REPORT OF THE 2019 SECOND INTERSESSIONAL MEETING OF THE ICCAT BLUEFIN TUNA MSE TECHNICAL GROUP

(*St. Andrews, Canada, 23-27 July 2019*)

1. Opening, adoption of Agenda and meeting arrangements

The meeting was held at the St. Andrews Biological Station, Department of Fisheries and Oceans Canada, New Brunswick in St. Andrews, Canada, from July 23 to 27, 2019. Drs Douglas Butterworth (Professor Emeritus, University of Cape Town) and Gary Melvin (SCRS Chair), the meeting Chairs, opened the meeting and Mr. Mike Sullivan, Director of St. Andrews Biological Station welcomed all the participants of the Bluefin MSE Technical Group ("the Group"). The Chairs proceeded to review the Agenda, which was adopted with a small change (**Appendix 1**). It was noted that this MSE Technical Group meeting was to deal with technical aspects of MSE, and that discussions pertaining to management policy issues would not be pursued. Due to time constraints, this report focuses on the main outputs of the meeting in this report.

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

Sections	Rapporteur
Items 1, 13-14	A. Kimoto
Item 2-10	C. Fernandez, D. Butterworth, G. Melvin
Item 11	J.J. Maguire, H. Arrizabalaga
Item 12	C. Fernandez, D. Butterworth, G. Melvin, J. Walter

2. Review of available documents

Several documents related to MSE for Atlantic bluefin tuna (BFT) were presented during the meeting.

3. Summary of developments since the February Bluefin Tuna Species Group and Bluefin Tuna MSE and Technical Group meetings, including feedback from the Panel 2 meeting

Presentation by the BFT MSE Contractee on developments since February 2019

The Contractee summarised the work undertaken since February (SCRS/P/2019/045), including the required adjustment of the input data (SCRS/2019/133) (see Section 4) and modifications recommended at the 2019 February Bluefin Tuna Species Group (BFTSG) meeting. These included alternative mixing scenarios and a series of robustness tests designed to evaluate sensitivity of the Operating Models (OMs) to alternative hypothses. The Group was impressed with the progress achieved and expressed its appreciation to the Contractee.

Feedback from Panel 2 meeting regarding management objectives

A presentation of key messages emerging from the Panel 2 meeting in March 2019 was provided.

The main objectives initially identified by this Panel 2 meeting were (see Panel 2 meeting report, Anon. (in press), in particular Part 2 and Appendices 7 and 8 within that report, for further detail):

- At least 60% probability of being in the green area of the Kobe plot over 30 years (Performance metric 21 from Panel 2 report, Appendix 8).
- $P(B<B_{LIM})$ over 30 years should not exceed 15% (Performance metric 28).
- Mean catch should be maximised in each management area over the years 1 to 30 and including short (years 1-10), medium (years 11-20) and long (years 21-30) terms (Performance metrics 1, 4, 5, 6).

- Stability in TAC: evaluate MP options with no limit in TAC changes, as well as limiting TAC changes to no more than 20%, 30% or 40% between consecutive management periods (Performance metrics 22, 23, 24).

The following points were expressed by participants at the present meeting. These will be further discussed at the third BFT MSE Techincal Group and the BFTSG meetings in September 2019:

- In general, further dialogue is needed with managers. At some point the Group will have to decide if it should engage further with the managers early in discussions about management objectives, or whether it should wait until some results from Candidate Management Procedures (CMPs) for final OMs are available so that a better understanding of what may realistically be achieved may be possible.
- In relation to the first objective: The OMs developed for the MSE provide a proxy of annual global F (instantaneous fishing mortality rate) for the stocks, expressed as exploitation rate U, where U is a harvested fraction of the biomass at the start of the year. Also, benchmarks based on U_{MSY} can be calculated to provide the advice on fishing mortality relative to fishing mortality rate at MSY. This is to be further considered by the Contractee.
- Furthermore, in relation to the first objective, the implications of using a dynamic B_{MSY} concept in the evaluation, instead of some static B_{MSY} values, need to be explained to managers.
- In relation to the second objective (depletion relative to B_{LIM}), initial discussions took place concerning its relevance, or lack thereof, for the purpose of evaluating CMPs.
- In relation to the fourth objective (stability of TAC), mention was made that a fixed percentage of maximum TAC change between consecutive management periods should perhaps be incorporated in all CMPs for development tuning purposes.
- Performance metrics 9 and 11, from the Panel 2 report, require further examination as it was unclear to the Group if they were correctly stated in the Panel 2 report.
- The meaning of the phrase "over 30 years" from the Panel 2 report needs clarification.

4. Review of data revisions made prior to the 1 April 2019 deadline

The data revision requested in the 2019 BFT intersessional meeting (Anon., 2019a) were conducted by the Secretariat in cooperation with the requisite experts. This resulted in the final agreed data (SCRS/2019/133) for use in the MSE.

5. Review of OMs for the interim grid and the robustness tests requested by Bluefin Tuna Species Group

In the process of this review during the meeting, aspects were identified that led to the meeting recommending moving to "Option B (Initiate process for stock assessment)" discussed in the 2019 BFTSG meeting (Anon., 2019a), as explained below.

The process leading to the meeting recommendation to move to Option B:

The Group had been tasked with evaluating whether the OMs were sufficiently advanced to be presented to the BFTSG. If the Group determined that the OMs met acceptability criteria, they would be forwarded to the BFTSG in September 2019, where a decision on whether the original MSE Roadmap timeline would be maintained (Option A) or the BFTSG should start planning for a stock assessment in 2020 (Option B), would be made. If the Group considered the OMs were not yet acceptable, option B would be implemented.

The Group acknowledged the substantial progress made in developing OMs, addressing data and coding issues, and initial development of CMPs. Nonetheless, after examining the diagnostics from the conditioned OMs (using the latest agreed data) and from further analysis conducted during the meeting, the Group concluded that additional technical work is needed to improve some important aspects of the OMs in relation to the features of latest agreed data. In these circumstances, the Group could not recommend a final reference set of OMs (a key needed output from the meeting to be able to achieve the planned schedule) and concluded that the MSE process will not be completed in time for the 2020 Commission meeting to provide TAC advice for 2021-2023 based on an MP. Therefore, the Group recommended moving to "Option

B", extending the MSE process for another year. The aim would be to complete the MSE process in time for the 2021 Commission meeting to provide TAC advice for 2022-2024. Option B includes a suite of potential methods to provide 2021 TAC advice, which range from a full stock assessment, a straightforward update of the 2017 stock assessment, or alternative interim approaches to be determined. If the "interim assessment" is an update of the models, including fitting of the indices, advice could be provided for 2021-2023.

The main diagnostic issues detected during the meeting, which led to the recommendation to move to Option B, are explained below.

The main issue that initiated the discussion was the poor fits of the OMs to the RRUSAFS (USA rod and reel fish small) fishery data (length composition data of the fleet and CPUE of the US_RR_66_114 index). These relate to the USA rod and reel recreational fishery RRUSAFS, which, by construction in the model, only includes length data less than 145 cm, but to which the OMs had estimated high selectivity for large lengths. The Group was concerned about the potential impact this misalignment could have on MSE results, particularly as this fleet was also used as the basis to provide the selectivity US_RR_66_114 index in consideration as a potential index for CMPs. It was noted that the current fits of the OMs to this US_RR_66_114 index were also very poor which could have been affected by mispecification of the selectivity. The Group also noted that several other fleets appeared to have similar selectivity misalignments.

A subgroup was convened to investigate these issues during the meeting, and undertook an exploration incorporating cut-off lengths for the selectivities of both the RRUSAFS fleet and the RRUSAFB (fish big) fleet (which includes the USA rod and reel commercial fishery, which catches larger fish than the recreational fishery). The computer code was modified during the meeting to incorporate these restrictions, leading to the outputs shown in **Figures 1-3**. In these figures, the label v5.2.3 refers to estimates from the OM1 original specification without cut-off lengths, whereas the v5.3.1 label refers to estimates from the same OM1 but incorporating cut-off lengths for the selectivities of the RRUSAFS and RRUSAFB fleets.

To address additional selectivity misalignments in other fleets and associated indices, modifications were incorporated in the OMs, as follows:

- Cut-off lengths for the selectivities of all five US rod and reel indices , two baitboat (BBold, BBnew) fleets and one purse seine fleet (Croatian PS) as well as several other fleets were imposed to restrict selectivity to within size bins with observed length data.
- Assigning a selectivity-at-length curve to the French aerial survey intended to approximately cover ages 2-4 only.

OM runs initially undertaken with these specifications indicated difficulties estimating the overall scale of the Western stock (in absolute terms). To further explore this uncertainty, the Group decided to fit OMs considering a range of different weights (CVs) for the Gulf of Mexico larval survey index. This is similar to the robustness test that had been run in advance of the meeting, which reduced the CV of this index (thereby making the model fit that index better) but altered the current status (SSB/SSB_{MSY}) of the Western stock. The aim of examining a range of different CVs for this index was to try to identify how low its CV could be taken without creating serious conflicts for the fits of other indices used in the conditioning of OMs.

A range of CVs for the Gulf of Mexico larval survey index (**Figures 3** and **4**) were considered, which resulted in a range of estimated depletions, but also produced some unexpected results. In particular, it was evident that the scales of the overall spawning biomass estimated for both the West and the East areas were very sensitive to the value of this CV and, for larger CV values, the estimates were much larger than those from the 2017 BFT stock assessments (**Figure 3**), though without leading to any clear differences in the quality of fit to the other indices of abundance.

The revisions to the model selectivities were essential improvements to the OMs. Nonetheless, the substantial sensitivity in absolute abundance of both the western and eastern stocks resulting from rather minor changes in weighting of the Gulf of Mexico larval survey indicated that the OMs require further evaluation than could not be conducted in the time frame of the meeting. The Group outlined a series of diagnostic explorations to be conducted prior to the BFTSG meeting in September 2019 and are reflected as part of the Workplan for further modeling (see Section 12).

These uncertainties prevented the meeting from being able to recommend a final reference set of OMs to be used in the MSE. In these circumstances, it was considered impossible that the MSE process could be completed within the timeframe originally scheduled and the Group recommended moving to Option B.

As already noted, Option B will extend the MSE process by a year, so that the first TAC based on an MP from this process would be for 2022-2024. It also means that some form of "interim assessment" would be necessary to provide advice on the TAC for the year 2021, the details of which will be determined at the BFTSG meeting in September 2019.

"MSE component" of Option B:

A workplan was prepared at the meeting to enable the progress on this to continue. The workplan is described in Section 12 of this report.

"Interim assessment component" of Option B:

Under Option B, it is necessary to provide advice for the 2021 TAC, however this is a matter for the discussion of the BFTSG meeting in September 2019. The Group drew the attention to the fact that the workload associated with the method adopted for such advice has implications for the rate of progress possible for further MSE work. The Group agreed that a full benchmark assessment would further delay the MSE.

6. Evaluation of OMs in relation to diagnostics for acceptability, to advise whether they meet acceptable criteria for presenting to the Bluefin Tuna Species Group

This could not be achieved in this meeting given the absence of finalised OMs at this point (see Section 5 about moving to Option B). The Group noted that previous discussion detailing acceptability criteria had taken place during an earlier meeting, and was reported at the 2019 February BFTSG meeting (Anon., 2019a).

7. Review of Interim Grid to make proposals for a Reference Grid

This could not be accomplished given the absence of results at this point. However, a general discussion was held on the principles underlying the selection of OMs and plausibility weighting (see Section 11).

8. Review of results from CMP developers

Various presentations were provided to the meeting on initial CMPs developed by several participants (**Appendices 3** and **4**). Despite the Group recommendation to move to Option B, the work conducted to date on CMP development was considered to be very useful. An issue related to "omniscience" (in this context a CMP making use of more information than intended and/or would be available in reality) was raised. The concern is that in reality, one would not know that the true dynamics followed exactly one amongst a known limited set of possibilities. Further consideration needs to be given to how to appropriately and fairly evaluate such CMPs, for example additional trials (i.e. expanding the set of OMs) may be required. The Group did, however, agree that for the time being such approaches could continue to be developed, pending the outcome of such further consideration.

9. Tuning of CMPs to a reference west and an east performance statistic for a specified OM to the extent possible, and preparation of summary results

In MSE processes, there are two levels of tuning: one corresponds to what may be called development tuning, whereas the other level refers to tuning in order to meet management and stakeholder objectives.

The general concept of tuning was illustrated using examples from other organisations that have undertaken MSE processes to develop MPs. The type of tuning in the examples presented was more closely related to the second of the two tuning levels mentioned above. The dominant trade-off between the catch taken over a period of years and the resulting resource depletion by the end of that period was highlighted. The objective of tuning is to facilitate evaluation of results of different CMPs for comparable resource recovery versus short-medium term catch trade-offs. Tuning, which is typically effected by selecting a depletion level (in relative terms, i.e. B relative to B_0 or B_{MSY}) that all CMPs should meet (usually in terms of a distribution median) for a single specified OM (or weighted average over a specified set of OMs) in some agreed future year, facilitates the comparison and the understanding of differences in performance between alternative CMPs. The median is preferably used for tuning because it is a computationally robust statistic (as distinct from e.g. a 10th percentile).

The role of robustness tests to further differentiate performance between alternative CMPs was also illustrated.

10. Coding package and Trial Specifications document modifications required

The Group briefly discussed the peer-review process for OMs and MPs based on the recommendations made at the 2019 February BFTSG meeting (Anon., 2019a), noting that this process was perhaps better described as an independent audit of the associated code (the "Package" in respect of the OMs). The Group continues to emphasize the importance of such an audit. The schedule set out at the 2019 February BFTSG meeting (Anon., 2019a) needs to be updated to align with the revised schedule under Option B.

A few updates to the Trial Specifications Document (TSD) were made during the meeting. Further updates will be needed once the MSE Contractee has completed checking code revisions related to selectivity specifications made during the meeting, and these would likely be completed only late in August 2019. The Group agreed that the TSD with those further specifications included should become the **Appendix 5** to this report.

The need for the availability of further information in the form of a glossary of technical MSE terms and a layperson's summary of the MSE process was raised. The Group noted that the Joint Tuna RFMO MSE Working Group (Anon., 2018a) had already developed the former. It was further agreed to discuss at the BFTSG meeting in September 2019 how the latter might best be prepared.

11. Discussion of plausibility weighting of OMs and exceptional circumstances provisions

Reference set of OMs and plausibility weighting:

The discussion on plausibility weighting centered on the principles that can be followed to arrive to a final reference set of OMs and to the relative weights that may be assigned to the different OMs. A basic criterion which any OM must fulfil in order to be considered, and in particular for inclusion in the reference set (or "grid") of OMs is that it must provide an adequate fit to the historical data – indeed this is the whole purpose of conditioning OMs to ensure that they are compatible with observations. The reference set includes those OMs corresponding to what are considered to be the key uncertainties which are both plausible and influential for the outputs from CMP testing. Having past that criterion, the issue then arises of how the different OMs in the reference set should be weighted. Different organisations have approached this differently. In some cases, a large number of OMs (e.g. around 500 OMs) have been included in the reference set in a balanced factorial design, with their relative weightings based on a combination of likelihood fits and expert judgement (CCSBT, 2009). In other cases, the reference set of OMs is small (e.g. less than 20 OMs) and the output has been examined for each OM individually (IWC, 2018). Yet another option may be to assign equal weights to all OMs in the reference set. Any reference set needs to be balanced, in the sense of adequately reflecting the set of scenarios considered to be plausible in reality while avoiding giving undue weight to a certain type of scenario by including too many OMs representing that type of scenario, and in particular avoiding a preponderance of overly negative or overly optimistic appraisals of resource productivity and/or current status.

For BFT, the process of finalising the reference set of OMs and assigning plausibility weighting can only occur after appropriate OM fits to the historical data have been achieved. Given the issues uncovered at this meeting, it will not be possible to finalise the reference set before September 2019. In the best of circumstances, by September 2019 a collection of OMs that fit the available historical data well could be available. In that case, an interim reference set could be put forward for initial CMP runs. All going well, by September 2020 the final reference set of OMs could be agreed and some relevant CMP results could be ready to show to the Commission. Final refinements and MSE simulation work could take place during the following year, so that an MP could be selected at the 2021 Commission meeting in time to be able to set the TAC for 2022-24 based upon it.

Exceptional Circumstances:

The concept of "Exceptional Circumstances" is an integral part of the process of establishing Management Procedures (MP). Generally speaking, Exceptional Circumstances are triggered when reality clearly diverges from what was simulated in the analyses conducted to adopt the Management Procedure such as when i) stock size indices move outside of the ranges tested by the MSE, ii) an extreme environmental regime shift occurs, or iii) the absence of some data makes it impossible to apply the agreed Management Procedure. Exceptional Circumstances define the conditions which would trigger a consideration for perhaps reviewing the Management Procedure. Exceptional Circumstances provisions should be pre-agreed so that any departure from the application of the Management Procedure is not subject to inappropriate influences, or subjective decisions. These are general guidelines applicable to the bluefin tuna MSE process. Specific rules for Exceptional Circumstances will be agreed later in the development of the MSE and adoption of a MP for bluefin tuna.

Exceptional Circumstances were recently discussed in 2018 at the ICCAT Methods Working Group (WGSAM, Anon., 2018b), the 4th meeting of the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers (Annex 4.4 to the *Report for Biennial Period 2018-2019, Part I (2018), Vol. 1*) and at the SCRS meeting. Most of these discussions were around the MSE process for North Atlantic albacore.

In Rec. 17-04 (recommendation adopting an interim Harvest Control Rule for North Atlantic albacore), paragraphs 12-14, the Commission requested that the SCRS develop criteria for the identification of Exceptional Circumstances, taking into account, inter alia, the need for an appropriate balance between specificity versus flexibility in defining Exceptional Circumstances, and appropriate robustness to ensure that Exceptional Circumstances are triggered only when necessary.

Arrizabalaga *et al*., 2018 reviews the definition and implementation of Exceptional Circumstances in CCSBT, IOTC, WCPFC and NAFO. WCPFC discussed an "emergency rule" for Pacific bluefin tuna, in the context of stock assessment because there is no agreed MP for that species. NAFO seems to have the most detailed definition of Exceptional Circumstances which includes defining the action to be taken on the basis of the severity of Exceptional Circumstances. Some Exceptional Circumstances have been defined for stocks that only have an agreed Harvest Control Rule (IOTC) whereas others were defined for stocks with an adopted MP (CCSBT). Some of the indicators used to identify Exceptional Circumstances are linked to data which are part of an adopted MP (e.g. CPUE), while other indicators are not necessarily tied to the input data for the MP.

The WGSAM has developed a set of potential principles that could inform the development of criteria for Exceptional Circumstances. These are general principles that could be adapted for use with any stock. The SWGSM agreed that the first two principles suggested by the WGSAM would signal the possibility of Exceptional Circumstances:

1. When there is evidence that the indices are outside the range predicted in the MSE process.
2. When there is evidence that the data required to apply the Management Procedure are not available or are no longer appropriate.

For item 2 above it should be clearly specified under which circumstances the data will be considered as insufficiently available, or not reliable to be used in the MP (e.g. how many data elements need to be missing or how poor the data has to be to be considered as grounds to invoke Exceptional Circumstances).

The SWGSM did not agree that changing or adding new management objectives constituted an Exceptional Circumstance nor that reviewing what constitute Exceptional Circumstances should be included in every review of the MSE.

Criteria to determine Exceptional Circumstances should include the indicators to be used as evidence, the process for gathering such indicators, and the normal reference range for the indicators. Sometimes anomalies in the data could indicate either a temporary situation or a more significant shift. In such cases, it may be difficult to determine exactly what constitutes Exceptional Circumstances. It would be difficult if not impossible to anticipate all such situations, and, therefore, the SCRS will use the established criteria while exercising professional judgment in making a determination that Exceptional Circumstances have arrived/are in effect.

It is the responsibility of the SCRS to i) determine the existence and severity of the Exceptional Circumstances and provide management advice to the Commission accordingly, and ii) to pre-determine what general steps should be taken each time Exceptional Circumstances exist.

Once Exceptional Circumstances are defined, the course of action to be followed has also to be agreed. This can range from collecting additional information to confirm the exceptional state of the system, to partially halt the application of the Management Procedure, or even abandon the Management Procedure totally and conduct a new MSE to revise the Management Procedure. In all cases, the process for adopting a TAC has to be clearly defined.

The determination of Exceptional Circumstances is tied to the timing and schedule of application of Management Procedure, the frequency of assessments and the ability to monitor the indicators that can be used as evidence for changes in the state of the system. Invoking that data are not sufficient or appropriate for the application of the MP can be done only at the time that the MP needs to be applied to calculate a new TAC. The determination of Exceptional Circumstances based on new evidence that the current state of the system is outside the range predicted under the hypotheses considered in the MSE will depend on when such evidence can be gathered. New evidence on population parameters (e.g. natural mortality, growth) will only come after new and comprehensive research programs have been completed. Evidence that the indices of stock biomass or the estimates of harvest used in the MP are outside the bounds considered in the MSE, can come as often as these indices are estimated: at most annually, more likely just before the application of the MP.

Once the determination has been made that Exceptional Circumstances be invoked, the SCRS will first make an evaluation of the severity of such determination. The severity will determine which one or a combination of the following actions, or others, should be taken:

a) collect additional information to confirm such determination of Exceptional Circumstances, possibly including new/additional indicators or additional year(s) of estimates of the indicator that trigger the determination;
b) trigger a new full assessment;
c) start a new MSE process which will incorporate a broader range of system states, including the system state that has been newly recognized as plausible;
d) continue using the MP to estimate the TAC until a new MP has been developed; and
e) halt the use of the MP and define a new way to estimate the TAC until a new MP can be adopted.

Table 1 (copied with few modifications from WGSAM) provides guidance on factors to be taken into account when evaluating the occurrence of Exceptional Circumstances, indicators to use, the frequency at which they should be examined, the criteria (range of observations) to be considered and the frequency of evaluation of Exceptional Circumstances. The table will be considered further and clarified by the BFTSG meeting in September 2019 and populated as information becomes available.

12. Work plan leading up to September 2019 meetings

The Group agreed a set of tasks for the BFT MSE Contractee in preparation for the September 2019 meetings. The following priority order was also agreed for the tasks identified, noting that not all of them will be accomplished for September and some may require work from experts in addition to the Contractee:

1. Check changes made to OM conditioning code during this meeting, and update the Trial Specification Document to include the revised selectivity specifications
2. Investigate how iterative re-weighting of data components affects model fit
3. Investigate options for modeling selectivity in response to points raised at this meeting
4. Integretation of age compositon data to potentially better inform biomass scale
5. Further sensitivities (e.g. L infinity for eastern fish; splitting the West Mediterranean larval index; single stock)

Concerns were expressed about fallback options if investigation of items 1 - 3 did not resolve the current scale-indeterminacy problem facing the OMs (see Section 5). The Group saw investigation of the impact of the inclusion of age-length key information (Workplan item 4) as the first such option. If that did not then resolve that matter, a full discussion of the matter and its possible wider implications would be needed at the BFTSG meeting in September 2019.

13. Summary of Actions needed

The following points will be further discussed at the third BFT MSE Techincal Group and the BFTSG meetings in September 2019.

- Necessity of further dialogue with managers (Section 3)
- Exploitation rate (U, harvested fraction of the biomass) as a proxy of annual global F and benchmarks based on U_{MSY} (Section 3)
- Implications of using a dynamic B_{MSY} concept (Section 3)
- Relevance of depletion relative to B_{LIM} (Section 3)
- Performance metrics 9 (D30: Depletion at 30 years) and 11 (Depletion at year 30 relative to no catch (i.e. "dynamic"), this differs from D30 because dynamic B0 may not be reached at year 30), from the Panel 2 report (Section 3)
- Incorporation of a fixed percentage (20%, 30% or 40%) of maximum TAC change between consecutive management periods in the CMPs development (Section 3)
- The meaning of the phrase "over 30 years" from the Panel 2 report (Section 3)
- The outcome by the Contractee on the items 1-5 in Section 12
- How to appropriately and fairly evaluate CMPs (Section 8)
- Further MSE meetings and consider a frequency and forms of future meetings of this Group, especially in the contex of the needs of CMPs developers (Section 8)
- A glossary of technical MSE terms and a layperson's summary of the MSE process (Section 10)
- Relative weights that may be assigned to the different OMs (Section 11)

For BFTSG

- Under Option B, it is necessary to provide advice in 2020 for the 2021 TAC (Section 5)
- Update the schedule of an independent peer-review (Section 10)
- Consider Exceptional Circumstances, Table 1 (Section 11)

14. Adoption of the report

The report was adopted during the meeting. Participants thanked the Canadian hosts for their kind hospitality and facilities provided, as well as the ICCAT Secretariat for the support provided to the meeting. The meeting was adjourned.

References

Anonymous. 2018a. Report of the 2018 Joint tuna RFMO Management Strategy Evaluation Working Group Meeting (Seattle, USA, 13-15 June 2018). http://www.tuna-org.org/Documents/tRFMO_MSE_2018_TEXT_final.pdf

Anonymous. 2018b. Report of the 2018 ICCAT Working Group on Stock Assessment Methods Meeting (WGSAM) (Madrid, Spain 7-11 May, 2018). ICCAT Col. Vol. Sci. Papers, 75 (2): 125-165.

Anonymous. (in press). Report of the Intersessional Meeting of Panel 2 (Madrid, Spain, 4-7 March 2019).

Anonymous. 2019a. Report of the 2019 intersessional meeting of the ICCAT Bluefin Tuna Species Group (Madrid, Spain – 11-15 February 2019).

Arrizabalaga H., Merino G., Murua H., and Santiago J. 2018. Characterizing exceptional circumstances in ICCAT: a summary of experience in other RFMOs. ICCAT Col. Vol. Sci. 75 (2): 166-170. SCRS/2018/063.

CCSBT. 2009. Report of the Operating Model and Management Procedure Technical Meeting. (13-17 July 2009 Seattle, USA).

International Whaling Commission. 2018. Report of the Scientific Committee. Annex D. Report of the Sub-Committee on the Revised Management Procedure. J. Cetacean Res. Manage. (Suppl.) 19: 115-153.

Table 1. (Table largely copied from the ICCAT Working Group on Stock Assessment Methods: WGSAM). Guidance on possible candidates indicators and criteria used to evaluate Exceptional Circumstances. Exceptional Circumstances would be invoked if indicators are estimated outside the normal range and would allow for latitude when applying the Management Procedure.

Principle	**Indicator**	**Frequency of estimation**	**Normal range criterium**	**Frequency of evaluation of Exceptional Circumstance**
System State	Stock biomass, SSB	Each full assessment	As defined by a full range of values in the OMs used in the MSE	Each full assessment
	Recruitment			
	Fishing mortality			
	Selection pattern			
	Growth parameters	After completion of new study		After completion of new study
	Maturity schedule			
	Natural mortality			
Application of MP (which includes the HCR)	CPUE indices	Potentially every year	As defined by a full range of values in the OMs used in the MSE	Each time the MP is applied
	Catch estimates			
	Stock biomass (for MPs that need it)			
Change of objectives				

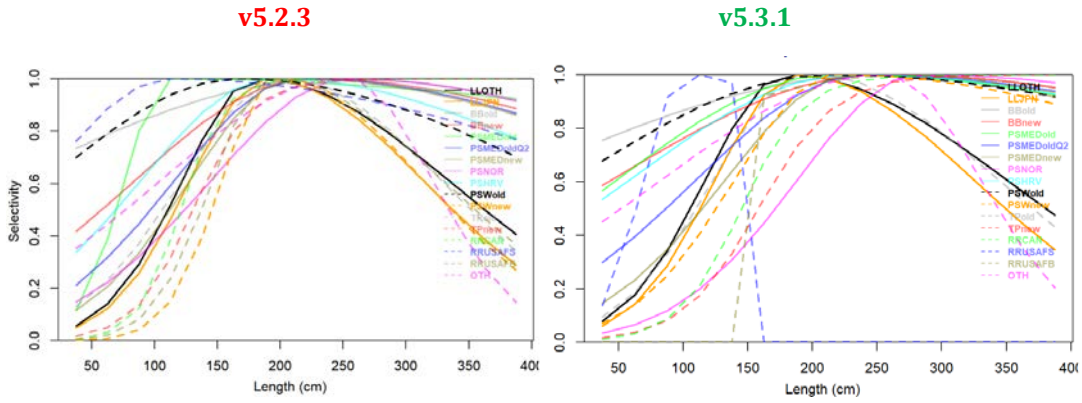


Figure 1. Selectivity-at-length of the 17 fishing fleets incorporated in OMs, without cut-off lengths (v5.2.3, left panel) and with cut-off lengths (v5.3.1, right panel) for the RRUSAFS and RRUSAFB fleets.

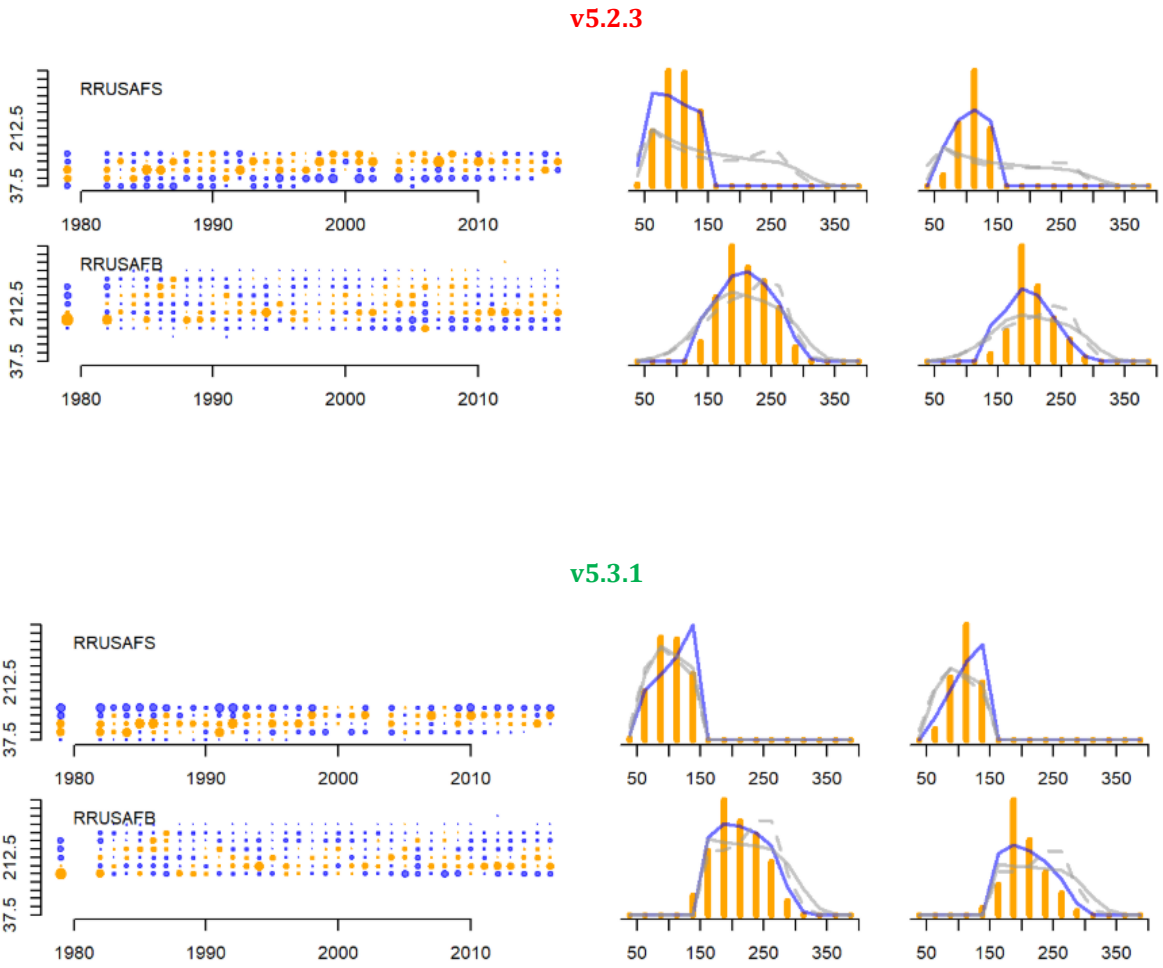


Figure 2. Fits (from OM1) to length composition data of the RRUSAFS and RRUSAFB fleets, without cut-off lengths (v5.2.3, upper panels) and with cut-off lengths (v5.3.1, lower panels). In these panels, the left-hand side shows standardised residuals and the right-hand side shows fits to the observed frequency data aggregating over the entire range of years and over the most recent 10 years.

v5.3.1

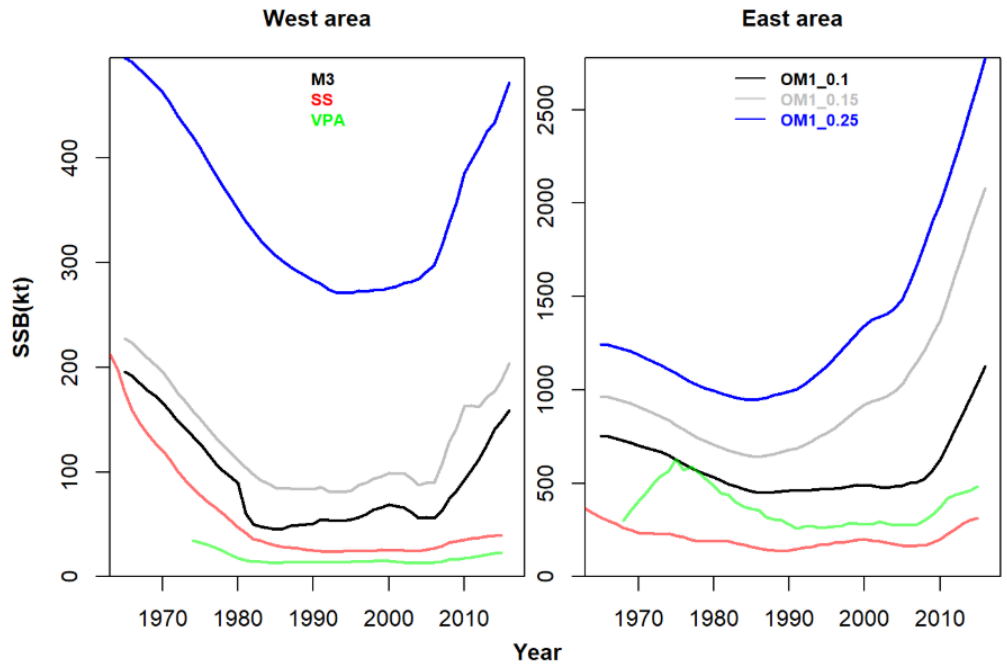
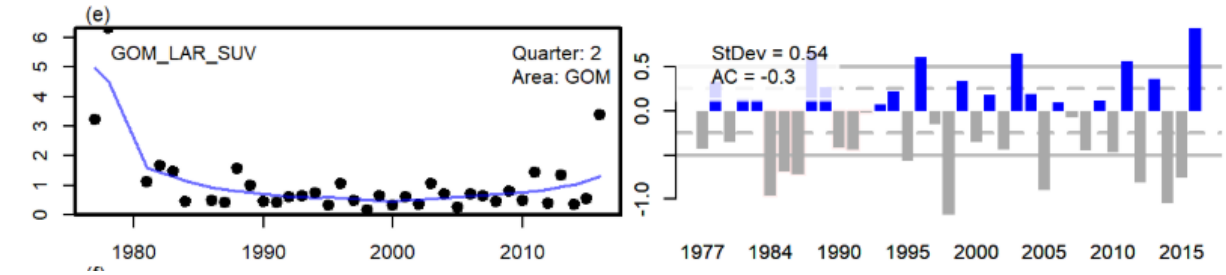
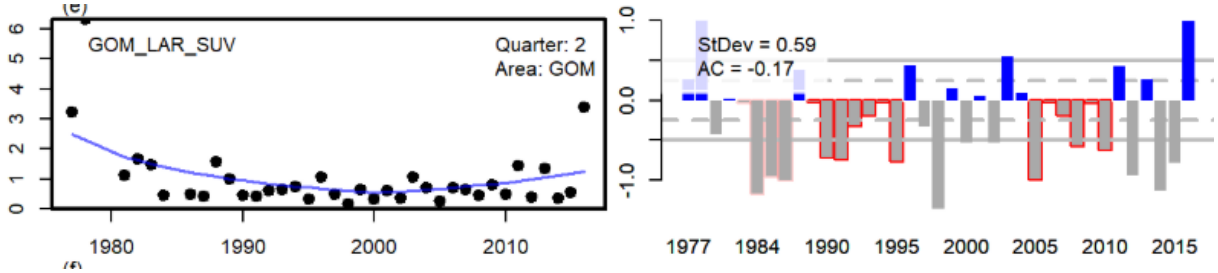


Figure 3. Comparisons of estimated spawning stock biomass in the West (left panel) and East (right panel) areas, from the 2017 Atlantic bluefin tuna stock assessments (VPA and SS, green and red lines, respectively) and the OMs fitted v5.3.1 with a CV of 0.1 (black), 0.15 (gray) or 0.25 (blue) for the Gulf of Mexico larval survey index.

CV 0.1



CV 0.15



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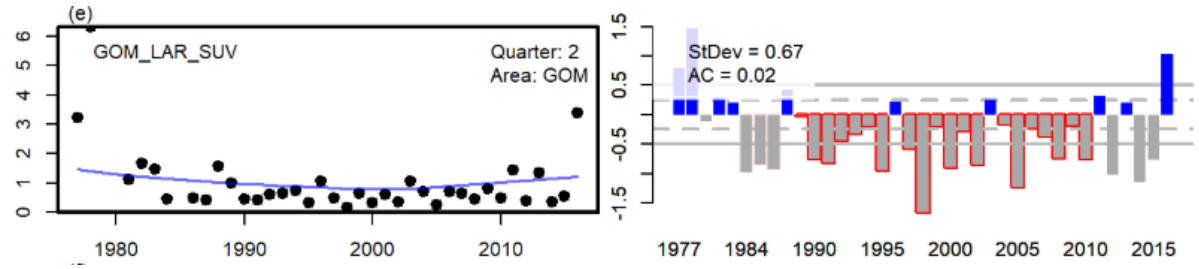

Figure 4. Fits to the Gulf of Mexico larval survey index from OMs (v5.3.1) fitted with a CV of 0.1 (upper panel), 0.15 (middle panel) or 0.25 (lower panel) for this index.

Appendix 1

Agenda

1. Opening, adoption of agenda and meeting arrangements

2. Review of available documents

3. Summary of developments since the February Bluefin Tuna Species Group and Bluefin Tuna MSE Technical Group meetings, including feedback from the Panel 2 meeting

4. Review of data revisions made prior to 1 April 2019 deadline

5. Review of OMs for the interim grid and the robustness tests requested by Bluefin Tuna Species Group

6. Evaluation of OMs in relation to diagnostics for acceptability, to advise whether they meet acceptable criteria for presenting to the Bluefin Tuna Species Group

7. Review of Interim Grid to make proposals for a Reference Grid

8. Review of results from CMP developers

9. Tuning of CMPs to a reference west and an east performance statistic for a specified OM to the extent possible, and preparation of summary results
   Tunings are to facilitate evaluation of results of different CMPs for comparable recovery vs short-medium term catch trade-offs

10. Coding package and Trial Specifications document modifications required

11. Discussion of plausibility weighting of OMs and exceptional circumstances provisions

12. Work plan leading up to September 2019 meetings

13. Summary of Actions needed

14. Adoption of the report

Appendix 2

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Appendix 3

List of Papers and Presentations

Number	Title	Authors
SCRS/2019/126	Engagement of U.S. Stakeholders in Management Strategy Evaluation of Atlantic Bluefin Tuna Fisheries	Cadrin S.X., Kerr L.A., Weston A., and Golet W.
SCRS/2019/127	Performance of a F0.1 management procedure using alternative operating models	Weston A.E., Kerr L.A., Cadrin S.X., and Morse M.R.
SCRS/2019/128	Japanese longline catches of bluefin tuna in the Atlantic ocean, 1950-1970	Schalit D.
SCRS/2019/129	Development of constant harvest rate and index-based candidate management procedures for Atlantic bluefin tuna using the ABT_MSE R package (ver 5.2.3)	Lauretta M., and Walter J.
SCRS/2019/130	Application of "Fixed Proportion" candidate management procedures for North Atlantic bluefin tuna using Operating Model package version 5.2.3	Butterworth D. S., Jacobs M. R. A., Rademeyer R. A., and Miyagawa M.
SCRS/2019/131	Master indices for initializing spatial, seasonal, multi-fleet, multi-stock models: alternative indices and sensitivities	Carruthers T.
SCRS/2019/133	Summary of input data (catch, size and indices) used in the Atlantic bluefin tuna Operating Models (version 5.2.3)	Kimoto A., Carruthers T., Walter J.F., Mayor C., Hanke A., Abid N., Arrizabalaga H., Rodríguez-Marín E., Palma C., and Ortiz M.
SCRS/P/2019/038	Preliminary evaluation of a CMP for Atlantic bluefin using MSE (ver 5.2.3)	Merino G., Arrizabalaga H., Andonegi E., Rouyer T., and Gordoa A.
SCRS/P/2019/044	Performance of 2 empirical management procedures tested on ABT MSE version 5.2.3	Hanke A.R., and Atkinson T.
SCRS/P/2019/045	Report of Activities April - July 2019 for Atlantic bluefin OMs	Carruthers T.
SCRS/P/2019/046	Designing and Testing a Multi-Stock Spatial Management Procedure for Atlantic Bluefin Tuna	Carruthers T.
SCRS/P/2019/047	Additional results of BFT OMs for v5.3.1	Carruthers T.
SCRS/P/2019/048	Model based CMPs using multi-model inference	Cox S.P., Johnson S.D.N., and Rossi S.P.
SCRS/P/2019/049	OM report for OM_1 and three CVs for the precision of the GOM Larval survey (v5.3.2)	Carruthers T.

Appendix 4

SCRS Document and Presentations Abstracts as provided by the authors

SCRS/2019/126 - A series of workshops with U.S. stakeholders in Atlantic bluefin tuna fisheries was initiated to explain Management Strategy Evaluation (MSE) and the ICCAT implementation of MSE for Atlantic bluefin tuna to get stakeholder perspectives on management objectives, aspects of operating models, alternative management procedures, and performance indicators. The first workshop was held in April 2019 in New Bedford Massachusetts to explain the concept of MSE as a tool for fisheries management, describe the MSE approach being developed by ICCAT, and present preliminary demonstrations as an illustration of MSE for Atlantic Bluefin Tuna. The workshop was announced as primarily informational and educational, with no binding decisions or formal consensus-based recommendations. U.S. stakeholders from commercial fishing groups, recreational fishermen, fishery managers, and scientists from university, research institutes, federal agencies, state agencies, and conservation groups attended the initial workshop and provided valuable feedback. Discussions at the workshop helped to inform U.S. scientists participating in ICCAT SCRS. Workshop participants offered recommendations for alternative operating models, performance metrics and candidate management procedures. Previously developed operating models and estimation models are being revised to address stakeholder perspectives and to evaluate alternative management procedures for meeting stakeholders' objectives.

SCRS/2019/127 - Management strategy evaluation (MSE) was used to determine if a F0.1 management procedure was robust to life history uncertainties of Atlantic bluefin tuna. This work was supported by the NOAA Bluefin Tuna Research Program to compliment the ICCAT MSE. Here we build off a previous analysis that used this MSE framework to evaluate F0.1 under stock mixing. Operating models were spatially explicit including two-populations and age structure. Models were initialized from ICCAT perceptions of recruitment, fishing mortality, and observation error with movement modeled independently using telemetry-based movement estimates. Alternative operating model scenarios incorporated key uncertainties in natural mortality-at-age, western maturity-at-age, and projected recruitment for eastern and western bluefin tuna. We evaluated the status quo management procedure for eastern and western bluefin tuna, including the current approach to stock assessment (virtual population analysis) and setting catch advice (F0.1 management procedure) adopted by ICCAT. Preliminary results indicated that F0.1 management produced some shortterm and medium-term decreases in stock and yield but performs well for maintaining or increasing long-term stock and yield metrics across scenarios. This MSE approach is being used along with the ABT-MSE tool to facilitate workshops to gather input from U.S. fishery stakeholders.

SCRS/2019/128 - From 1957 to 1970, Japanese longliners targeting tropical tunas in the Central Atlantic encountered Atlantic bluefin tuna. During this period, catches of bluefin tuna were widely disbursed within the region. This event is one of the most fascinating changes in bluefin tuna spatial distribution observed in the second half of the twentieth century. In particular, the catches that occurred off the coast of Brazil have received much attention in the scientific literature. However, the overall catch data alone provides an incomplete picture. ICCAT is now in the process of conducting a Management Strategy Evaluation of Atlantic bluefin tuna and these older Japanese longline catches are to be incorporated in this process. ICCAT may find it useful to examine these catches more closely with a view toward ensuring that assumptions regarding this data are correct. Therefore, a survey of the scientific literature for discussion of and data pertaining to Japanese longline activity in the Atlantic Ocean during this period may yield some answers to important questions.

SCRS/2019/129 - Three candidate management procedures for Atlantic bluefin tuna are evaluated using the ABT_MSE package in R. The first procedure is based on constant harvest rate strategies for both the east and west stocks, with the target rates tuned to each operating model using terminal F multipliers that achieve median spawning biomass ratios in projections near 1.0. The second management procedure evaluated uses juvenile indices of abundance to predict future changes in allowable catches. The third procedure evaluates the ability to achieve SSB of the West stock at or above current estimates (measured by stock-of-origin indices of abundance in the MSE), a strategy that has been used by managers in the West Atlantic as an objective given uncertainty in spawning biomass estimates and associated benchmarks. Each procedure is evaluated against zero-catch and harvest at levels that produce MSY scenarios for comparison of tradeoffs among strategies. Observations from indices of abundance were assumed to represent the true abundance of spawning biomass and juveniles for each stock and area, respectively, with observation error

(observation model = Good_Obs). Therefore the inference gained is based on the assumption that accurate indices of relative abundance are obtainable in the near future versus whether existing abundances accurately represent stock biomass.

SCRS/2019/130 - Two adjustments are made to the simplest form of the fixed proportion CMPs developed earlier. Caps are placed on the TACs for both the West and the East area so as not reduce resource abundance unduly in circumstances where regime shifts occur. In addition, the TAC for the West area can be reduced further if an index, based on results from the Gulf of Mexico larval survey, drops below a specified threshold; this is necessary to prevent undue depletion in circumstances where the current abundance of the stock of tuna of western origin is low. Results for two variants of this new CMP (FXP_1 and FXP_2) are presented for the interim grid and primary robustness test Operating Models (OMs) (OM1-OM15 of Package version 5.2.3). These reflect more and less conservative approaches, and are intended as initial examples of this form of CMP, and are NOT intended as final candidates. Rather their purpose is to provide rough initial bounds on what variants might ultimately be considered to provide acceptable CMP performance. The results point to the importance of the assignment of plausibility to the scenario reflected by the primary robustness test of lower current western stock abundance. Assigning high plausibility to this can necessitate a reduction in average annual catches of some 1 000 mt in the West area and about 10 000 mt in the East area (at least as far as control rule parameter variants have been able to be explored – this has certainly been a limited exercise only to date). Results for further robustness tests will hopefully follow shortly as a separate Annex. Suggestions for further exploration of control rule variations are made.

SCRS/2019/131 - Version 5 of the M3 model is presented that now calculates apical fishing mortality rates based on annual deviations from a spatial-seasonal index of abundance – the master index. Multiple indices and index weightings are proposed to test whether the model estimates of M3 version 5 are dependent on the choice of master index, a model input that has not yet been subject to detailed peer review. Three master indices of varying seasonal-spatial distribution and trend were constructed from varying data sources. When the influence of these indices was down-weighted by prescribing a large coefficient of variation in the annual deviations, M3 model predictions were similar, independent of the master index used.

SCRS/2019/133 - ICCAT Atlantic Bluefin tuna Working Group (BFTWG) continuously has engaged in MSE process for Atlantic bluefin tuna and has been developing unique operating models (OMs) by taking into account the mixing of the stocks. In the 2019 February BFTWG meeting, the roadmap for the BFT MSE was updated, and the WG requested to review and finalize catch and size input data for the OMs by the 1st of April, 2019. This document provides the summary of input data (catch, size, and CPUEs) in the ABFT OMs (version 5.2.3).

SCRS/P/2019/038 - a CMP previously proposed for Atlantic bluefin tuna, was updated with the most available version of the software (version 5.2.3). This CMP was index based, using an average of 4 indices for the Eastern stock (Japanese Longline, French and GBYP aerial surveys and Mediterranean larval survey) and just one for the Western (Gulf of Mexico larval survey). CPUE targets were fixed at 75% for the east (given the recent high values of eastern CPUEs) and 100% for the west. CPUE observations were assumed to be perfect and TACs were allowed to vary at steps of +/-20% in both cases. The resulting CMP was then compared with MSY(UMSY) and zero catch (ZeroC) MPs available in the ABFT MSE Rpackage, using a set of 30 different OMs. Results were quite different across OMs, and some were difficult to understand, particularly for the ZeroC MP in the Western stock, as there were cases where, assuming a catch rate of 0, the probability of this stock to be in the green was still really low (close to 25%).

SCRS/P/2019/044 – This presentation reviewed the design and performance of 2 empirical management procedures which were tested on ABTMSE version 5.2.3. While both cMPs were similar in their underlying structure, one was configured according to industry specifications. Both cMPs performed well across all reference set and most robustness set OMs in terms of yield, biomass ratio and depletion. However, the industry cMP achieved larger yields bringing the biomass ratio very close to or somewhat below 1.

SCRS/P/2019/045 – This presentation provides the summary of activities on Bluefin MSE, between April and July 2019. Various modifications were made in OMs to reflect the requests by Bluefin WG in February, 2019. The results of OMs version 5.2.6 were shared with the Group.

SCRS/P/2019/046 – A CMP was presented that assumes a mixing rate to use all indices in the inference of stock specific fishing mortality rate and biomass levels.

SCRS/P/2019/047 – This presentation provides the additional results of BFT OMs for version 5.3.1 requested by the BFT Technical Group. Comparisons of robustness projections for zero catch and 100% current catches, and age composition of each stock for OM_1 (high M) and OM_2 (low M) are available to the BFT Technical Group meeting.

SCRS/P/2019/048 - We developed a class of model-based management procedures for Atlantic bluefin tuna based on multi-model inference. The basis of the procedures were five assessment models tuned to five operating models from the reference OM grid, matching productivity and biomass for the recent historical period from 1965 - 2016. In each management interval, these five assessment models were fit to the approved management indices, producing projections of East and West stock biomass, stock mixing, and biological reference points. These estimates were used in harvest control rules, and the five TACs were averaged to produce harvest advice for the East and West area. Multiple MPs were then defined based on varying precautionary TAC caps, maximum target harvest rates, and HCR control points. We found that MPs with lower caps, lower maximum harvest rates and control points avoided overfishing on the reference grid more often. We also found that the subset of OMs that our AMs were tuned to capture the uncertainty of the whole reference OM grid well, evidenced by commensurate performance of our MPs on OMs both inside and outside the tuning subset.

SCRS/P/2019/049 - This presentation provides the additional results of BFT OMs for version 5.3.2 requested by the BFT Technical Group. Since the Technical Group recommended to change the selectivities of several fleets during the meeting, the OMs were updated from version 5.2. 6 to version 5.3.2. The presentation contains OM report for OM_1 and three CVs for the precision of the GOM Larval survey (v5.3.2).

Appendix 5

SPECIFICATIONS FOR MSE TRIALS FOR BLUEFIN TUNA IN THE NORTH ATLANTIC
Version 19-5: August 31, 2019

Specifications for the MSE trials are contained in a living document that is under constant modification. The most recent version of the document (Version 19-5: August 31, 2019) can be found here.