was highlighted especially from a minimum size enforcement standpoint. The discussion centered on types measurement collected from various CPCs. It was mentioned that observer programs in Venezuela, Uruguay and USA have historically collected curved fork length. On the other hand, Mediterranean fleets (e.g. Italian, Spanish, Greece) are measuring in straight LJFL and in most recent years the curved LJFL on the Domestic Observer Programmes. From a practical perspective, it was recognized that measuring straight LJFL at sea is problematic. This discrepancy in reported measurements is an issue and should be taken into consideration when reporting stock assessment parameters. The Secretariat and CPCs indicated that they will be taking steps to ascertain which type of measurement is reported by CPCs.

SCRS/2021/092 reported on evidence that the swordfish is slowly returning to the Black Sea and adjacent areas, after several decades of absence. The first evidence from the Marmara Sea is from 2016, while the first catches in the SW part of the Black Sea were made in 2018. All the information is coming from Turkey, while no data are available for the other coastal states, possibly showing that the swordfish is progressively returning to the Black Sea. All events are documented also with all the available information and pictures. This new information, which is very positive, shows the recovery of an ancient distribution area by this species and the author recommends that local scientists monitor this space recovery.

The Group welcomed the new information.

SCRS/2021/096 provides a comparative analysis of the SWO size measurements of the Chinese Taipei longline fleet in the Atlantic Ocean, obtained by the National Data Collection System (2002 to 2019). The comparison was made to explore potential inconsistencies between the data from logbooks and the records from onboard observers. Larger and juvenile swordfish were both captured in open waters of tropical Atlantic Ocean. Swordfish larger than 150 cm LJFL account for a larger proportion of the catch for the Chinese Taipei longline fishery. Small swordfish (<125 cm LJFL) were recorded by observers, but rarely shown in the logbooks because the captains and crews did not bring the fish onboard and released the fish directly.

Questions centered around which data were reported to ICCAT and how length measurements were obtained. The presenter indicated that Task 2 data are from logbooks and observer data are also reported since 2015, which was confirmed by the Secretariat. Furthermore, the presenter clarified that length of discarded fish were estimated not measured and that the proportion of live and dead discard is unknown. It was suggested that methodology should be developed to integrate logbook and observer data and that this paper highlights the importance of observer programs. Given the new information, the Group inquired if Chinese Taipei will be submitting revised data. The presenter indicated that revised submissions are possible. The Group thanked the authors for their analysis and encouraged Chinese Taipei and other ICCAT CPC scientists to use their Domestic Observer Programme information to estimate SWO discards (if possible, separated into dead and alive) and report them to ICCAT.

2.3 Tagging data

The Secretariat presented a summary of swordfish conventional tagging updated in terms of total number of records, valid records and records under review. **Table 4** shows releases and recoveries per year and **Table 5** shows the number of recoveries grouped by number of years at liberty. Three additional figures summarise geographically the SWO conventional tagging available in ICCAT. The density of releases in 5x5 squares (**Figure 2**), the density of recoveries in 5x5 squares (**Figure 3**), and the SWO apparent movement (arrows from release to recovery locations) shown in **Figure 4**.

3. Review of work done in 2020/early 2021 on North Atlantic Swordfish MSE

The Chair gave a presentation (SCRS/P/2021/040) with an overview of the MSE work for the northern swordfish in late 2020 and early 2021. The last stock assessment of swordfish, conducted in 2017 and using data up to 2015, estimated the spawning biomass to be close to SB_{MSY} , and fishing mortality to be below F_{MSY} .

The operating model uncertainty grid for the MSE was first developed in 2018, with 7 axes of uncertainty and a total of 288 OMs. Based on an examination of the preliminary results from this uncertainty grid, the MSE modeling group made three changes so far in 2021: 1) the conditioning model was updated to the latest version of Stock Synthesis 3 (v3.24 to v3.30); 2) two axes of the uncertainty grid (CPUE CV and effective sample size of the length composition data) were collapsed in to a single axis with three levels of relative weighting between the two data streams; and 3) the model was updated to include a retention curve and an assumed level of 88% discard mortality on the undersized fish.

The Group briefly discussed these changes, particularly the data-weighting and discard mortality, and noted that they would be discussed in more detail in later sections of the meeting.

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

4.1 Implications of the new MSE roadmap adopted by the Commission

The SWO Coordinator presented the latest version of the MSE roadmap adopted by the Commission. After presentation and discussion of the MSE work (sections 4.2 to 4.6 of this report), the roadmap was again discussed and edited. Most of the activities related with the SWO MSE progress seem to continue to be on time for possible adoption of an interim MP by the Commission in late 2022. One activity that was delayed was the work on the exceptional circumstances, as the Group noted that at this point, it might be better to see how ALB progresses on that point, and also that it is possible to adopt an interim MP before work on exceptional circumstances is completed.

The roadmap with the new edits introduced at the meeting is presented in **Appendix 5**. The MSE roadmap will be further analyzed and edited as needed at the September SWO Species Group meeting, after the update of the MSE status then.

4.2 Discussion on the MSE code review

On behalf of the contractor (Landmark Fisheries Research), S. Johnson presented the *Peer review of the north Atlantic swordfish management strategy evaluation (MSE) code and algorithms* (SCRS/2021/097). The review focused on 2 main areas: 1) documentation of the code and 2) examination and simulation testing of the code.

The contractor discussed three major recommendations for the documentation. In particular, the contractor stressed the need for a more detailed description of the algorithms used to collapse the two-sex, multi-fleet Stock Synthesis 3 (SS3) model into the single-sex and aggregated fleet operating model (OM) used for simulation testing of management procedures in the MSEtool package.

Next, the contractor summarized seven major code recommendations. He noted that the plus-group calculation code was incorrect, and the error would bias the simulated population under recruitment process errors. The MSE contractor agreed that this was an important issue to be fixed and noted to the Group that this error did not impact the analyses done so far and would be fixed before simulation testing of management procedures would commence.

The contractor recommended additional testing related to the aggregated selectivity model. First, a sensitivity analysis of the weights used to average the aggregated fleet selectivity, and second, that additional projection uncertainty axes changing the selectivity pattern in the projection period given the uncertainty in the estimates used to define the aggregated selectivity.

The third major code recommendation was to relax the convergence criterion of the Newton-Raphson algorithm used to calculate fishing mortality from the total allowable catch (TAC) limit and recommended a relative error instead of an absolute error. The contractor also recommended the removal of redundant and commented out code from the MSE package to improve readability and reduce the likelihood of errors in future applications of the code.

The next recommendation was to compare the simulated length-composition data from the aggregated fleet model used in the MSE testing to the predicted data from the SS3 models, after aggregating according to the weighting used for the selectivity model. This would be especially important given that the simulated length data may be used by candidate management procedures to generate TAC advice.

The final major code recommendation was to investigate why the simulated catches from the model were not constant when tested with constant catch management procedures. There was some discussion in the Group if this could be related to the discarding or to the previously mentioned issue with the plus-group calculations. The contractor noted that either of these options could be possible, or it could be related to some other issue, such as a lack of discard induced mortality within the total mortality term in the Baranov catch equation. MSE analysts should do further testing to understand the cause of the issue and fix any issues related to it.

The Group discussed if there were benefits to simulating a larger number of age-classes in the OMs, instead of a relatively large proportion of the population accumulating in the age 25+ plus-group. The contractor noted that this was possible to do but would likely lead to increased computational requirements that would be unlikely to impact the population dynamics in any meaningful way.

The contractor concluded by noting that, in general, the SWOMSE package and its dependent package MSEtool were good examples of applied scientific computing software, that would help identify suitable management procedures for the SWO fishery after the Major recommendations are addressed.

The Chair of the Swordfish Species Group thanked S. Johnson and Landmark Fisheries Research for their thorough review of the MSE documentation and code.

4.3 Discussion of finalizing the reference set of OM's

The Group was presented with paper SCRS/2021/098 on data weighting within the OM. The data weighting investigation compared three different methods of varying the weighting of the length-composition data and the CPUE indices within the OM. The intent of the work was to include the uncertainty in the proper

weighting of each data source into the overall uncertainty grid. The results of the investigation showed that the method (Method 2) that fixed the lambda of the length data at 1.0 and varying the lambda on CPUE data best described the uncertainty that should be included in the uncertainty matrix.

It was noted that a weight of 0.10 on CPUE produced a higher percent change than the 0.05 weight. It was explained that the resulting estimates when changing weight on data sources are not linear, and that the differences might be metric specific, for example, the 0.05 weight on CPUE had the biggest percent change in virgin biomass, but not on stock status. Further exploration of model results is still necessary to fully understand these dynamics.

The Group agreed on the use of one axis of uncertainty (changing the lambdas on CPUE) instead of having the CPUE CV and ESS axis, however further investigation into the exact weight of the different data sources is still necessary.

The presenter also showed how including discard mortality influenced the estimates of yield, retained and discarded.

This analysis assumes that the selectivity is the same before and after the implementation of the minimum size regulation, however if fishermen have moved away from areas with small swordfish the selectivities have changed.

Currently an 88% discard mortality is being applied, modelled as to include at-haulback mortality and post-release mortality, and also assumes that all fleets have the same discard mortality. It was noted that this estimate is from a work on at-haulback mortality of swordfish (Coelho and Muñoz-Lechuga, 2019), and that this value is related to fish under 125 cm LJFL, as it was found that at-haulback mortality decreases with increasing swordfish size. Concerns were raised as to if this value is too low (post-release mortality should be added) or if it applies to all fleets (some might have lower at-haulback mortality e.g. due to circle hook usage, fish size, SST).

It was suggested that discard mortality could be an axis of uncertainty in the grid, or as robustness OM. The Group agreed to keep the 88% discard mortality and agreed to explore alternative discard mortality in Robustness OMs.

The Group acknowledged the progress done in this work and supports further analysis and implementation on the grid.

Documents SCRS/2021/099 and SCRS/2021/100 were presented and discussed together.

Document SCRS/2021/099 presented an update to the operating model uncertainty grid. The revised grid has 6 axes of uncertainty, with 2-3 levels within each axis, for a total of 216 OMs. The results found the three levels of natural mortality (M), three levels of steepness (h), and three alternative weightings of the indices and length composition data had the largest impact on the variability in the estimated stock dynamics. Down-weighting the CPUE indices resulted in markedly higher estimates of stock status, particularly when M and h were in the highest levels.

Document SCRS/2021/100 presented OM fit to indices (CPUEs) and length composition data. Plots of the fits to these input data are shown for the three levels of relative weighting to the CPUE and length composition data and the three levels of natural mortality. In general, the overall fits to the CPUE indices were poorest for the OMs where $M = 0.3$. The estimated stock status for these OMs was the highest (mean spawning biomass relative to spawning biomass at maximum sustainable yield >2), although the variability in the estimates was also the highest for this level.

The author showed the length composition data that has an apparent “shift” between the pre-implementation of the minimum size measure and the post-implementation for some fleets. Results currently presented are “corrected” for this apparent shift, until further analysis is performed to discover the reason for this. Several explanations for this apparent shift were discussed, one possible explanation is that data is reported in different size bins and bin assignment could be different between the two periods, it could also be a length type issue, or possibly different conversion factors being applied between different periods. The Secretariat agreed to investigate the reason behind this shift in the coming months.

The author noted this work was a preliminary look and the results should be considered more for the approval of methodology as opposed to final results.

The Group discussed the various graphics and possible explanations for some of the observed patterns. Some patterns discussed were the spread of the population trends and the bimodality of the density plots. It's possible that some of these patterns are a result of the steps in the uncertainty grid (e.g. step of 0.10 in natural mortality and steepness).

Several aspects of the fit to CPUE were discussed. It was noted that there is conflicting signal between CPUE and length data when M values are high ($M=0.3$). It was also noted that it looks like CPUE fit is best for fleets that catch larger fish than for fleets where catch is composed of smaller fish.

Following the discussion to each document there was a more general discussion of the current development of the MSE and future steps.

During the several presentations under these sections, the Group was presented with several changes to the OM grid that were introduced by the Core Modeling Team. After a presentation as to why the changes were made the Group agreed to the recent changes to the OM grid (collapsing the two effective sample size (ESS) and CPUE CV axes to a single axis that deals with weights of data sources). The relative weighting of the two data sources will be further explored. Moreover, the Group agreed with using the Stock Synthesis software version update, from version 3.24 to version 3.30, as presented in Schirripa and Hordyk (2020).

There was a short discussion on the inclusion of the environmental effect, this axis does not seem to influence the stock status or trends. It was noted that despite not seeming to have an effect in the historical period, the AMO effect should be considered in the projections. There was also a comment that the recent genetic studies seem to indicate that there is mixing between the South and North Atlantic stocks and also between the North and Mediterranean stock, and it is still unknown how this would impact the stock estimates.

There was a general discussion on the details of accounting for discard mortality in the OM grid, the current swordfish minimum size regulation, the appropriate modeling of the regulation, and the details of the discard mortality rate selected. The authors explained that, given the various nuances of the minimum size regulation (e.g., the 15% allowance, in numbers, of undersized fish, when the 125 cm LJFL exception is taken), it was not possible to model the regulation exactly with the current OM. However, the manner in which it is being modeled should be sufficient to evaluate the effects of this, or similar, regulations. The Group discussed the value being used for discard mortality (88%) and how this rate was arrived at, how it can change in relation to several covariates (e.g., temperature, fish size, gear type) and how it can vary between fleets. The authors agreed that while all of these factors do in fact influence the actual discard mortality rate, with a discard mortality as high as 88%, changes of plus or minus $\pm 10\%$ would not significantly change the results of investigations into the effects of the regulation.

The Group then briefly weighed the merits of the minimum size regulation in general and whether, given the high rate of discard mortality and the 15% undersized fish allowance, the regulation was having the desired conservation effect. However, it was pointed out that nothing had been presented at this meeting to suggest this conclusion could be reached and that further work needed to be done before any conclusions could be drawn. Consequently, the decision was made to continue investigation of size data and the impacts of the minimum size regulation and its potential role in the North Atlantic Swordfish MSE.

The Group discussed the work presented on data weighting and thought that further investigation was warranted. However, an inquiry was made as to exactly what question was being asked in order to guide the continued investigation. In response, the Group discussed that since the CPUE data and the length data provided differing evidence with regard to the status of the stock, that they represented two, equally plausible, hypotheses. And as such, each hypothesis should be represented within the OM grid. The Group felt that more work should be conducted before the set of observational lambdas were finalized but did not recommend any specific course of action.

The Group agreed that the use of a select set of standard stock assessment diagnostics, such as those presented at the 2021 Working Group on Stock Assessment Methods meeting (WGSAM), were an appropriate way forward to help with determining OM grid model plausibility. These diagnostics could include, but not be limited to, hindcast-cross validation, tests of convergence and tests of model stability. The Group discussed that perhaps such diagnostics need not be run on all models contained within the OM grid, but rather a selected few that represented more extreme hypotheses. The plausibility of some models with regards to stock status estimates or trends, for example, in some models the stock had suffered almost no depletion, was questioned. The development of plausibility tests to check for combinations that are not biologically sensible was also discussed.

4.4 Discussion on performance metrics

Document SCRS/2021/094 concluded that the key MSE Performance Indicators for the northern SWO MSE should be the probability that the stock is in the green quadrant of the Kobe matrix, the probability that the stock is above the Limit Reference Point, mean catches, and the average variability in yield between time periods. Additional precision from the Commission is needed over what time period Performance Indicators are to be calculated, required probabilities in Res. 19-14, the assessment period interval, and if/what additional Performance Indicators should be presented.

The Group discussed how to consider risk and how these statistics should be averaged across many OMs. By way of a response, it was noted that one way to consider the mean risk was as the product of the probability of an event and the consequences of that event; lacking some sort of cost function to describe the consequences of a given event it was not possible to calculate risk. With respect of averaging across OMs, it was noted that the Group had a number of options: present results for a smaller reference set; they could attempt to weight each OM quantitatively; or they could use equal weights for each OM.

The Group discussed the list of possible performance metrics that had been compiled for northern albacore. It was noted that in the in the initial discussions about Performance Indicators for the stock, PA2 had proposed a very large list of indicators that was subsequently pared down. The Group agreed that as an initial proposal, they would use the set of key performance metrics and the larger list that had been used for albacore as a place to start discussion with Panel 4 about Performance Indicators.

The Group discussed Radar plots (also known as Spider Plots) as a way to present the performance of a given MP. Some in the Group liked these plots, others did not. One drawback was how to interpret the plot's area. Some noted that these plots need not be considered as a quantitative tool, i.e. that it should not be examined by area at all but rather as a tool about how to look at each axis individually. The Group agreed that as long appropriate explanation for interpreting them, RADAR plots may prove to be useful.

4.5 Discussion on start testing of candidate management procedures

The Group discussed:

1. The acceptability of model based and empirical cMPs
2. The data that would be simulated for cMP development
3. The SLICK cMP performance evaluation tool.

It was noted that cMP development had been delayed by progress in developing an agreed upon reference grid of operating models. Nevertheless, it was agreed that the Group did not need to be prescriptive with respect to the development of particular kinds of cMPs (model-based vs empirical) and it should be left to managers to decide which type of MP was preferred based on the performance of their metrics. It was discussed that the functioning of empirical MPs were easy for managers to understand and that model based MPs can require more inputs, need to be evaluated for fit and require more computing time during simulation testing, however in principle it was acknowledged that it would not be an issue to include a variety of surplus production type models in the MSE package. An advantage of a model-based MP is its ability to provide reference point and absolute biomass estimates whereas an empirical MP does neither. Finally, it was clarified by the MSE developer that any cMPs provided would be run against the reference grid in preparation for the next meeting of the Group. It was noted that OpenMSE has 128 CMPs built into the package that are available for testing and the Group is encouraged to develop or continue to develop custom MPs.

The discussions on which data should be simulated for cMP development concluded that in order to ensure the greatest diversity of cMPs for testing, the individual regional indicators, combined index and catch composition should be projected. Developers would then have maximum flexibility to design their best performing MP. It was noted that updates of the combined index will not be provided as a regular contribution of the Secretariat and that it will depend on CPC scientists or an external contractor to complete. Further, it was noted that confidentiality issues may affect the generation of the combined index into the future. It was suggested that if an index based on the combined index was selected for providing advice, then there may be extra incentive to overcome confidentiality issues. Also, it was noted that the strict data sharing rules of the USA is not expected to affect its ability to participate in future combined index updates. The availability of fleet CPUEs into the future was an important consideration in terms of what should be projected and it was noted that the advantage of a combined fleet index was that it may be robust to the unavailability of a CPC's data. There was, however, discussion on how robust the combined index would be to missing data, as discussed in section 4.6.

In the case of length-based indicators, the dependency on the Secretariat was recognized for providing the necessary length composition data. It was indicated that an advantage of length-based indicators was that they are relatively easy to calculate and thus could also be used to detect exceptional circumstances (although concerns were raised about the ability to do so on an annual basis, as discussed in section 4.6). Given that length-based indicators could be tested in a closed loop simulation, their usefulness for providing TAC advice could be evaluated.

With respect to the properties of the projected indicators, it was clarified that the projected indicators would mimic the properties of the real-world index. Thus, both the stimulated and real-world indices would represent the relative abundance for the same indexed age groups and the simulated index has the appropriate error added in order to simulate the performance of the real-world index.

With respect to the time scale for review of CPUE indices used in the MP, it was clarified that this would occur in the year of the MP update year. However, if a CPUE index was considered appropriate for use in monitoring for exceptional circumstances, there would not be an annual requirement for review. The index data would be updated and the base model rerun in each year except in an MP update year when a review and potential revision of the base model would occur.

The Group reviewed the Shiny application, called Slick (<https://harveststrategies.org/management-strategy-evaluation/presenting-mse-results/shiny-app/>) that demonstrated the relative performance of competing cMPs for a suite of performance metrics using a variety of visualization options. The Group recognized the usefulness of the package for assisting with cMP selection and suggested potential refinements. It was recognized as a useful tool for managers to appreciate the trade-offs when attempting to achieve multiple management objectives. The standardized approach for visualizing MSE data from any MSE process was considered a very useful attribute.

4.6 Proposal on criteria for determining exceptional circumstances

Advice intervals

The Group was presented with a table (**Table 5**) outlining a candidate framework for advice intervals. The table summarizes the frequency of MP application, relative to MP implementation, stock assessments, EC evaluations, and the data requirements for each component. It was proposed that the application of the MP could occur in the third year of each 3-year MP advice interval, with exceptional circumstances monitoring occurring whenever the relevant data for this evaluation are updated. TAC would be fixed through each interval, to enhance catch stability. Under this proposal, stock assessments would be planned to occur every sixth year of the cycle, but could be invoked earlier if triggered as a response to exceptional circumstances.

Concerns were raised about the demands of evaluating exceptional circumstances every year. However, it was noted that in most cases the check for the existence of exceptional circumstances is not expected to require major effort (e.g. catch, relative to TAC). Furthermore, some indicators used for monitoring would be unlikely to change much each year.

It was suggested that the impact of different advice intervals on MP performance could be assessed in order to inform the selection of interval length.

With respect to the timing of OM reconditioning, some questioned if it would be necessary to do so. The Group considered that reconditioning should only be necessary if and when there was strong evidence that conditions had changed enough to warrant reconditioning.

Overview

SCRS/P/2021/041 provided an overview of criteria used for detecting exceptional circumstances (ECs) among ICCAT MSE processes. ECs occur when reality diverges from scenarios that are simulated in the analyses conducted to adopt the harvest control rules. The presentation reviewed potential EC indicators, the criteria used to evaluate those indicators, the frequency at which criteria are evaluated and the decision process that occurs after ECs are detected. The presentation paid particular attention to the ongoing EC work of the Albacore Species Group and Panel 2 and noted if and where the Swordfish Species Group may consider diverging from that process.

The Group discussed several of the points raised in the presentation. It was noted that some potential approaches to evaluating exceptional circumstances could be difficult to carry out on an annual basis; for instance, the work involved with the length-based indicators may be prohibitive to do annually.

There was some discussion as to whether or not the unavailability of one CPC's data (temporarily, or permanently moving forward) from a combined index would necessarily trigger exceptional circumstances. It was noted that this could be tested in an assessment context by evaluating the impact of removing that CPC's data from the calculation of a combined index used in a model. A question arose as to whether or not such an absence of data for the combined index (e.g. missing data for a fleet that was included in the construction of the combined index, which was then used in the MP) could be tested within the MSE. The MSE contractor responded that that could be done, if the process for developing the index were modeled within the MSE.

The Group noted that the development of protocols for evaluating exceptional circumstances, and of defining appropriate responses if exceptional circumstances are declared, is advancing for both the North Atlantic ALB and BFT MSEs. It was also noted that there is a benefit to consistency in the protocols across species, while allowing for differences due to differences in fisheries, life history, and MP structure. Therefore, there was general agreement that development of exceptional circumstances protocols for SWO should have a lower priority relative to other needed work on the OMs and MSE, which would permit the protocol development to be informed by the work of the other Species Groups and Panels.

5. Update of the ongoing and future activities of the Atlantic and Mediterranean Swordfish Programme

5.1 Review of the 2021 Swordfish Biology Workshop Report

SCRS/P/2021/038 provided an overview of progress on the ICCAT swordfish biology program in the North and South Atlantic and Mediterranean. The author reviewed the program objectives related to the main project study areas: sampling, ageing and growth, reproduction and maturity, and genetics. There was a description of sampling materials collected and the spatial-temporal coverage relative to fishing catch, noting areas where further samples were required. The presentation briefly described progress related to the progress of the project study areas and described analysis next steps, noting that further analyses would target unknowns important to the stock assessment and MSE processes.

The Group thanked the labs and experts contributing to sample collection and analysis, noting the broad collaboration among the many Groups. There was brief discussion on priority locations for additional sample collections to fill spatial-temporal gaps (see section 5.5). There were offers from members of the Group to fill some of these gaps and the potential to obtain samples from additional gear types.

SCRS/P/2021/042 described the ICCAT swordfish biology workshop, held online 22-26 March 2021. The objectives of the workshop included creation of ageing and maturity reference sets and planning for next steps for analysis of spines, otoliths, gonads and tissue samples. The workshop included scientists from ICCAT CPCs, the ICCAT Secretariat, academia, private research institutes and invited experts. Major progress was made on developing a standardized set of protocols for both assessment of age and maturity

stage. The workshop participants reviewed initial results from project collaborators related to genetic analysis. A number of recommendations were developed to strengthen future sampling efforts and cataloguing of those samples.

The Group noted the progress related to creation of reference sets for ageing and maturity.

5.2 Update on ageing and growth analyses

Presentation SCRS/P/2021/037 showed an update on the age and growth component of the biology program for swordfish. For this component, both spines and otoliths are being collected and processed for comparison of age readings between both structures. Progress on this component under Phase 3 was made on the processing of further samples and the start of a reference set for both spines and otoliths. Future sampling needs was also presented.

The Group acknowledge the presentation and encouraged for the continuation of sample processing and analysis.

5.3 Update on reproduction and maturity analyses

There were no additional analyses available for presentation on reproduction and maturity.

5.4 Update on genetic analyses

Presentation SCRS/P/2021/039 provided a brief but comprehensive overview of all results achieved during the study. Regarding genome assembly and comparative genomic analysis already concluded, the authors presented total number of genes, genes shared with other fish, swordfish-specific genes, the gene families in expansion and in contraction and a general overview of the whole genome structure. The authors then discussed the results regarding the genetic population analyses. The PCA showed a strong genetic diversity (PC1=62.3%) between Mediterranean and Atlantic specimens, however BIL94B seems to be a mixing area. With the set of samples available, the preliminary genetic analyses confirmed two main SWO populations: Atlantic and Mediterranean, with two sub-population in the Atlantic (NA and SA). The report of the workshop showed that two possible sub-population have also been found for the Mediterranean although results do not allow us to clearly attribute populations to different fishing areas.

The Group asked if there is overlap among the populations. Details on the results presented in the previous meeting have been reiterated, there is a clear albeit limited allelic frequency typical of both the Atlantic and Mediterranean. Similarly, specimens fished in Atlantic showed allelic frequency of Mediterranean fish. All data confirm the sharing of allele frequencies between the 2 populations.

The Group asked if it is possible to do epigenetic analysis for the determination of age. The importance of the study of the epigenome in particular of the methylome for the determination of age was emphasized. This technique is already in use for other species including humans and some fish. The process requires optimization and standardization of a reference scale in which the specimens have been classified through conventional methods. At each age will be assigned a specific grade of methylation through which it will be possible to estimate the age of the specimen in question.

Finally, the Group requested details in the sex determination through genetic analysis (WGS). Information about the possibilities offered by the WGS results that should provide a set of genes for gender identification should be obtained. This will also make it possible to classify the sex of the landed specimens who arrived eviscerated. In addition, the WGS can make us identify a set of specific genes to quickly and inexpensively identify the different subpopulations.

5.5 Discussion on sampling activities

Presentations on the Biological Sampling Program and analyses related to ageing and genetics were reviewed by the Group. The Group acknowledged the significant effort and success of the Consortium in terms of the scope and numbers of the samples collected as well as the quality of the analyses. The program was compared with more successful broad scale efforts to collect data on marine turtles and sharks. The Group encouraged the consortium to continue their work and expand the list of contributors.

Discussion on priority sampling areas for the next phases

The Group suggested that priority areas for sampling in Phase 4 should include the area southwest of the Sargasso Sea between December and July where swordfish are known to spawn; the waters surrounding Cabo Verde archipelago; the Gulf of Mexico; the western Caribbean Sea; the eastern Mediterranean (e.g., Turkey) and the Mediterranean Sea during the winter months when there is no swordfish fishery. Analysts involved in ageing also indicated gaps in sampling associated with large and small swordfish and certain quarters when there is no fishing while analysts involved working on genetics requested more samples from the southern Atlantic and also expressed interest in obtaining historical samples of tissue.

It was questioned if young of the year samples would be useful. It was noted that for daily ring counts fish would have to be less than 70-80 cm LJFL. It was noted that while samples of fish between 70 and 80 cm LJFL could be provided from some areas (eastern Caribbean Sea), these samples are relatively rare. Nevertheless, even a few samples were considered important for resolving ageing questions related to daily growth. Discussion on where the samples of small fish could be obtained indicated that fleets observing the 125 cm minimum size threshold have a 15% allowance to retain undersized fish whereas those observing the 119 cm threshold would not be able to contribute without a research mortality allowance.

It was clarified that historical samples would be accepted by the consortium to inform on assessment related objectives and fill gaps in our knowledge about the biology of the species. The USA noted that it had resolved its data confidentiality issue for a large fraction (440/928) of the samples from 2002-2003 that it provided to the consortium allowing it to provide the requested month and 5-degree square information (440 specimens have time and location information provided). It also offered to provide samples from gears other than longline (buoy gear, deep drop lines, sport) which the group supported. Uruguay noted the inability to contribute samples during the pandemic due to lab closures and indicated that genetic and gonad samples from the area south and east of 20 degrees south latitude would be forthcoming.

Discussion on logistics of specific materials collection (e.g., gonads, otoliths, vertebrae)

The Group noted that shipping samples was a major logistical hurdle especially when a preservative was included with the sample. Coordination of the sampling to address the gaps identified by the Group and analysts was considered important and that this should also include a prioritization of the gaps given the uncertain funding situation. It was acknowledged that priority should be given to filling gaps that result in products which support the assessment. The need to increase the compensation for gonads was expressed given that these samples are more difficult to obtain and store.

5.6 Project Phase 4 planning and Terms of Reference

The Group reviewed Terms of Reference for Phase 4 of the biology project. Sampling and analysis will focus on addressing gaps noted in Section 5.5.

5.7 Planning for Phase 5

The Group briefly discussed priority analyses for future project phases, including age validation through bomb radiocarbon.

Update on SWO satellite tagging

The Group was informed about the status of the satellite telemetry tagging for swordfish. In 2019, eight miniPAT tags were deployed in swordfish by observers on EU-Portugal and EU-Spain vessels and the Uruguayan research cruise in the North and South Atlantic (Rosa *et al.*, 2020). In 2020 most onboard observer programs were stopped so there were no opportunities to deploy tags. In addition, because of the battery issues with wildlife computer tags, the tags had to be returned to the manufacturer for a battery replacement. The replacements and new tags have just arrived to ICCAT Secretariat (17 May 2021). Those tags are being distributed to the same teams that had them before (2018-2019), namely 12 tags for the Mediterranean (four for France-Corsica with Francois Poisson; 4 for Spain IEO-Malaga with David Macias; and 4 for Italy with Fulvio Garibaldi). Additionally, eight are scheduled for the Atlantic (IPMA-Rui Coelho, both for the NE Atlantic closer to the Iberian Peninsula and in the Equatorial stock mixing area).

In addition to those previous 2019-2020 tags now replaced, in 2021 there was the acquisition of 12 new tags. The original strategy was to deploy the tags in the Mediterranean and closer to the stock mixing areas (Med:NE Atlantic, and N:S Atlantic). The Group will continue to evaluate if tagging should be expanded beyond those priority areas. The SWO tagging coordinator will contact the existing teams immediately after the 2021 Swordfish Intersessional meeting to coordinating the shipment of tags aiming deployment during 2021. This process might be somewhat delayed as during this meeting the Secretariat received a communication from the tag manufacturer (Wildlife Computers) regarding a new issue on the tags software bug, which is expected to be solved soon. But as soon as that is solved by wildlife computers, the tags will be distributed.

5.8 Other biological information

SCRS/2021/059 summarized the biological samples collected for swordfish under the Chinese Taipei domestic observer program from 2019 to 2020. The samples were examined by fish size, gender, month, and sampling location. In total, biological samples were collected for 66 individuals for 1 year of sampling, which include length and weight data, anal fin spines, gonads and otoliths. Spine samples were available for juvenile swordfish under 120 cm LJFL for both sexes. However, otoliths were only available for male samples smaller than 90 cm LJFL. Both spine and otolith samples have been sent for further ageing analysis as part of the ICCAT swordfish biology programme.

In the discussion, the ability to collect complete sample sets for each specimen has been highlighted, as well as the importance of the onboard observers for this sampling activity. It is hoped that this work will continue also in 2021, even if problems related to the Covid 19 will be probably limited to the opportunity of collecting muscle samples for genetic analysis.

A preliminary analysis on the presence and distribution of swordfish larvae in the Balearic area was presented in SCRS/2021/093. Authors analyzed the possibility of applying TUNIBAL surveys to investigate the early life ecology of the Mediterranean swordfish, exploring the hydrographic preferences of larval habitats. The estimated larval index of swordfish in the period 2012-2016 shows an initial increase between 2012 and 2014, followed by a decrease of abundance between 2014 and 2016. Further work could include processing already collected data from recent years using the same methodology and, if gear standardization is possible, use of earlier samples.

During the discussion it was observed that the number of sampled larvae is rather low (36 in the period from 2012 to 2016), probably due to the fact that the survey was designed mainly for other species and to the different reproductive behavior of swordfish compared to the other tunas. Suggestions have been made regarding sampling strategies (depth and different types of bongo nets used (bongo 90 and 60) to optimize swordfish larvae catches and standardization of the results. As for the analysis of the data, which are still to be considered preliminary, it was suggested to test the use of negative binomial models to better accommodate for the numbers of larvae in the sample. It would then be fundamental to have information on the size of the larvae, to evaluate any overlap between different stations and to have an idea of the age in days, in order to be sure not to analyze the habitat preferences of adults rather than of the larvae themselves.

It was asked whether the larval samples were available for further ageing and genetic analysis. Unfortunately, the samples collected up to now have been preserved in formalin, which presents challenges for further genetic analysis. Although this is a preliminary work, pending further data and analysis, the Group recommends carrying on the research regarding swordfish larval habitats in the western Mediterranean region and to evaluate the possibility of incorporating additional hauls in the TUNIBAL surveys to specifically target the collection of swordfish larvae DNA samples.

6. Workplan for 2021

The 2022 workplan for the Swordfish Species Group is provided in **Annex 6**.

7. Recommendations

Recommendations with financial implications

- *Biology and stock structure study - Swordfish Year Programme (SWOYP) (this recommendation applies to both the North and South Atlantic and Mediterranean stocks):* An understanding of the species biology, including age, growth and reproductive parameters, as well as stock structure and mixing is crucial for the application of biologically realistic stock assessment models and, ultimately, for effective conservation and management. Given the current uncertainties that still exist, the Group recommends as high priority to continue biological studies on swordfish. An ICCAT project on swordfish biology, genetics and satellite tagging started in 2018 and the Group recommends that the project continues for 2022 and is provided with financial support. The costs for continuing such work in 2022, for each project item, would be the following, for each study item (Priority: *High*):
 - Satellite tagging work: €10,000 for 2022, requested mainly to cover expenses with deployments of previously acquired tags and some tagging equipment (tagging poles, etc.).
 - Reproduction: €15,000 for ongoing work processing and analyzing of gonads;
 - Age and growth: €90,000, divided as: €10,000 to finish processing spines and otoliths collected under previous phases; €30,000 for a trial bomb-radiocarbon age validation study; €50,000 for a trial study on comparison of 3 structures (vertebrae, spines and otoliths).
 - Genetics: €110,000; divided as: €100,000 for continued population analysis of tissues samples for stock differentiation; €10,000 for a pilot study on epigenetic ageing, to be completed in conjunction with the bomb radiocarbon study.
 - Age and growth reference set workshop: €20,000 for 7-8 participants plus 2 experts (workshop should be scheduled as a 5 in-person days)
 - Sampling and shipping (priority on missing areas/sizes as defined in the project summary): €10,000
- *MSE for N-SWO:* Delivering MSE results for northern swordfish according to the schedule agreed upon by the Commission will be very challenging and require time and resources. Funding to start this work was provided in 2018, and a contractor was hired to start the work. The Group recommended funding for continuing the swordfish MSE work for 2022 and 2023. Funds requested for 2022 to continue this work are €90,000 (priority: High)

The Table below contains the overall funding requests made by the Swordfish Year Programme (SWOYP) for 2022:

Swordfish	2022 (€)
Tagging, rewards and awareness	
Electronic tagging, rewarding and awareness	10,000
Biological studies:	
Reproduction	15,000
Age and growth	90,000
Genetic	110,000
Other (if any, identify)	€
Sample collection and shipping	10,000
Workshops/meetings	
Age and growth reference sets workshop	20,000
MSE	
Progress of the N-ATL MSE	90,000
TOTAL	345,000

General recommendations

- Independent review of ICCAT MSE processes: The Group reiterates a Recommendation from the WGSAM for a common Independent Peer Review team (1-3 reviewers) for an overall review of all ICCAT MSE approach, to start in 2022.
- The Group Recommended the future dissemination of T1NC information with both the positive catches and the “0” catches (whenever available discriminated by catch type: landings, dead discards, live releases) recorded in the ICCAT database system (ICCAT-DB).
- (*) The Group continues to note that there is a general lack of discard data reported by most CPCs, including dead discards and live releases. The Group reminds CPCs that the reporting of discards is required and is essential for assessing the stocks status. Such information is required to be provided by CPCs well in advance of the next stock assessment. The Group also strongly recommends that both dead and live discards be estimated by each CPC and reported to ICCAT, backwards in time as much as possible.
- The Group recommends that it is important for CPCs to also report data on discards-at-size for swordfish, in T2 data. This information is needed to address ICCAT Rec. 19-04 Parag 3: *“In the development of the operating models, the Commission would like the SCRS to allow for the evaluation of minimum size limits as strategies to achieve management objectives”*.
- The Group recommends the SCRS to continue work on tools for visualization of performance metrics results, and to standardize the presentation of information across the various species groups MSEs.
- The Group continue recommending that the straight LJFL be the preferable measurement taken for swordfish length, because this type of measurement is particularly relevant when dealing with the minimum size regulation and even other biological issues (L0, L50, L100, length/age correlation, length/weight correlation). When it is not possible for practical reasons to take the straight LJFL, then the curved LJFL could be taken indicating the type of method, and whenever possible including the fish condition factor and the sex.
- The Group recommends reviewing and updating the ICCAT manual on swordfish, including taking into account the measurement issues.
- The Group recommends that a specific code for the curved LJFL and curved UJFL (i.e. CLJFL and CUJFL) should be considered by SCRS SC-STAT for the inclusion among the ICCAT codes.
- (*) Considering the implications for stock assessment and the MSE process, the Group recommends that CPCs statistical correspondents should inform the Secretariat and SWO SG about the methodology used for collecting swordfish length and if it changed over time (curved or strait LJFL). The Secretariat will confirm with the statistical correspondents on the types of measurements submitted for swordfish.
- The Group recommends that the specification of the type of measurement (curved or strait LJFL) shall be included in any ICCAT Recommendation concerning size limits in swordfish.
- The Group endorses the Recommendations that were developed during the SWO Biology Workshop (document to be made available possible later in the year).

8. Other matters

8.1 Indices of abundance

SCRS/2021/087 and SCRS/2021/088 were presented together and provide standardized catch rates (in weight and in number) of the EU- Spain surface longline fleet targeting swordfish for the North and South Atlantic stock, respectively. In both cases, an alternative-sensitivity MIXED procedure was performed measuring the CPUE in mean round weight per year, which was scaled in order to compare it with the standardized CPUE in weight per 1000 hooks. The North Atlantic indices of relative abundance show a slight

decrease until the mid-nineties after which CPUE increases with stable or slightly upward trends thereafter. The trend for the South indicates stability for the period 1993-2004 followed but a slight but sustained upward trend.

The Group acknowledged the work produced by the authors and it was confirmed that the North Atlantic index presented here was not incorporated in the previous assessment – rather the age-specific CPUE (presented in SCRS/2021/089) was used in the previous assessment. It was noted that the inclusion of “ratio” as a covariate could produce hyper-stable results that may not reflect the stock dynamics and that means to test and validate the model’s consistency should be considered. A change in gear, with the introduction of new monofilament in the fleet around the year 2000. The Group suggested that both of these indices be updated and presented at the 2022 Data Preparatory meeting. The Group suggested that the authors explore reducing the number of ratio categories perhaps to as few as two.

SCRS/2021/089 reported standardized age-specific catch rates (in number of fish) for the EU-Spain surface longline fleet in the North Atlantic for the period 1982-2019. The standardized CPUE for age 1 suggests a very positive phase of recruitments during 1997-2019, which resulted in positive effects on other ages. The Group acknowledged the work of the authors and there was discussion relating to the rationale for filtering the data and the decision to exclude data that did not meet the 85% size-sampling coverage threshold. It was suggested that the potential bias resulting from this filtering procedure be explored, specifically any bias that may be introduced due to only sampling trips with relatively high catch rates or volumes.

The authors noted that they used the 'aging' program (Schunete and Fournier, 1980) established and recommended by ICCAT from 1991 to date to carry out the age slicing. It is the same one that was used in the VPA processes and to generate the CAA data for swordfish. Restrepo's contribution was not a new method, it is the adaptation of the original ICCAT system in FORTRAN to a QBASIC language for a more user-friendly management and implementation. The conversion from size to age used the growth curve for North Atlantic swordfish (Arocha *et al.*, 2003).

The Group asked if the annual CPC values for the individual age groups were increasing and decreasing in the same year or if there was a displacement in time which one might expect if a cohort were moving through the population. The authors confirmed that indeed cohorts were displaced in time and age in subsequent years. The Group requested that this index be updated and presented at the upcoming 2022 Data Preparatory Meeting.

8.2 Responses to the Commission

North Atlantic Swordfish

The Commission shall establish at its 2021 meeting conservation and management measures for North Atlantic swordfish on the basis of the SCRS advice resulting from the latest stock assessment as well as the *Resolution by ICCAT on Criteria for the Allocation of Fishing Possibilities* [Res. 15-13]. Rec. 17-02, parag. 5

Since the stock assessment did not take place in 2021 as originally planned by the SCRS, the Group is not in a position to provide the requested response to the Commission.

South Atlantic Swordfish

When assessing stock status and providing management recommendations to the Commission in 2021, the SCRS shall consider the interim limit reference (LRP) of $0.4 * B_{MSY}$ or any more robust LRP established through further analysis. Rec. 17-03, parag. 12

Since the stock assessment did not take place in 2021 as originally planned by the SCRS, the Group is not in a position to provide the requested response to the Commission.

9. Adoption of the report and closure

The report was adopted during the meeting. The Chairs, the SCRS Chair and the Secretariat thanked all the participants for their efforts to work effectively and efficiently during the meeting. The meeting was adjourned.

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