2020 ICCAT REPORT OF THE SWORDFISH MSE TECHNICAL GROUP MEETING
(Online, 4-5 June 2020)

SUMMARY

The Northern Swordfish MSE Technical Team reviewed the candidate OM grid, discussed cMP development, developed discussion points for interactions with the Commission, and made a workplan for the remainder of 2020. The contractor presented OM summary reports. The group discussed methods for evaluating model fit and OM conditioning status. The group developed a preliminary list of candidate robustness OMs relating to discarding, minimum size limits, index fits, changes in selectivity, and multi-stock scenarios. The group discussed potential cMP types, methods for cMP development within the N-SWO MSE framework, and metrics for evaluating cMP performance. Given the timing of PA4 meetings and stock assessment schedules, the group discussed appropriate scope and timing for interactions with the Commission. The Group discussed advice intervals related to both N-SWO stock assessments and MSE updates. The Group decided that given the progress regarding exceptional circumstances, the N-SWO MSE group would adapt these criteria. A number of small subgroups were formed to continue work intersessionally for several of these items. The Group anticipates a fall 2020 meeting to continue MSE work.

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

The online Swordfish MSE Technical ("the Group") meeting was held from 4 to 5 June 2020. Kyle Gillespie (Canada), the Rapporteur for the North Atlantic swordfish stock, opened the meeting and served as Chair.

On behalf of the Executive Secretary, the Assistant Executive Secretary and the Chair of the Standing Committee on Research and Statistics welcomed the participants to the meeting. The Chair proceeded to review the Agenda which was adopted after minor changes (**Appendix 1**).

The List of Participants is included in **Appendix 2**. The following served as rapporteurs:

Sections	Rapporteur
Item 1	N.G. Taylor, K. Gillespie
Item 2	N. Duprey, K. Gillespie, M. Schirripa, A. Hanke, D. Rosa
Item 3	N. Duprey, N.G. Taylor, A. Hanke
Item 4	S. Miller, R. Coelho
Item 5,6	K. Gillespie
Item 7	N.G. Taylor, K. Gillespie

2. Update on the OM reference grid and model validation

2.1 OM fits and red face tests

The contractor presented SCRS/2020/031 that was a review of the operating model uncertainty grid and updated work on diagnostics. The previous issues with convergence have been resolved by turning off the estimated variance for CPUEs and widening the bounds on some selectivity parameters. Some of the OMs (73 of 288) parameters were close (within 1%) to the bounds; these all occurred in 3 size-selectivity parameters (Japan Early, and USA fishing fleets). The Group discussed the fact that the OMs with parameters against bounds were more optimistic on average than those that were not. It was noted that removing these OMs would reduce the skew in the distribution of OM outcomes. There was no consensus as to whether further action was required with respect to the problematic OMs.

The OM summary report now has histograms showing stock status by OM factors and plots of historical SSB by axis of uncertainty. An Index Fit Report was also presented which provides a summary of statistical properties of fits to survey and fleet indices.

The Group discussed the index fit report results and if there were any concerns in these plots at this stage. There were questions about why the Spanish index fit so poorly. The reason seemed to be a problem with scaling, which would mean difficulties with estimating the catchability parameter, q. If so, this could be easily solvable, and the contractor plans to look into this more.

There was a great deal of discussion on using the combined index that was used in 2017 in CMPs. The pros and cons were expressed as:

- Good insurance against losing a CPUE in the future that might be used in a MP
- Can be used with a Stock-Production model
- A jack-knife-type procedure needed to better understand the influence on the combined index of removing individual CPC fleets
- Use of the combined index could mask stock issues one would see if looking at individual indices
- However, an additional pro is that the combined index deals with the problem of individual indices potentially reflecting local availability rather than overall abundance

The combined index has been used in the past for the SWO assessment and needs to be produced by the ICCAT Secretariat (Ortiz *et al.*, 2017). The Group discussed the possibility of using a such a combined index in the development CMPs.

The Group discussed similarities in the resulting B/B_{MSY} between some of the factors in specific axes of uncertainty (recruitment variability [values 0.2 and 0.6] and CPUE CV [0.3 and 06] were two axis of uncertainty that were highlighted as having similar SB/SB_{MSY}). This conversation opened up the discussion on if all 288 OM's were needed and informative, and if no meaningful differences were found between some model results should they all remain. It was noted that OM SSB/SSB_{MSY} plots were available in the summary report and while some factors looked to have similar results, more metrics would need to be explored (e.g. F/F_{MSY}, $B/B0$, etc.). It was mentioned that the lack of strong differences between the factors may indicate the MSE does not have a wide enough spread in the factor values. However, knowing that they are similar is just as important as knowing that they are different.

The Group discussed if the OMs fit diagnostics were sufficiently good to allow further progress on MSE development and it was decided to review existing "red face" tests before proceeding (candidate red face tests in **Appendix 4**).

2.1.1 Operating model summary report

Discussions on the operating model summary report mostly revolved around what information should be in the report and how this information should be interpreted. One of the points the Group made was that the use of stacked bar plots was a bit confusing. Perhaps overlay plots would be better interpreted. The Group also discussed that many of the frequency plots were right skewed. It was noted that this could be partially due the stacked bar plotting the same data.

The Group discussed how to rank the goodness of fit of each OM. It was noted that likelihood components were not comparable, and in fact could lead to misinterpretation if the reader was not aware of this fact. Length compositions are always going to make a significant contribution to total likelihood values due to sheer number of data. Percentage that each likelihood components made of the total was suggested but this was declared statically incorrect. Another option could be to use the convergence criteria, which is a single value and is comparable between models.

The Group brought up the very divergent estimate of SSB in early years and the move towards convergence around the year 2000, then divergence increases after 2000. It is unclear why this is happening and why the convergence/divergence at year 2000.

It was noted that alterations to Table 4 in section 4 of the OM report (Parameter and Likelihood Table) are needed to make this information more comparable and easier to decipher. There was a suggestion that perhaps they should be removed as it could lead to incorrect comparisons. Comparisons of likelihoods cannot be done across all OM factor levels and their comparisons cannot be made between all OMs. This led into discussions on other methods that could be used for plausibility weighting.

2.2 OM plausibility weighting

The Group discussed the value in assigning plausibility weights to the OMs in the reference set in preparation for cMP evaluation and selection. Given that the current grid consists of 288 OMs, it was considered unnecessary to assign weights to each OM and that plausibility would result as a natural function of which realities for the stock were most common. It was also noted that a concern with this approach is that removing OMs from the grid could alter the perception of the reality that appears to be most common. It was also discussed whether the range of levels within the current axes of uncertainty was plausible. It was noted that the Group had defined plausible levels and that the issue was rather whether the combination of the levels from the different axes was producing OMs that did not represent a realistic reality for the stock.

The Group discussed that the SWO WG should chose values for each axis of uncertainty in the MSE that bracketed the settings used in the 2017 stock assessment base case. In particular, it was noted that for steepness, two values were below the base case and only one above, which could have an effect on the distribution or balance of model outcomes regarding stock status (plots from the OM summaries) around the base case. It was noted that having perfectly balanced factor levels for each axis (with values both above and below the base case by the same degree) would not necessarily result in the same balanced structure in the results (namely in stock status). Also having a skewed distribution of the results might just be an emergent property of the axes interactions occurring within the OMs and not something that is wrong.

Reference was made to the need to have the base case as the median outcome across all OMs for the grid to be balanced, however it was recognized that the base case need only fall within the envelope of OM outcomes since it is not considered to be the true state of the stock.

With respect to the rationale for the selection of the levels for each axis of uncertainty, it was impressed upon the Group that these decisions needed to be adequately justified.

It was also noted that the methodology for calculating performance indicators might influence the choice of weighting between OM runs and vice-versa. Discussion on performance indicators has not been conducted so far and a small group (**Appendix 3**) has been formed to generate candidate indicators.

2.3 Grid completeness and other axes of uncertainty

The Group considered whether the current reference grid was complete in terms of both adding more levels to the currently defined axes of uncertainty and including new axes of uncertainty. The current grid was considered appropriate but if a compelling robustness scenario (see section 2.4) was identified, there is the potential to elevate it to the reference set of OMs.

The Group also discussed tools for assessing the relative influence of the axes of uncertainty such as a GLM approach to reduce the size of the grid. It was encouraged to reserve this task until cMPs have been developed in order to be able to evaluate the influence of the axes with respect to the cMP interim performance metrics.

2.4 Robustness OMs

The Group discussed defining a set of robustness OMs which relate to uncertainty scenarios that could be tested during OM projections and which could further challenge cMP performance and support cMP selection. It was agreed that these new uncertainty scenarios would need to be placed into categories describing their importance in the event that time constraints only permitted development of a subset of the full list. Tier 1 robustness OMs would address uncertainties identified by The Commission and/or other priority uncertainties that have realistic implementation within the current grid. Tier 2 robustness OMs would address uncertainties that are lower priority and/or would require major restructuring of the current grid. It was also considered important that sufficient detail be provided to the developer in order to construct the new OMs.

The Group recommended the following uncertainty scenarios:

Tier 1

1. Scenarios related to discarding given that a minimum size recommendation is in place for northern Swordfish and that the state and quantity of fish below the threshold is not well determined, it was recommended to investigate:

    a) The effect of removing the threshold and retaining everything caught (retention curve = selectivity curve):

    b) The effect of avoidance of juvenile habitat (selectivity curve = retention curve, no discards)

    c) The effect of various levels of discard mortality (currently defined retention and selectivity curves, discard mortality equal to 0%, 50% and 100%)

    d) The effect of poor reporting of discards (Current retention and selectivity curves; discard biomass included in catch data equal to 100%, 50% and 0%)

    e) The effect of crossing c) and d).

2. Effect of conditioning on the combined index: Contrast performance of an OM fit with the combined index only with that of the unit indicators. Evaluate performance of cMPs based on projections from both OMs where the projected data used can be the projected combined indicator or the combined projected unit indicators as appropriate.

3. Effect of Spanish Index: The Spanish index did not fit the data well. If the fit can't be fixed, A single OMs could be compared with the Spanish index included or excluded from the conditioning process.

4. Scenarios related to selectivity change: The potential that selectivity of the fishery will change in the future due to distributional shifts in the demographic components of the stock can be explored by increasing catch of juveniles, adults, adult females and adult males.

5. Scenarios related to there being two stocks: If divergent trends in east Atlantic and west Atlantic indicators are a reflection of trends in separate stocks that do not mix on the fishing grounds, contrast the change in reference points etc. for each area with that of the entire area. This may be possible within the current configuration with a single SR relationship for both stocks and explicitly defined areas.

Tier 2

6. Scenarios related to uncertainty associated with using different modeling platforms within a model-based cMP: fit different models to the same data and explore sensitivity of the outcomes to the type of population model.

3. Status and plans for the development of preliminary CMPs

3.1 cMP types (model-based vs. empirical)

The MSE contractor provided an update on the status and plans for the development of preliminary cMPs. First, he provided a summary of the differences between model based and empirical cMPs as well as the simulation procedures applied to generate simulated data that will be used by cMPs of either type. He highlighted that model-based MPs use a stock assessment model to estimate stock status for eventual use in harvest control rules, this can be data-intensive depending on the assessment model type. Empirical MPs do not use a stock assessment models, but instead use rules based on data to adjust TAC (e.g. indices). It was confirmed that the SWO OMs simulate age- and size-composition data for the projection period and would therefore allow for age-based models to be evaluated with model-based MPs. He then provided a short overview of how to develop cMPs including simple, model-based, and empirical indices. Finally, he provided a summary of the closed-loop procedure used for evaluating cMPs and performance metrics. The contractor drew attention to a cMP development guide he have developed (available on Github) which gives more detail on developing a cMP for the SWO MSE.

The Group discussed cMP types and the question was put to the Group if they wanted empirical or model-based cMPs: no preference was expressed provided that assumptions that underlie the data generation remain valid and that violations in the data generation assumptions (for example changes in selectivity) be examined using robustness tests. Empirical or model-based cMPs are discussed further in section 3.3 below. In addition, the importance of testing a diversity of cMPs was emphasized.

3.2 cMP development responsibilities

The Group discussed where the responsibility for developing cMPs rests and it was suggested that it was on National Scientists to develop them. It was noted that the R package MSETool has a suite of model based and empirical cMPs that are available for testing and modification. Also, the developer offered to assist interested participants in supporting the development of their cMP ideas.

The developer also indicated that the SWO MSE package includes references MP such as zero catch or current catch to assist with tuning and benchmarking the performance of cMPs.

3.3 Performance Metrics

The MSE contractor's presentation provided a summary of candidate performance metrics. The proposed metrics included the broad categories of stock status, safety, yield, and stability. Stock status performance measures include the probability that spawning stock biomass is greater than the spawning stock biomass that produces MSY and that the fishing mortality is less than the fishing mortality that produces MSY. The safety performance metric would be expressed as the probability x, of the stock going falling below some limit (Blim) for example 0.4SB$_{MSY}$. Yield statistics would be expressed as mean catches. Stability could be expressed as the average change in the annual yield or inter-annual variability in catch. In addition to these, the Commission has requested that there be statistics related to the evaluation of minimum size limits (the proportion of total removals that are discarded).

The Chair noted that the Commission had asked that performance metrics be formulated in specific terms. He proposed the document put forward in the Panel 2 report that was a framework specifying the broad categories of the performance measures that should be developed (Res 19-14) to form the basis for formulating performance measures. The Group highlighted the need to define clearly how to calculate the set of performance statistics across the large number of operating models. In addition, it was noted that Res 19-14 should not be considered final as it is work under development. He also presented the set of performance metrics that was proposed for bluefin tuna noting that a similarly large list of metrics might not be desirable for SWO and that the DLMtool has a predefined suite of performance metrics available for testing. The Group agreed that they would form a sub-group (see **Appendix 4**) that could present a list of performance metrics associated with each of the categories in Rec. 19-14 at the September 2020 SWO Working Group meeting.

4. Points of discussion for future Interactions with the Commission

4.1 MSE roadmap

The Chair presented the MSE roadmap agreed for North Atlantic swordfish at the Commission's annual meeting in November 2019. The roadmap sets a workplan for both the SCRS and Commission in the lead up to a 2022 target date for MP adoption.

The Group noted that this roadmap was developed by the Commission to reflect recent progress and outlook from the SCRS, but it should not be regarded as final. Rather, it should be considered as aspirational guidance, and the Group should not sacrifice quality to meet the deadlines, especially in light of potential COVID-related delays this year. The SCRS Chair noted that until there is an agreed method for the SCRS to make decisions virtually, it may be difficult to adhere to previously agreed timelines. It was also noted that this small MSE Group must pass all of its decisions to the broader Swordfish Working Group for approval. This may not extend timelines too much, however, given the membership overlap of the two groups and the success the Swordfish SWGs have had with webinars and ability to schedule them as needed.

Looking at 2020 steps, the Group agreed that the MSE work is on schedule, with preliminary results from candidate MPs expected to be presented to the full Swordfish SWG in September. It is anticipated that the Swordfish SWG will also finalize OM conditioning and adopt a final uncertainty grid at that time.

Regarding the 2021 roadmap, the Group agreed that cMP development will continue, with a plan to present preliminary results to the Commission at an intersessional meeting of SWGSM or Panel 4, preferably in early 2021, so the SCRS can incorporate their feedback into the subsequent work for the remainder of the year. It was pointed out that the Group should propose specific timing for the scheduling of intersessional meetings to ensure that the SCRS gets the information it needs at the appropriate time. The roadmap says that the Commission will adopt operational management objectives, building upon the conceptual objectives agreed in Res. 19-14, and associated performance indicators in 2021.

There is a stock assessment scheduled for 2021 as well, which would necessitate both data preparatory and assessment meetings. However, the Group questioned whether the stock assessment could be postponed until 2022 or later to not detract from progress in the MSE process. As a compromise, the Swordfish SWG could update CPUE indices next year or do a strict update assessment, only adding recent years of data (as is being done for Atlantic bluefin tuna this year). A concern was noted that a strict update assessment can

sometimes have minimal time savings compared to a full assessment, especially if a full assessment is then needed the following year. A justification for a strict update was made based on the fact that the current MSE OM is based on the 2017 SS3 assessment, so by doing a new full assessment in 2021, there would be a disconnect between the assessment and the MSE OM; however, some participants felt this was not an issue. The Group agreed that the Swordfish SWG should consider this issue during its September meeting and make a recommendation to the Commission on its preference for 1) a CPUE indicator analysis, 2) a strict update assessment or 3) a full assessment. It is then the Commission's decision on how to proceed, and they will give the SCRS a directive on assessment format and schedule. It was noted that options 1 and 2 would be faster to carry out in 2021 and would provide advice for a period of 1 or 2 years, while option 3 would be more time consuming for the SWO SWG in 2021 but would produce advice for more years.

The Group concluded that the roadmap is reasonable and endorsed the outlined steps for 2020 and 2021, including finalizing OM conditioning and the uncertainty grid in September 2020. If this progress anticipated for September is hindered by unforeseen obstacles or surprises in the initial CMP results, the Group will reassess the proposed 2021 tasks, including at what point feedback from the Commission is needed, potentially suggesting that the intersessional SWGSM or PA4 meeting be scheduled for later in 2021. In terms of the OM finalization slated for September, it was noted that some axes of uncertainty are still pending. Those could be tested as robustness tests in the projections, rather than including them all in the uncertainty grid, but a decision has not yet been made.

4.2 Exceptional circumstances

The Group acknowledged the progress made by Panel 2 in developing an Exceptional Circumstances Protocol (ECP) for northern albacore (PA2 March 2020 intersessional report, Addendum 1 to Appendix 8). The Chair presented the draft ECP, with its list of indicators and decision tree. The Group agreed that the basic framework of that protocol should be applied to North Atlantic swordfish as a template starting point given the same broad principles apply to swordfish and the considerable effort by both the SCRS and the Commission to develop it.

Per PA2's request, the draft protocol will be reviewed by the Albacore Working Group this year, and additional stock-specific elements are likely to be added. For example, it is important to clarify the table of indicators for exceptional circumstances, as well as certain text elements such as what constitutes "essential" data sets for the MP, to ensure that exceptional circumstances are applied consistently and appropriately.

To determine which indices are "essential," the Group agreed to run the MSE with individual indices removed. This jack-knife analysis would help to quantify and therefore justify why the absence of certain indices would or would not trigger an exceptional circumstance. The Group will propose to the Commission that it will focus on this next year tested across all OMs rather than doing an assessment. The Group agreed to discuss this again and finalize this decision at the fall meeting after initial CMP performance across the uncertainty grid can be evaluated.

The Group agreed to refine the draft ECP following its revision by the Albacore SWG to make it applicable for swordfish, reflecting stock-specific elements such as whether the final MP is model-based or empirical. More broadly, it was noted that the SCRS could discuss whether it wants a common set of EC principles applied to all species, or if there will be different principles for each Species Group.

4.3 Advice interval

The Group discussed the need to determine the advice interval for the future MP, noting that the northern albacore HCR has a 3-year management cycle, which could be used as a precedent. The SWO Coordinator explained that the Commission typically sets swordfish TACs for 3-4 years and that the SWO SWG has set its assessment schedule accordingly based on the Commission's request. The SCRS Chair pointed out assessment frequency is subject to change based on other stocks' assessment schedules.

Longer advice intervals help to balance work schedules and enable fishery stability. However, advice intervals should not be too long, or they might needlessly delay opportunities to increase catch or dangerously postpone necessary catch reductions in response to stock status changes. It was pointed out sometimes it is necessary to stray from the agreed advice interval if exceptional circumstances are identified.

The Commission will determine the advice interval. However, the Swordfish SWG can offer guidance to the Commission on the interval, taking into consideration cMP properties such as frequency of data inputs and how time-consuming it is to run. Before advising the Commission on the length of the management cycle, the Group agreed to set its preferred science schedule for swordfish, including how often a full assessment is needed and whether CPUE indices should be updated every year. It was also noted that the advice interval can impact cMP performance, so the Group might want to evaluate the advice interval as part of the cMP development process. Nevertheless, the Group acknowledged that the advice interval is not tied to the projection period over which performance metrics are calculated.

A question was raised about whether assessments are needed once an MP that is producing advice is in place, especially if it is a model-based MP. The answer was that having occasional stock assessments provides corroboration that the MP is performing as expected. This would be especially relevant when using empirical MPs. For example, southern bluefin tuna has a 3-year advice interval but does assessments every 5 years to confirm the MP is performing as expected. The MSE analyst pointed to a recent publication that discusses how the MP approach can reduce the necessary frequency of assessments (Huynh et al. 2020). The idea is to have shorter intervals to develop TAC advice and longer intervals for assessments to corroborate MP performance.

The Group agreed to establish a small group to outline options for an advice interval to propose to the Swordfish SWG in September. The Chair will lead the group.

4.4 Additional points to be discussed in the PA4 meeting

Two additional issues were raised to explore with the Commission at the 2021 intersessional meeting. First, it is important to determine whether cMPs should assume continuation of the interim limit reference point of $0.4B_{msy}$ set for swordfish in Rec. 13-02. It was also pointed out that every HCR must clearly define what happens at the limit reference point and what it means. Limit reference points do not need to be an inflection point in the HCR, as in the case for northern albacore where the $0.4B_{MSY}$ limit is considered as Blim and fishing mortality is reduced to scientific monitoring when that biomass is breached.

Secondly, it is important to know whether the Commission has a preference for an empirical or model-based MP, or if the Commission will accept either based on CMP performance.

These two issues, as well as those discussed above in Section 4, will be combined with the issues identified at the 2020 SWO SWG intersessional to create a compiled list of issues to discuss with PA4. The list will be presented for agreement at the September SWG meeting.

5. Workplan until the end of the 2020 MSE contract

Task	Responsibility
Develop red face tests and apply to OM and index fit reports	SWO MSE technical team
Finalize OM conditioning and adopt final uncertainty grid (contingent on no major issues in OMs)	MSE contractor, SWO MSE technical team
Define and begin development of robustness OMs	MSE contractor, SWO MSE technical team
Continue development of OM reports	MSE contractor
Investigate minimum size limits	SWO MSE technical team subgroup
Candidate performance metrics	SWO MSE technical team subgroup

Suggest intervals for advice to Commission	SWO MSE technical team subgroup
Investigate influence of various indices and combined index through jack-knife analysis. Decide which indices are included in projections	MSE contractor, SWO MSE technical team
Develop initial cMPs	National scientists with support from MSE contractor
Continue development of metrics for model comparison (e.g. convergence criteria)	MSE contractor, SWO MSE technical team
Tailor exceptional circumstances developed by PA2 and Albacore SWG to SWO biology	SWO MSE technical team

6. Other matters

It was noted that several data inputs needed for the MSE are often only available after a significant time lag (e.g. catch, CPUE indices, catch at size/age, etc.). The Group agreed that the MSE modelling structure must take these time lags into account, particularly given anticipated data availability issues due to COVID-19. It was suggested that the contractor and the SWO MSE technical team test the robustness of the projections and cMPs to data lags and gaps.

7. Closure

The Chair thanked the Group for their engagement and the excellent discussion during this meeting, despite the added difficulties of teleconferencing. The Chair noted the efforts and contributions from both the ICCAT Secretariat and the SWO MSE contractor. The Group noted the exceptional work completed to date by the current MSE contractor. It was noted that the small groups formed during this meeting will continue their work intersessionally and will update the SWO MSE technical team and SWO SWG at meetings this fall.

References

Huynh, Q. C., Hordyk, A. R., Forrest, R. E., Porch, C. E., Anderson, S. C., & Carruthers, T. R. (2020). The interim management procedure approach for assessed stocks: Responsive management advice and lower assessment frequency. Fish and Fisheries, 21(3), 663-679.

Ortiz, M., Mejuto, J., Hanke, A., Ijima, H., Walter, J., Coelho, R., Ikkiss, A.I. (2017) Updated Combined Biomass Index of Abundance of North Atlantic Swordfish Stock 1963-2015, Collect. Vol. Sci. Pap. ICCAT, 74(3): 1275-1294

Agenda

1. Opening, adoption of agenda and meeting arrangements

2. Update on the OM reference grid and model validation

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    2.2. OM plausibility weighting
    2.3. Grid completeness and other axes of uncertainty
    2.4. Robustness OMs

3. Status and plans for the development of preliminary CMP

    3.1. cMP types (model-based vs empirical)
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5. Workplan until the end of the 2020 MSE contract

6. Other matters

7. Closure

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Study groups

Subgroup	Description	Membership
Performance metrics	Develop candidate performance metrics	Nathan Taylor (lead); Nicholas Duprey; Alex Hanke; Craig Brown; Michael Schirripa; Kyle Gillespie; Rui Coelho; Daniela Rosa; Adrian Hordyk
Advice intervals	Develop candidate advice intervals under MSE for consideration by the Commission	Kyle Gillespie (lead)
2021 MSE work plan	Develop a draft SWO MSE workplan for 2021, taking into account the PA4 and Commission meeting schedule	Kyle Gillespie (lead); Nick Duprey, Rui Coelho
Selectivity, mortality and size limits	Investigate impacts of minimum size limits on selectivity and mortality estimates	Adrian Hordyk (lead); Craig Brown; Michael Schirripa; Alex Hanke; Ai Kimoto; Kyle Gillespie; Ikkiss Abdel; Daniela Rosa; Franco Biagi

Appendix 4

Candidate Red Face tests

Test	Description
Input data	Check correct data formatting; checks of occurrence of gear types by area and season via appropriate plots
OM diagnostics	OM should be run in the MSE model with 0 catch and current catch
Likelihood fits	-Examine contribution of various likelihood components to determine if a data source is the main driver of model fit. -Examine fits for systematic trends in residuals as evidence for severe model misspecification, noting the relative prioritization of data weighting
Predicted catch	Predicted annual catches by fleet should be similar to those observed (+/- 10%)
Future catch	Allocation of future catches should match experts' knowledge of spatio-temporal fleet distribution
Length/stock composition	In both past years and future projections, length and stock composition of catches by fleet and area should reflect experts' knowledge