REPORT OF THE 2020 THIRD INTERSESSIONAL MEETING OF THE ICCAT BLUEFIN TUNA SPECIES GROUP

(Online, 1-3 December 2020)

"The results, conclusions and recommendations contained in this Report only reflect the view of the Bluefin Species Group. Therefore, these should be considered preliminary until the SCRS adopts them at its annual Plenary meeting and the Commission revises 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 and assignment of rapporteurs

The third intersessional Bluefin Species Group ("the Group") meeting was held online from 1 to 3 December 2020. Drs John Walter (USA) and Ana Gordoa (EU-Spain), the Rapporteurs for the Western Atlantic and Eastern Atlantic and Mediterranean stocks, respectively, opened the meeting and served as Co-Chairs. SCRS Chair, Dr Gary Melvin (Canada), welcomed the participants, noting the challenging circumstances under which the meeting was being held. On behalf of the Executive Secretary, the Assistant Executive Secretary welcomed the participants to the meeting and highlighted the importance of the meeting for the ongoing works of the Group. However, he noted that holding the meeting in late 2020, and after the SCRS plenary, is not in line with the usual SCRS procedure. The latter implies that the SCRS will only be able to adopt the meeting report in October 2021, until that moment none of the findings, results and recommendations can be considered endorsed by the SCRS.

The Chairs proceeded to review the Agenda which was adopted after minor changes (**Appendix 1**). Due to the time constraints, the Group focused on the main outputs from the meeting in this report and any technical aspects were expanded in Appendices.

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, 2, 8, 11	A. Kimoto
Items 3-4	N.G. Taylor
Item 5	M. Lauretta
Item 6	E. Andonegi
Item 7	J. Walter, J.J. Maguire, A. Kimoto
Item 9	S. Tensek
Item 10	M. Ortiz

2. Brief presentation of September meeting bullet points and decisions

The Chair provided the summary of the September BFT MSE Technical Group meeting (Anon. 2020a) with a list of tasks to the Group, and highlighted that the main objective of this meeting incudes possibly adopting the reference grid and the approach to plausibility as well as decisions regarding GBYP future activities including consideration of the advice from the external peer review of the aerial survey.

3. Outline/identified patterns on robustness OM conditioning reports

The Group reviewed a presentation of robustness operating models (ROMs) provided by the BFT MSE Consultant (SCRS/P/2020/065). The presentation focused on two of the three primary robustness tests: senescence and Western stock growth. The Brazilian catch scenario had been revised but satisfactory convergence of the fit of the model to the data has yet to be achieved. The analysis began with a comparison of these ROMs with their interim grid equivalents. The general finding was that while there is variability in results between the robustness and corresponding interim grid OMs, estimated stock trajectories look

broadly like their interim grid counterparts and fall within the envelope of uncertainty captured by interim grid OMs. Residual patterns for ROMs to indices and length compositions were also comparable to the residual patterns of interim grid OMs fits and, in some cases, provided somewhat better fits. The Group noted that developing a process for detailed review of the model fits by the BFT MSE Technical Group to identify any problematic model estimation/data fits is still required; this detailed review could not be conducted at the meeting due to time constraints.

The Group discussed the presentation. They enquired as to the overall purpose of considering robustness tests and reviewing their fits to the data. In response, explanations were provided that the reasons for conducting the robustness tests was to determine if i) there were consequential factors that justified elevating any robustness tests to the reference grid, and ii) to screen across scenarios that are possible but less plausible to determine whether Candidate Management Procedures (CMPs) are also robust to factors different from those included in the interim grid. Robustness tests had been dividing into primary and "other" classifications: the two that had been examined in the presentation were ones that were candidates for replacement of an existing axis of uncertainty in the current interim grid of OMs. The conclusion at this stage was that there was no reason to reject any of these ROMs and, accordingly, they remain as candidates for consideration for inclusion in the interim grid.

It was also noted that similar model fits and trajectories might still result in appreciable differences in CMP performance. In such cases, important differences do not emerge until CMPs are examined in the simulation testing. A potential example was the senescence scenario: this might be of sufficient importance to include it to the interim grid because it might lead to important differences in future stock trajectories. The Group agreed to discuss this further in Section 6.

4. Update from CMP developers on progress and summarization of development tuning

The BFT MSE Consultant provided a summary of most preliminary CMP results (described individually in SCRS/2020/160, SCRS/2020/165, SCRS/2020/166, SCRS/2020/167 and SCRS/P/2020/064) sent to him for the interim grid set of OMs (SCRS/P/2020/066). All but one developer group (SCRS/2020/167) had sent their CMPs to the Consultant on time. All CMPs were included in the Shiny App, which was updated at the meeting. The CMPs were tuned to one or more of median Br30 (SSB in projection year 30 divided by dynamic SSB_{MSY}, per stock) =1.0, 1.25 and 1.5 for deterministic simulations (no future observation errors in indices or variability about the stock-recruitment relationship) for Western stock. No tuning criteria had been specified for Eastern stock, for which the various developers made different selections.

A summary of the results is as follows:

- Most CMPs could be tuned to 1-1.5 Br30 median for Western stock (not all tunings were available for all CMPs).
- While CMPs could be tuned consistently with respect to this Br30=1 criterion, they showed quite variable results for average catch and average annual variability in catch.
- Other things being equal, Western stock tunings did not appear to impact Eastern stock outcomes.
- Relative conservation performance of the CMPs varied across recruitment scenarios.
- Recruitment scenarios 2 and 3 were the most challenging in term of Western stock biomass outcomes.
- Most CMPs could be tuned to median Br30 = 1.5 for Western stock, but there was very large variability in performance about the median results.
- Only two sets of stochastic CMP results were submitted. These showed a greater variation in Br30 performance than the corresponding deterministic runs.

The Group discussed the presentation in which there was a great deal of interest. The Group noted that: i) one great advantage resulting from the comparisons amongst CMPs is that it allows developers to consider how they might adjust their procedure to improve performance; ii) there are complex interactions causing performance trade-offs when tuned to a single performance statistics; and iii) there is a large amount of information provided for the CMP developers to review in these comparisons, and to the extent possible it would be useful for participants to review the updated CMPs documents and Shiny App comparison provided by the Consultant.

Two additional observations were that tuning CMPs to Eastern stock first might assist the overall tuning process, and that it was very difficult for any CMP to provide satisfactory conservation performance to every OM that incorporates the recruitment 3 scenario. Moreover, the asymmetry between Eastern and Western stock biomasses meant that tuning Eastern stock close to median Br30=1 can result in accepting bigger risks for Western stock; this will require careful consideration in the future. A request was made for the tuned values of the CMP control parameters to be provided. For some CMPs, these are listed in the associated description document, and they are also given in the mathematical descriptions of each of these CMPs provided in their SCRS documents. It will be essential to be document in the report of the Group next meeting as Appendix.

SCRS/2020/167 was discussed. This paper arrived late so it results could not be initially be included in the comparison described above for the other CMPs. Two classes of multi-model CMPs were developed and tested. Only model based CMPs were tuned to a range of Br30 values, tuning first for Eastern stock and then for the Western one. Model-based CMPs tuned to median biomass targets across the reference OM grid avoided crashing both Eastern and Western stocks in over 97.5% of simulations, but asymmetry of TAC effects on the two stocks is potentially the largest hurdle for management. The paper suggested that a potential tuning procedure to address this east-west asymmetry could be to refine CMPs so that TACs for the East area responded to biomass trends for West stock. The MSE Consultant was able to incorporate this CMP along with the others during the meeting.

During the meeting, the MSE Consultant updated his summary to include all CMPs received to date. He provided an additional presentation summarizing the results from all CMPs.

The Group developed general guidelines for CMP developers:

1) Aim to reduce the 90%ile range for Br30 across the interim grid OMs.
2) Note that the AAVC (Average variation in catch) statistics reported for some CMPs are higher than would be likely to be acceptable.
3) Try to avoid lower 5th percentile values for Br30 which are very low.
4) There is a trade-off between catches possible for the East and the West areas – it is unlikely that the Commission would wish to seek catches much higher than achieved historically in the East area at the expense of catches much lower than allocated historically in the West area.
5) Ongoing work to revise several indices currently included may result in different indices for the next reconditioning. At the present time CMP developers should make their own decisions about indices to be tested in their CMPs and then await developments from the Index Sub-group and the reconditioning.

The Group discussed if implementation costs involved in actually applying a given CMP should be considered as part of CMP selection. The Group agreed that, at this point, the primary focus would be on CMP performance but that they expected discussions about costs involved in implementing a given MP would occur in the future.

5. Updated results of the importance of OM reference grid factors

SCRS/2020/161 evaluated alternative performance metrics (safety, stability, yield, and depletion) for 18 CMPs, and used model selection criteria to determine the most influential grid factors on CMP performance. The authors specifically addressed the concern, raised during the September BFT MSE Technical Group meeting (Anon. 2020a), that model overfitting may be problematic. The results confirmed appropriate model specification, and that the number of parameters estimated was not notably high compared to the information provided by the model outputs available. The primary finding was that there was considerable variability in the performance metrics related to individual CMPs and that several OM interim grid factors were determined to have appreciable influence on the results (explaining at least 5% of the null model deviance). The interim grid factors considered were Stock (East vs West), Lengthcomp (data weighting), SpawnMort (maturity/natural mortality alternative assumptions), Scale (absolute biomass priors), Regime (stock-recruitment), as well as all second and third order interaction terms. Across all CMPs, the significant grid factors included Stock, Lengthcomp, SpawnMort, Scale, Regime, Stock:Scale, Stock:Regime, Stock:LengthComp, Regime:Scale, LengthComp:Scale, SpawnMort:Scale. This important work highlighted some of the trade-offs in alternative CMP performance, and that factor selection differed by the metric evaluated and by CMP.

Overall, biomass scale and recruitment regime were determined to have the highest influence, spawn fraction/natural mortality had moderate influence, and movement ("mixing") of Western origin fish to the East Atlantic had the lowest effect. The Group discussed whether the results provided sufficient evidence to reduce the Western stock mixing scenarios to one of the two alternatives. It was noted that selecting one of the existing scenarios is beneficial, since it allows the existing uncertainty grid to be reduced by half and does not require further reconditioning of the model. This decision will be made in Section 6. The BFT MSE Technical Group Chair clarified that the alternative scenario would not be dropped altogether, but rather will be evaluated as a robustness test.

6. Discussion on grid finalization and possible reconditioning

6.1 Existing grid factors and levels

SCRS/2020/154 reviewed the behavior of individual OMs for further consideration and finalization of the OM reference grid, aiming at identifying particular OMs that might show a particularly implausible behavior which consequently would need to be differentially weighted. The analysis was conducted for the 64 conditioned OMs of the interim grid, focusing primarily on information related to biomass, movement and mixing. Four features were identified from the individual OMs results: a) a large difference in abundance between the two stocks; b) a low spawning migration of Eastern BFT from the South Atlantic Ocean to the Mediterranean; c) a recent steep decline of west area biomass (that appears to be caused by the trend of the fraction of Eastern BFT in this West area); and d) remarkably large regime shifts, with four-fold or larger recruitment since 1988 (until 2016). In relation to a), the authors commented that this difference in stocks' size was a characteristic of OMs with the Recruitment 1 scenario (R1), which also tend to have high biomasses, recruitment levels and have high portion of the East stock in the West area biomass.

In discussion, it was noted that the difference is very high when comparing stocks' sizes, but less steep if the comparison is made between the two areas. With regards to b), it was suggested that the location of the northern limit of that southern Atlantic stratum needed to be revised, but that this would be considered for the next round of the MSE process after adoption of an MP. For the current version, this stratum contains the southern part of Spain and Portugal, including the Straits of Gibraltar. It was also highlighted that results provided for the proportion of fish in the Mediterranean are an average over three months; it might be that fish movements or migrations occur over much smaller time periods, e.g. on the scale of a month, so that the proportion of fish entering the Mediterranean would be much greater than the value reported. This last point opened a short discussion about the time adults spend in the Mediterranean, and the Group pointed that it would be worth checking the existing databases where this information could be confirmed. However, it was also suggested that most observations of fish exiting the Mediterranean show migrations to the north, which would not explain these high biomasses in the southern Atlantic. The authors commented that this apparent low level spawning migration in Eastern stock might cause concern among stakeholders about the plausibility of these OMs.

Related to c), it was noted that this feature was observed in eight OMs, all with the Recruitment 2 scenario (R2) and high abundance scale in the West area and low length composition weighting. The authors argued that this steep decrease was not seen in any of the indices. The Consultant was asked to report residual plots for index fits for these and other OMs to check whether there were notably worse fits for the eight OMs identified.

The Consultant provided the additional results during the meeting. It was previously noted that some OMs estimate an alternative trend in spawning stock biomass in the West area which increases before 2005 and decreases afterwards. This alternative trend differs from that estimated by single-area, single-stock assessment models. The Consultant provided a brief presentation on whether there was empirical support for this alternative trend. When examining the fits of these OMs to the indices and stock of origin data, this did not indicate that the alternative trend was inconsistent with those observations. The alternative trend can be attributed to estimated migration of Eastern stock fish, which is not possible in single-area, single-stock assessment models.

Regarding d), the authors commented that the expected large decrease of recruitment after future regime shift in Recruitment 3 scenario (R3) would make it difficult for CMPs to be able to react adequately for those OMs.

A final suggestion was to conduct a similar analysis to the one provided in this document, but focusing only the 'very- plausible' OMs, rather than on the arguably 'implausible' ones.

6.2 Proposals for revisions to the reference grid - possibly considering a robustness test

SCRS/2020/164 noted that most instances of poor conservation performance of CMPs over the interim grid occur for OMs for which there is a regime shift in the future (the R3 scenario), and also a low abundance scale is assumed for the West area. To improve that performance would require a considerable sacrifice in catch for the other OMs. The document also noted that the increase of the Western proportion arises from a decrease of Eastern origin bluefin in the West area. The reason this might be problematic is that the indices detect this too slowly, so that the TAC is not decreased much initially, but comprises a much greater proportion on Western origin bluefin, resulting in a large reduction in the Western stock abundance. As a basis to detect and avoid such situations, the IWC approach of an "acceptable with research" CMP was put forward. In this case, this would involve tuning under the R1 and R2 OMs only, with implementation over a short initial period where an annual index of the proportion of Western origin bluefin in the West area is put in place to provide a basis able to detect a regime shift in Eastern stock. Additionally, close-kin genetics could be developed to provide an improved estimate of the absolute abundance of the Western stock.

The possibility of generating such a stock proportion index in the Package would be considered, but it was suggested by the Consultant that such data may prove to be too noisy to be sufficiently informative to a CMP. The likely reason that such an index is too noisy, at present may be that it comes from both otolith chemistry and genetics. The Group found that the current and potential GBYP genetics samples available for the OMs still had low simple sizes for the West Atlantic and, to truly generate a time series of genetic stock of origin for that area, would require incorporation of genetic samples currently available from the West BFT close-kin genetics pilot into the conditioning. However, this was not deemed possible by March 31, 2021.

The Group asked about the potential effects of having a smoother change in the magnitude of recruitment that accompanies a regime shift, i.e. one that occurs over a longer period. It is likely that a number of additional robustness tests related to the nature of a future regime shift may need to be developed in this regard and may be considered at the 2021 April BFT intersessional meeting.

Another point made related to the fact that models assume a constant movement rate, dictated by the stock of origin and mixing information. However, there could be other factors (environmental variability, food availability, etc.) that might affect that proportion and are not being considered. In response, it was clarified that the residuals of the fits already incorporate that noise, with observations that are not assumed to be perfect. A difficulty could be to disentangle between the noise that can be attributed to observation error, and that can be caused by process variability. It was noted that the ability to detect regime shift may be hampered if there are changes over time in migration rates.

In further discussion, the need of being extremely careful in rejecting CMPs was raised. The rules associated to that process should be agreed and clear. It was suggested that the evaluation of the CMPs should therefore be conducted across a weighted average of the reference grid as the first option, and that a formal process would be required if evaluation of MPs on selected OMs is deemed necessary. The authors expressed the hope that the BFT Species Group could develop a consensus recommendation without needing to have to invoke the "acceptable with research" option described in the document, which should be seen rather as a fallback option.

6.3 Grid finalization and the timing of reconditioning

Time frame of additional years for updated conditioning: 2017-2018

Data Guillotine: March 31, 2021, data not updated by then will not be updated.

Why re-condition?

Constructing and conditioning the OMs for the MSE is not a trivial task. It has required years of discussion, and the conditioning itself has needed months of computational work. The Group agreed that updating is not an exercise to be agreed lightly – the reasons that it may be needed must first be established and agreed.

The most cogent rationale would be that the existing OMs have been conditioned on data up to 2016 only, with projections that start in 2017 and CMP-generated TACs applying only from 2022 onwards. Since 2016, known catches have been taken, and further resource monitoring data, at least, have become available. These may impact the starting conditions for the stock trajectories that are projected, and hence have an important impact on CMP performance statistics values. An additional rational is the work of the Index Sub-group that may lead to important changes of the indices of abundance.

Nevertheless, from a whole process overview standpoint, especially given meeting the deadline of having final MP proposals ready for the Commission's selection and adoption by late 2022, one or more completely comprehensive reconditioning would not be practical, so that consideration has to be given to the following.

- A reconditioning exercise, even with minimal changes to the details of the OMs, would likely require about 25% of the time budgeted annually for the Consultant
- Almost certainly there is time for only *one* reconditioning during the remainder of the current process (ending late in 2022)
- Care needs to be taken to focus and possibly change *only* those aspects that are likely to have a major impact on CMP performance statistics

Items included for re-conditioning

1) Update of catches taken to 2018

2) Update of abundances indices until 2018, based on the fact that recoding of the models to deal with impartial data through 2019 would be time-prohibitive and not all indices are available up to 2019.
   a. Routine extensions of existing indices for further years- almost all of these are available as 'strict updates'. These are almost all available now and will be used unless revisions in (b) and (c) below are approved by the BFT Species Group in April 2021.
   b. Further revisions to some indices where considered a priority and will only affect a few indices. Prioritization will be made as part of the Index Sub-group Terms of Reference (see Section 8.2).
   c. Index revisions and SCRS documents would need to be provided to the BFT Species Group 1 week (standard time for presentation of SCRS documents) before the 2021 April BFT intersessional meeting so that they can be reviewed by the Group.

3) Revising the specifications for observation error (standard deviation and autocorrelation) for the updated indices.
   This would need to be considered by the Consultant in consultation with several members of the BFT MSE Technical Group to be consistent with similar decisions made at the February meeting in 2020 (Anon. 2020b). Any departures from previous treatments will be presented at a webinar for the BFT Species Group.

4) Revision of uncertainty axes included in the interim grid.
   Use mixing axis level I (1% mixing), and the 20% mixing factor (level II) will be moved to the Robustness test. SCRS/2020/161 found that the mixing axis was not consequential for important CMP performance statistics and hence the grid could be simplified by condensing that axis to a single level/value. The 1% mixing (level I) was chosen due to the low probability of finding Western origin individuals in the East, as observed from tagging programmes.

   It was also decided to use the senescence vector in the low M/high Maturity OMs to avoid large relative biomasses of fish of older ages which occurs because of the high survivorship under such low M cases. These low M cases otherwise suggest relatively large numbers of older fish (above age 35) which have never observed.

5) Update of length data in M3 Decision.
   This requires CATDIS (it is available until 2017, if possible to 2018; we will use this). The advantage that including such information brings potentially improved estimation of recent recruitment strength.

- Though there are known issues with Mediterranean Purse Seine length data from 2013-2017 that has not been corrected this will not need to be corrected for input to the MSE.
- Deadline: **March 31, 2021**, if not possible to update then we will use existing CATDIS through 2017, which means only adding one year of data.

6) Review of results of such reconditioning
Obviously this is essential, but for reasons of overall time constraints, it needs to be a relatively swift process; the lessons learnt in the process to date need to be used to guide this exercise towards this end; furthermore, major changes are unlikely if only updates 1), 2) and 3) above are considered. This review will require BFT Species Group participants to review reconditioning reports as they become available, with an additional webinar (beyond those meetings appearing on the ICCAT calendar) to confirm that the results meet "acceptability criterion" (e.g. red face test). Further it will need to be check that any decisions regarding index treatments and autocorrelation time periods are acceptable and remain largely as originally defined by the BFT MSE Technical Group February meeting (Anon. 2020b).

Other options considered but not included in this reconditioning

1) Level choices on uncertainty axes
Only as noted in (3) above.

2) Introduction of "central" level choices on uncertainty axes
An option for Revision to the reference grid was discussed to add central abundance and central length composition weighting levels but was not chosen as it did not substantially decrease the number of runs. While not prioritized now, such an exercise might be helpful for defining a "Reference Case" which typifies the "centre" of the grid, with level choices intermediate between current "extremes" – i.e. corresponding to some form of form of "best" assessment, if necessary for plotting and displays. However. some uncertainty axes are not amenable to this, such as the recruitment axis.

3) Reconsideration of the Recruitment 3 scenario (future regime shift) OMs
See, e.g., SCRS/2020/164 and the suggestion similar to the IWC "Acceptable with research" CMP option. This reconsideration might include taking R3 OMs outside of the grid but, at present, R3 will remain in the grid with several options to consider the merits of having an index of Western stock proportion in the West area and possibly considering adding it to the BFTMSE package. Furthermore, the form of a regime shift e.g. further options, such as adding more gradual regime shifts in addition to the present instantaneous change, will likely warrant consideration as further robustness tests as CMP testing reaches later stages.

4) Changing the basic structure of the OMs (number of strata, strata boundaries, age-grouping, etc.)
This would simply require far more time than is available for the current round. It can be considered in the period after 2023 for the exercise of considering the first revision of the MP (planned in the current process to be adopted in 2022).

5) Updating other data than mentioned above (e.g. archival tagging, genetics)
Processing these data would take too long. Additions to existing datasets already included in the conditioning would likely not result in changes with any major impact on performance statistics.

7. Plausibility weighting of OMs

Subsections 7.1-7.4 have been condensed into a single section for brevity.

Poll will assign quantitative scores to all or selected axes (see Table 2 of the September BFT MSE Technical Group meeting (Anon. 2020a)). Each level within an axis will get a quantitative score such that all levels sum to 1. The default scoring among levels will be equal (0.5/0.5 or 0.33/0.33/0.33) within an axis. A participant can choose not to score an axis (in which case no values will be tabulated), to score equally (in which case the scores will be the default probability) or to assign a different score to each level of an axis.

Questions decided by the Group:

a. Which axes to score: All existing interim grid choices plus Western stock growth.
b. Blind: The poll will be blind (people cannot see other's scores when they score).
c. Authored: Results should be authored (e.g. sign the poll), not anonymous.
d. Justification: Participants who differ from the default scoring will provide a brief scientific justification for their different weighting.
e. Eligible participants: Poll will be open to all attendees to the third intersessional Bluefin Species Group meeting in December 2020.
f. Timing: Poll will be online and will be open from (possibly) December 2020 to February 1, 2021.
g. Process for conducting 'Delphi' score reconciliation.
    i. Scores from poll will be summarized ahead of the 2021 April BFT intersessional meeting.
    ii. If scores are relatively aligned then scores stand as is, as quantitative weights.
    iii. Situations where scoring shows substantial divergence (e.g. some score 90:10 and others 10:90) will need to be reconciled at the 2021 April BFT intersessional meeting.
    iv. Arguments for/against will be made by the more divergent scorers, rescoring conducted and then the scoring repeated.

8. Path forward

8.1 Any revisions to BFT Workplan

The Group reviewed and added some details to the BFT 2021 workplan adopted by the 2020 SCRS Advice (Section 12.1.5, Anon 2020c, details underlined) based on the recommendations from this meeting.

The Group noted that the time allocated for reconditioning the OMs (workplan 2-a) is appropriate assuming that no problems are found with model fitting or major updates. If complications arise, potential delays will depend on the responses of the Group and the ability to address them in the reconditioning process.

Bluefin tuna workplan in the 2020 advice to the Commission (Section 12.1.5 in the 2020 SCRS Advice)

The Bluefin Tuna Species Group gives priority to the MSE process but also recommends focused research efforts from specified Technical Sub-groups to address key uncertainties identified in the 2020 update assessments. The Species Group recommends conducting East and West assessments in 2022 on the basis of targeted investigations conducted by the Technical Sub-groups. These Technical Sub-groups will be tasked with addressing specific issues outlined under (4, below) and possibly funded through specific calls for tenders. The Technical-Groups will present scientific papers on the subjects to the BFT Species Group at 2021 meetings however the actual implementation of the work for assessment advice will occur in 2022 and will be conducted by the full BFT Species Group.

Given the priority placed upon the MSE process the SCRS recommends four meetings: (1) a 5 day in person (physical) bluefin tuna intersessional meeting; (2) a 5 day in person candidate management procedure developers workshop; (3) a 5 day in person bluefin tuna second intersessional meeting; and, (4) a 2-day in person meeting prior to the Species Group meeting to compile CMP recommendations and results. While the meetings are open to all participants it is envisaged that only the intersessional meeting and the 2-day meeting prior to the BFT Species Group would require full participation of the BFT Species Group. This workplan assumes that TAC advice for 2021 and 2022 will be adopted.

The Group is aware that the Commission may request a West BFT stock assessment in 2021. A proposal to conduct this and to fit it into this workplan was proposed to the Group. Although this potential West BFT assessment is not addressed in this workplan, the actual work will be modified as necessary to take the West BFT assessment into account if the Commission requests it. If the Commission requests that a stock assessment for West BFT be carried out in 2021, it is important that such assessment work not be permitted to interfere with the work planned to advance the MSE process. The tentative SCRS and Commission Calendar for 2021 that is currently being considered addresses this, through the timing of meetings and by allocating increased time overall for BFT meetings. In addition, any assessment meeting time will be clearly delineated and will not be permitted to expand into time allocated for MSE discussions.

The workplan follows the remainder of the workplan for 2020:

a) 28-30 September 2020. BFT Technical Group MSE meeting (online)
b) December MSE webinar, and additional as needed

The workplan for 2021 is as follows:

1. Update indicators used in the MSE and the stock assessment to 2019 (or the most recent year) by March 31, 2021.

   Hold four meetings:
   a) Bluefin intersessional meeting (5-day meeting in about March/April)
   b) MSE CMP developers small meeting (about 5 days June); financed by GBYP for developers (exact same terms as was planned for 2020; 1 per CMP group, Chairs, MSE Chair, 2-3 Experts)
   c) Bluefin 2nd intersessional meeting (5-day meeting: September 2-9)
   d) Extended Bluefin Species Group meeting (5 days total, 2-days prior to September SCRS and 3 days during the Species Group week).

2. Work and dialogue related to the MSE

   a) CMP developers continue work to refine CMPs. BFT MSE Technical Sub-group and BFT Species Group continue MSE work.
      a. Conduct online plausibility weighting poll round 1 (January)
      b. Collate scores for the 2021 April BFT intersessional meeting
      c. Webinar (March) to develop and agree a procedure to reconcile divergent scores for weighting OMs prior to the 2021 April meeting. The procedure and resulting proposed weights will be available in a SCRS paper prior to the 2021 April meeting.
      d. Index Sub-group conducts work revising indices to present to the BFT Species Group in April 2021.
      e. Submit updated size data and revised or updated indices by March 31, 2021.
      f. The Secretariat will provide the updated dataset to the MSE Consultant by mid-April, 2021.
      g. April-May: MSE Consultant will check in with the BFT Species Group on the status of the reconditioning and the Group will evaluate scaling back the additional request on conditioning.
      h. June: Consultant conducts reconditioning (6 weeks), sends HTML files by mid-June 2021. (2 weeks for the Group to check the reconditioned OMs)
      i. End-June: Webinar to discuss reconditioning and to evaluate red-face checks of OM (intersessionally)
      j. Developers re-development tune CMPs (one month)
      k. mid-July: Developers' meeting (MSE CMPs meeting)
      l. BFT Species Group meeting

   b) Dialogue with Panel 2, Commissions, once sufficient progress on MSE has occurred.
      a. Panel 2 February (present MSE update and CMP/indicators)
      b. Panel 2 October/November (present update on CMP results)

3. In addition to the aforementioned SCRS meetings, other workshops organized directly by GBYP will require the involvement of bluefin tuna Species group. Those workshops are open to any scientists.

   a) around February-March 2021, workshop for the design of GBYP e-tagging plans (online)
   b) around February-March 2021, workshop on application for Close kin methodology to BFT Eastern Stock (online)
   c) 2021 April BFT intersessional meeting, for defining GBYP 2021 work-plan, considering outputs from Close-kin and e-tagging workshops (online)

4. Task Technical Sub-groups. The purpose of the Sub-groups is to create focused research teams to address specific issues. The teams can operate under their own timing and meeting schedule but will need to report back to the BFT Species Group in September 2021 with their findings and are free to report electronically at any time deemed appropriate. Each Sub-group has an appointed coordinator and will be tasked with developing a workplan (which may be part of a call for tenders for specific funding if necessary). Each Sub-group will be tasked with the following topics:

a) Sub-group 1 (Indices, Coordinator Matthew Lauretta, membership to be determined but will consist of assessment lead modelers, possibly external experts, however the meetings will be open to all. TOR to be drafted by coordinator in consultation with the BFT Chairs):
    a. Evaluate whether the following indices can be improved including through more explicit incorporation of environmental or ecosystem factors: US RR LPS indices and Canada Acoustic index. Noting the potential role of ecosystem factors in affecting the interpretation of many indices, the Committee recommends that effort be directed towards both identifying environmental factors that affect catchability at basin and local scales and incorporating these factors in the index standardization or modeling. The Committee recommends that the bluefin tuna Species Group index analysts attend the Working Group of Stock Assessment Methods (WGSAM) workshop focused on incorporating habitat modeling and environmental considerations into indices and surveys;
    b. Examine the potential effect of recent changes in management and adequacy in representatively sampling the fishery for fishery dependent indices.
    c. Building on the joint CPUE modeling workshop continue to develop joint indices for West BFT (e.g. the Gulf of Mexico between Mexico and United States and for the Northwest Atlantic between United States and Canada);

b) Sub-group 2 (Models, Coordinator Tristan Rouyer, membership to be determined but will consist of assessment lead modelers, possibly external experts, however the meetings will be open to all. TOR to be drafted by coordinator in consultation with the BFT Chairs.
    a. Research to further develop alternative assessment models or to improve existing models. The focus will be on development of reliable models for the East stock, deal with mixing, and prepare for the availability of new data types (e.g. close kin).
        i. ASAP
        ii. Stock Synthesis
        iii. M3 (for both East and West, possibly)
        iv. Improvements to VPA
            1. Extension of plus group
            2. Address issues related to the catch at age for the East

5. Responses to the Commission work
    a) Continue Sub-group on Growth in Farms
    b) Continue the catch rate analysis (*National scientists and Secretariat staff*)

8.2 Sub-Groups TORs

Following the BFT 2021 workplan, two new Technical Sub-groups were created. Drs M. Lauretta and T. Rouyer volunteered to lead and coordinate BFT Technical Sub-group on Abundance Indices and BFT Technical Sub-group on Assessment models, respectively. The Group recognized and accepted the proposal of the Terms of Reference for the Index Sub-group (**Appendix 5**). The Terms of Reference for the Model Sub-group will be agreed by the Group at the 2021 April BFT intersessional meeting.

8.3 MSE roadmap

The Group reviewed and updated the SCRS MSE roadmap document for bluefin tuna (**Appendix 6**) in the 2020 SCRS Advice (Appendix 10, Anon. 2020c). It was pointed out that this MSE roadmap is a part of Commission Documents. The Group was informed that this updated MSE roadmap will likely be presented to the intersessional Panel 2 meeting, although the changes would not formally be adopted by the SCRS until September 2021.

9. GBYP matters

9.1 GBYP aerial survey: Overview of the external advice

Due to the recurrent concerns, GBYP contracted the external review of the GBYP aerial survey design, implementation and statistical analyses, in order to make the Group aware of the main issues and provide recommendation how to move forward. The reviews were prepared by two independent peer reviewers (SCRS/2020/162 and SCRS/2020/163).

The Group found the reviews very useful and thanked the reviewers for their contribution and recommendations for improving the survey. The former GBYP Coordinator explained that most of these improvements have not been possible in the past due to logistic and legislation impediments and warned that some of them are probably still difficult to implement.

The Group was especially concerned about the future of the index of GBYP aerial survey, given that it is currently used in the MSE. Given the problems identified on the survey design and methodology along with the various errors identified in the current calculations, the Group was concerned if the index can still be used, once the methodology is corrected and the index is recalculated. It was acknowledged that base data are more reliable in some areas than the others because of less inconsistencies and better timing of the survey, covering the spawning peak. The reviewers explained that existing base data could still be useful if the methodology is re-evaluated. They also commented that the inconsistencies in data could be better corrected by a model-based approach, which would provide more information than design-based methods. Model-based methods would also help to identify problems in the data, especially considering the limits of the survey areas. They warned that surveying only 4 areas in the Mediterranean could be a problem, if the stock is expanding or changing spatial distribution, in which case the proportion of surveyed population is not constant. Therefore, they recommended to regularly assess the fraction of the target population outside the survey areas and suggested to cover larger areas in a rotation scheme. Finally, they concluded that the existing data can possibly provide a decent time series if the errors in estimates are fixed.

The Group also discussed if the actual index obtained from the aerial survey represents a relative value of spawning biomass or whether it can potentially represent an absolute index of abundance. It was recognized that it is currently used as a relative index and it would be difficult to turn it to an absolute index, even if high coverage of areas is obtained, because some animals are always under the surface and therefore cannot be detected. It was also acknowledged that, even if the best information on all animals in spawning areas is obtained, the interannual variability in the proportion of spawners that are outside the spawning areas in the Mediterranean alters the proportionality between any index and the abundance of spawners, a situation that would also affect a relative abundance index. It was also discussed if the use of habitat model could further correct the current bias, by including spatial and temporal variables into a statistical based standardization model.

In relation to the recommendation for using video or photo cameras in animal counts, the Group was concerned if the strip width they can cover would be too narrow, due to limitations of the cameras and prescribed altitude of the plane. The reviewers explained that lately the technology has improved, which permits flying on higher altitudes and still obtaining a good resolution and recommended widening the field of view by placing multiple cameras. In addition, they clarified that the narrow strip does not represent the problem, as long as sufficient numbers of replicates are made. They recommended switching to completely digital counting at some point in the future, even if it implies disconnecting from the current time series and starting a new series. One possibility can also be carrying out the surveys with both observers and digital system, which would temporarily provide continuation of the existing series. Also, it would provide a potential to calibrate one method against the other. The overlapping between two methods would imply extra cost in the initial period, but would provide savings in a long run. The experts also recommended contracting companies that routinely perform digital counting, since their costs are not high. They also recommended to initiate the pilot study for testing of a digital system in one area only.

The Group commented that it is generally difficult to make decisions on implementing particular improvement, such as switching to video cameras and expanding areas and their coverage, if the associated costs and the total level of available funding are not known. It was therefore recommended to ask the Commission to ensure the funds, if it is essential to use the aerial survey index. If the Group continues to recommend using the index for the MSE, the decision should be made on the Commission level. CPCs should also provide help by solving legal and logistic issues.

It was also discussed how the current GBYP aerial survey index interacts with the other indices, in order to possibly standardize and complement it. It was noted that French aerial survey targets a different fraction of population. It was acknowledged that the larval survey in the Balearic Sea targets a similar fraction of population, but it was discussed if the current values of indices represent the same trend or not.

The Group also discussed if the survey could move to satellite imagery, which possibly represents a cheaper and more objective method for providing an index of animal abundance, and would remove the need for the aerial survey. The Group decided that it is still too early to switch to that method, but that it will be further explored and considered in the future.

Finally, the Group provided a series of recommendations on how to move forward in the short and long term (**Table 1**). For that purpose, a series of options were previously prepared to guide the decision-making process. The final recommendations will be provided to GBYP funders in order to decide on the future of the survey and possibly ensure multi-year funds.

Recommendations

Alternative options

1. Explore satellite imagery as a replacement/covariate or model-assisted survey design. Infra-Red camera was considered not useful for bluefin tuna survey.

Actions (short term)

1. Correct code and calculations by 31 March 2021 → use in MSE conditioning (yes), once corrected, may be useful as a time series. Can we use it in the future (yes), we model it in an appropriate way, once we have the corrected time series.
2. Develop model-based index (faster) to address trends and bias (contract) (target 2021, possibly consider for MSE, only if it can be completed by 31 March 2021).
3. Develop habitat models (2021).
4. The decision for the 2021 Aerial survey will be considered by GBYP the Steering Committee.

Longer term considerations

1. Initiate a paired spotter-video pilot program
2. Define which area upon which to focus pilot programs on

9.2 Information on GBYP Phase 11 proposal to the EU

The GBYP Coordinator shared with the Group a document containing a GBYP Phase 11 proposal to the EU. Given the time constraints, the Group did not fully discuss this at this meeting.

9.3 Additional information regarding other GBYP matters (time permitting)

The GBYP Coordinator provided the report of the GBYP Steering Committee meeting held on 16 November 2020 to the Group. Given time constraints, the Group did not fully discuss this at this meeting.

10. Other Matters

The were no other matters discussed by the Group during the meeting. It should be noted that an SCRS document (SCRS/2020/158) was made available to the Group on the acoustic index of abundance for Western BFT from the Gulf of Saint Lawrence.

11. Adoption of the report and closure

The report was adopted during the meeting. The Chairs of the Group and SCRS Chair thanked all the participants for their efforts. It is with a heavy heart that the Group heard that this would be the last meeting chaired by Dr Ana Gordoa. The co-Chair expressed that she has steered the Group through many challenges, always providing steady and insightful wisdom. She is a trusted colleague and a friend to each of us in the Group. The Group will miss her leadership but we hope that she will continue her contributions to bluefin tuna science. While we regret that we cannot toast her in person, we hope that soon we will share that glass of wine and a proper salutation for her service. The meeting was adjourned.

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Jech J.M., Johnson J.J., Lutcavage M., Vanderlaan A.S.M., Rzhanov Y., and LeRoi D. 2020. Measurements of juvenile Atlantic bluefin tuna (*Thunnus thynnus*) size using an unmanned aerial system. *Journal of Unmanned Vehicle Systems* 8 (2): 140-160. doi: 10.1139/juvs-2018-0039.

Table 1. GBYP Aerial survey – recommendation how to move forward in the short and long term: options and final decisions.

Issue	Possible actions	Additional Cost	Comment/question	Decision
1. Status quo index	Do nothing	None		No
2. Correct errors in code to check variance and index calculation and to use the correct estimator	Correct code	Cheap, one time	This is an absolute necessity, Alnilam should be responsible for this. It is needed by March 2021 for use in any reconditioning of the MSE.	Yes
3. Methods not described in sufficient detail	Document methods and code	Cheap	This is an absolute necessity, Alnilam should be responsible for this.	Yes
4. Correct for differential depth availability (behavior)	Synthesis information on spawning behavior relative to physical variables	Cheap		Yes
	Habitat modeling for vertical distribution	Cheap (use existing PSAT tag info. Acoustic data are already available, but their processing expensive)		Yes
		Moderate option (one way to inform the habitat modeling would be to gather acoustic data from industry to inform vertical distribution)		No, costs of getting industry participation and acoustic processing
	Paired acoustic sampling	Expensive, long term increases in survey costs		No, cost prohibitive
5. Correct for differential spatial availability	Habitat modeling	Cheap	Not always a panacea, habitat not always=fish	Yes
	Expand spatial domain	Expensive, long term increases in survey costs		No, not in short term and not until we have habitat models
	Redesign survey to include wider areas over multiple year			

6. Spotter effect, differential detectability	Increased observer training Double sampling with video, high value of overlap between observers and video Move away from humans	Expensive initially, could be cheaper long-term and more objective Video component tech needs to be developed	Not clear that it would have backward compatibility. Video still needs to be read and video tech needs to be developed. Hard to keep human observers	Yes Yes Yes (when: Pilot survey in 2022)
7. Analysis Methodology. Left truncation (bubble windows or not use)	Correction for the implemented period (2010-2103)	Cheap Possible?	Necessary, Alnilam?	Yes
8. Develop model based index (with covariates of time of year, oceanography, bubble windows)	Build statistical model to account for (4,5,6) Contracts for statistical work	Cheap, one time	How viable is full time series, e.g. can we create a whole time series?	Yes
9. Use drones	High cost of expanded coverage	Expensive initially, could be cheaper long-term	Endurance, cannot go as far, requires substantial investment in tech- see Jech et al., 2020. Possibly long-term cost savings	No
10. Restrict improvements in survey to one region	Conduct 2-6 in Balearics?	Maintain current cost	But we would lose the 3 other regions. Is one region even useful?	No
11. All 2-9	Do it all	Likely double costs.	If we do 2-9 is the historical time series salvageable?	Possibly, particularly the model-based will be useful. Index that is published needs to be revised. If we correct code: Potentially useful.

Appendix 1

Agenda

1 Opening, adoption of agenda and meeting arrangements

2 Brief presentation of September meeting bullet points and decisions

3 Outline/identified patterns on robustness OM conditioning reports

4 Update from CMP developers on progress and summarization of development tuning

5 Updated results of the importance of OM reference grid factors

6 Discussion on grid finalization and possible reconditioning
- 6.1 Existing grid factors and levels
- 6.2 Proposals for revisions to the reference grid - possibly considering a robustness test
- 6.3 Grid finalization and the timing of reconditioning

7 Plausibility weighting of OMs
- 7.1 BFT MSE TG presents initial approach for plausibility weighting to BFT SG
- 7.2 Agree to protocols and guidelines for plausibility weighting
- 7.3 Agree on which axes are to be scored and how scoring would be conducted
- 7.4 Develop online 'poll'

8 Path forward
- 8.1 Any revisions to BFT Workplan
- 8.2 Sub-Groups TORs
- 8.3 MSE roadmap

9 GBYP matters
- 9.1 GBYP aerial survey: Overview of the external advice
- 9.2 Information on GBYP Phase 11 proposal to the EU
- 9.3 Additional information regarding other GBYP matters (time permitting)

10 Other matters

11 Adoption of the report and closure

Appendix 2

List of Participants

CONTRACTING PARTIES

ALGERIA
Ferhani, Khadra
Centre National de Recherche et de Développement de la Pêche et de l'Aquaculture (CNRDPA), 11 Boulevard Colonel Amirouche, BP 67, 42415 Tipaza Bou Ismail
Tel: +213 550 735 537, Fax: +213 24 32 64 10, E-Mail: ferhani_khadra@yahoo.fr; dpmo@mpeche.gov.dz

CANADA
Carruthers, Thomas
2150 Bridgman Ave, Vancouver Columbia V7P 2T9
Tel: +1 604 805 6627, E-Mail: tom@bluematterscience.com

Duprey, Nicholas
Senior Science Advisor, Fisheries and Oceans Canada - Fish Population Science, Government of Canada, 200-401 Burrard Street, Vancouver, BC V5V 4V1
Tel: +1 604 499 0469; +1 250 816 9709, E-Mail: nicholas.duprey@dfo-mpo.gc.ca

Gillespie, Kyle
Fisheries and Oceans Canada, St. Andrews Biological Station, Population Ecology Division, 125 Marine Science Drive, St. Andrews, New Brunswick, E5B 0E4
Tel: +1 506 529 5725, Fax: +1 506 529 5862, E-Mail: kyle.gillespie@dfo-mpo.gc.ca

Hanke, Alexander
Scientist, St. Andrews Biological Station/ Biological Station, Fisheries and Oceans Canada, 125 Marine Science Drive, St. Andrews, New Brunswick E5B 2T0
Tel: +1 506 529 5912, Fax: +1 506 529 5862, E-Mail: alex.hanke@dfo-mpo.gc.ca

Maguire, Jean-Jacques
1450 Godefroy, Québec G1T 2E4
Tel: +1 418 527 7293, E-Mail: jeanjacquesmaguire@gmail.com

EGYPT
Elfaar, Alaa
E-Mail: alaa-elfar@hotmail.com

EUROPEAN UNION
Álvarez Berastegui, Diego
Instituto Español de Oceanografía, Centro Oceanográfico de Baleares, Muelle de Poniente s/n, 07121 Palma de Mallorca, España
Tel: +34 971 133 720; +34 626 752 436, E-Mail: diego.alvarez@ieo.es

Andonegi Odriozola, Eider
AZTI, Txatxarramendi ugartea z/g, 48395 Sukarrieta, Bizkaia, España
Tel: +34 661 630 221, E-Mail: eandonegi@azti.es

Arrizabalaga, Haritz
AZTI Marine Research Basque Research and Technology Alliance (BRTA), Herrera Kaia Portualde z/g, 20110 Pasaia, Gipuzkoa, España
Tel: +34 94 657 40 00; +34 667 174 477, Fax: +34 94 300 48 01, E-Mail: harri@azti.es

Bridges, Christopher Robert
Heinrich Heine University, Düsseldorf AG Ecophysiology, Institute for Metabolic Physiology: Ecophysiology / TUNATECH GmbH Merowinger, Platz 1, 40213 Duesseldorf Nrw, Germany
Tel: +4901739531905, E-Mail: bridges@hhu.de; christopher.bridges@uni-duesseldorf.de

Coco, Ornella
Scientific Advisor, Oceanis Srl, 89043 Salerno, Italy
Tel: +39 342 582 8477, E-Mail: ornellacoco.biomol@gmail.com

Di Natale, Antonio
Aquastudio Research Institute, Via Trapani 6, 98121 Messina, Italy
Tel: +39 336333366, E-Mail: adinatale@acquariodigenova.it

Gordoa, Ana
Centro de Estudios Avanzados de Blanes (CEAB - CSIC), Acc. Cala St. Francesc, 14, 17300 Blanes, Girona, España
Tel: +34 972 336101, E-Mail: gordoa@ceab.csic.es

Macías López, Ángel David
Ministerio de Ciencia, Innovación y Universidades, Instituto Español de Oceanografía, C.O. de Málaga, Puerto pesquero s/n, 29640 Fuengirola Málaga, España
Tel: +34 952 197 124; +34 619 022 586, Fax: +34 952 463 808, E-Mail: david.macias@ieo.es

Maxwell, Hugo
Marine Institute, Furnance, Newport, County Mayo, F28PF65, Ireland
Tel: +353 894 836 530, E-Mail: hugo.maxwell@marine.ie

Muñoz Lechuga, Rubén
Instituto Português do Mar e da Atmosfera - I.P./IPMA, Avenida 5 de Outubro, s/n, 8700-305 Olhão Faro, Portugal
Tel: +351 289 700 504, E-Mail: ruben.lechuga@ipma.pt

Pappalardo, Luigi
Scientific Advisor, OCEANIS SRL, Vie Maritime 59, 89043 Salerno, Italy
Tel: +39 081 777 5116; +39 345 689 2473, E-Mail: oceanissrl@gmail.com; gistec86@hotmail.com

Pignalosa, Paolo
Technical Director, Oceanis Srl, Via Marittima, 59, 80056 Ercolano - Napoli, Italy
Tel: +39 81 777 5116; +39 335 669 9324, E-Mail: oceanissrl@gmail.com

Reglero Barón, Patricia
Centro Oceanográfico de las Islas Baleares, Instituto Español de Oceanografía, Muelle de Poniente s/n, 07006 Palma de Mallorca Islas Baleares, España
Tel: +34 971 13 37 20, E-Mail: patricia.reglero@ieo.es

Rodríguez-Marín, Enrique
Ministerio de Ciencia, Innovación y Universidades, Instituto Español de Oceanografía, C.O. de Santander, Promontorio de San Martín s/n, 39009 Santander, Cantabria, España
Tel: +34 942 291 716, Fax: +34 942 27 50 72, E-Mail: enrique.rmarin@ieo.es

Rouyer, Tristan
Ifremer - Dept Recherche Halieutique, B.P. 171 - Bd. Jean Monnet, 34200 Sète, Languedoc Rousillon, France
Tel: +33 782 995 237, E-Mail: tristan.rouyer@ifremer.fr

Rueda, Lucía
Ministerio de Ciencia, Innovación y Universidades, Instituto Español de Oceanografía Málaga, Puerto pesquero s/n, 29640 Fuengirola Málaga, España
Tel: +34 952 197 124, E-Mail: lucia.rueda@ieo.es

Tugores Ferra, Maria Pilar
ICTS SOCIB - Sistema d'observació y predicció costaner de les Illes Balears, Parc Bit, Naorte, Bloc A 2ºp. pta. 3, E-07121 Palma de Mallorca, España
Tel: +34 971 439 998, E-Mail: pilar.tugores@gmail.com; ptugores@socib.es

GUINEA REP.

Camara, Ousmane Tagbe
Directeur General Adjoint, Centre National des Sciences Halieutique de Boussoura (CNSHB), B.P.: 307, Conakry
Tel: +224 628 68 81 16, E-Mail: oustcamara@gmail.com

Soumah, Mohamed
Tel: +224 622 01 70 85, E-Mail: soumahmohamed2009@gmail.com

JAPAN

Butterworth, Douglas S.
Emeritus Professor, Department of Mathematics and Applied Mathematics, University of Cape Town, Rondebosch, 7701 Cape Town, South Africa
Tel: +27 21 650 2343, E-Mail: doug.butterworth@uct.ac.za

Fukuda, Hiromu
Head of Group, Highly Migratory Resources Division, Fisheries Stock Assessment Center, Fisheries Resources Institute, Japan Fisheries Research and Education Agency, 5-7-1 Orido, Shimizu-ku, Shizuoka-shi, SHIZUOKAKEN 424-8633
Tel: +81 543 366 035, E-Mail: fukudahiromu@affrc.go.jp

Kitakado, Toshihide
Professor, Faculty of Marine Science, Tokyo University of Marine Science and Technology, Department of Marine Biosciences, 4-5-7 Konan, Minato, Tokyo 108-8477
Tel: +81 3 5463 0568, Fax: +81 3 5463 0568, E-Mail: kitakado@kaiyodai.ac.jp; toshihide.kitakado@gmail.com

Miura, Nozomu
Assistant Director, International Division, Japan Tuna Fisheries Co-operative Association, 2-31-1 Eitai Koto-ku, Tokyo 135-0034
Tel: +81 3 5646 2382, Fax: +81 3 5646 2652, E-Mail: miura@japantuna.or.jp; gyojyo@japantuna.or.jp

Nagai, Daisaku
Manager, International Division, Japan Tuna Fisheries Co-Operative Association, 31-1, EITAI 2-CHOME, Koto-ku, Tokyo 135-0034
Tel: +81 356 462 382, Fax: +81 356 462 652, E-Mail: nagai@japantuna.or.jp

Nakatsuka, Shuya
Director, Pacific Bluefin Tuna Resources Group, National Research Institute of Far Seas Fisheries, Japan Fisheries Research and Education Agency, 5-7-1 Orido, Shizuoka Shimizu 424-8633
Tel: +81 543 36 6035, Fax: +81 543 36 6035, E-Mail: snakatsuka@affrc.go.jp

Rademeyer, Rebecca
Marine Resource Assessment and Management Group, Department of Mathematics and Applied Mathematic - University of Cape Town, Private Bag, 7700 Rondebosch, South Africa
Tel: +651 300 442, E-Mail: rebecca.rademeyer@gmail.com

Tsukahara, Yohei
ScientistHighly Migratory Resources Division, Fisheries Stock Assessment Center, Fisheries Resources Institute, Highly Migratory Resources Division, Fisheries Stock Assessment Center, Fisheries Resources Institute, Japan Fisheries Research and Education Agency, 5-7-1 Orido, Shizuoka Shimizu-ku 424-8633
Tel: +81 54 336 6000, Fax: +81 54 335 9642, E-Mail: tsukahara_y@affrc.go.jp

Uozumi, Yuji
Adviser, Japan Tuna Fisheries Co-operation Association, Japan Fisheries Research and Education Agency, 31-1 Eitai Chiyodaku, Tokyo 135-0034
Tel: +81 3 5646 2382, Fax: +81 3 5646 2652, E-Mail: uozumi@japantuna.or.jp

KOREA REP.

Lee, Mi Kyung
National Institute of Fisheries Science, Distant Water Fisheries Resources Research Division, 216 Gijanghaean-ro, Gijang-eup, Gijang-gun, 46083 Busan
Tel: +82 51 720 2332, Fax: +82 51 720 2337, E-Mail: ccmklee@korea.kr; cc.mklee@gmail.com

MEXICO

Ramírez López, Karina
Instituto Nacional de Pesca y Acuacultura - Veracruz, Av. Ejército Mexicano No.106 - Colonia Exhacienda, Ylang Ylang, C.P. 94298 Boca de Río, Veracruz
Tel: +52 22 9130 4520; +52 229 176 8449, E-Mail: kramirez_inp@yahoo.com

UNITED STATES

Aalto, Emilius
120 Ocean View Blvd, CA Pacific Grove 93950
Tel: +1 203 809 6376, E-Mail: aalto@cs.stanford.edu

Brown, Craig A.
Chief, Highly Migratory Species Branch, Sustainable Fisheries Division, NOAA Fisheries Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, Florida 33149
Tel: +1 305 586 6589, Fax: +1 305 361 4562, E-Mail: craig.brown@noaa.gov

Kerr, Lisa
Gulf of Maine Research Institute, 350 Commercial Street, Portland ME 04101
Tel: +1 301 204 3385, E-Mail: lkerr@gmri.org

Lauretta, Matthew
NOAA Fisheries Southeast Fisheries Center, 75 Virginia Beach Drive, Miami, Florida 33149
Tel: +1 305 361 4481, E-Mail: matthew.lauretta@noaa.gov

Peterson, Cassidy
NOAA Fisheries, 75 Virginia Beach Drive, Miami, FL 33149
Tel: +1 630 639 1280, E-Mail: cassidy.peterson@noaa.gov

Schalit, David
176 Mulberry Street - 4th floor, New York 10013
Tel: +1 917 573 7922, E-Mail: dschalit@gmail.com

Walter, John
NOAA Fisheries, Southeast Fisheries Center, Sustainable Fisheries Division, 75 Virginia Beach Drive, Miami, Florida 33149
Tel: +305 365 4114, Fax: +1 305 361 4562, E-Mail: john.f.walter@noaa.gov

OBSERVERS FROM NON-GOVERNMENTAL ORGANIZATIONS

MONTEREY BAY AQUARIUM

Boustany, Andre M.
Monterey Bay Aquarium, 886 Cannery Row, Monterey, CA 93940, United States
Tel: +1 831 402 1364, E-Mail: aboustany@mbayaq.org

PEW CHARITABLE TRUSTS – PEW

Cox, Sean
School of Resource and Environmental Management, Simon Fraser University, 8888 University Drive, British Columbia Burnaby V5A1S6, Canada
Tel: +1 78 782 5778; +1 604 763 1414, Fax: +1 778 782 4968, E-Mail: spcox@sfu.ca

Galland, Grantly
Pew Charitable Trusts, 901 E Street, NW, Washington, DC 20004, United States
Tel: +1 202 540 6953, Fax: +1 202 552 2299, E-Mail: ggalland@pewtrusts.org

Johnson, Samuel D.N.
School of Resource and Environmental Management, 8888 University Drive, Burnaby, BC V5A1S6, Canada
Tel: +1 604 365 7133, E-Mail: samuelj@sfu.ca

THE OCEAN FOUNDATION

Miller, Shana
The Ocean Foundation, 1320 19th St., NW, 5th Floor, Washington, DC 20036, United States
Tel: +1 631 671 1530, E-Mail: smiller@oceanfdn.org

Pipernos, Sara
The Ocean Foundation, 1320 19th St. NW, Washington DC 20036, United States
Tel: +1 860 992 6194, E-Mail: spipernos@oceanfdn.org

SCRS CHAIRMAN

Melvin, Gary
SCRS Chairman, St. Andrews Biological Station - Fisheries and Oceans Canada, Department of Fisheries and Oceans, 285 Water Street, St. Andrews, New Brunswick E5B 1B8, Canada
Tel: +1 506 652 95783, E-Mail: gary.d.melvin@gmail.com; gary.melvin@dfo-mpo.gc.ca

SCRS VICE-CHAIRMAN

Coelho, Rui
SCRS Vice-Chairman, Portuguese Institute for the Ocean and Atmosphere, I.P. (IPMA), Avenida 5 de Outubro, s/n, 8700-305 Olhão, Portugal
Tel: +351 289 700 504, E-Mail: rpcoelho@ipma.pt

INVITED EXPERT

Buckland, Stephen T.
CREEM, The Observatory, Buchanan Gdns, St Andrews, Scotland KY16 9LZ
Tel: +44 1334 461841; +44 1334 461842, E-Mail: steve@st-andrews.ac.uk

Parma, Ana
Principal Researcher, Centro para el Estudio de Sistemas Marinos, CONICET (National Scientific and Technical Research Council), Blvd. Brown 2915, U 9120 ACF Puerto Madryn, Chubut, Argentina
Tel: +54 (280) 488 3184 (int. 1229), Fax: +54 (280) 488 3543, E-Mail: parma@cenpat-conicet.gob.ar; anaparma@gmail.com

Vølstad, Jon Helge
Representing Center of Independent Experts, Strangehagen 22, 5011 Bergen, Norway
E-Mail: jonhelge@hi.no

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ICCAT Secretariat

C/ Corazón de María 8 – 6th floor, 28002 Madrid – Spain
Tel: +34 91 416 56 00; Fax: +34 91 415 26 12; E-mail: info@iccat.int

Neves dos Santos, Miguel
Ortiz, Mauricio
Kimoto, Ai
Taylor, Nathan
Alemany, Francisco
Pagá, Alfonso
Tensek, Stasa

Appendix 3

List of Papers and Presentations

Number	Title	Authors
SCRS/2020/154	Review of behavior of individual operating models from BFT MSE reference grid	Nakatsuka S., and Tsukahara Y.
SCRS/2020/158	2019 update to the Gulf of Saint Lawrence acoustic index of abundance for Atlantic bluefin tuna	Minch T, Turcotte F., and McDermid J.L.
SCRS/2020/160	Further refinement of the MFXP (modified fixed proportion) CMP	Butterworth D.S., and Rademeyer R.A.
SCRS/2020/161	Towards an assessment of the important sources of uncertainty affecting bluefin tuna management procedure performance	Hanke A., Ortiz M., Arrizabalaga H., Andonegi E., and Duprey N.
SCRS/2020/162	Independent peer review of the revision of GBYP aerial survey design, implementation and statistical analyses (ICCAT GBYP 12/2020) of the Atlantic-wide research programme for bluefin tuna (ICCAT GBYP Phase 10)	Buckland S.T.
SCRS/2020/163	Review of the revision of GBYP aerial survey design, implementation and statistical analyses (ICCAT GBYP 12/2020) of the Atlantic-wide research programme for bluefin tuna (ICCAT GBYP Phase 10)	Vølstad J.H.
SCRS/2020/164	A possible approach to address the poor performance of CMPs under some R3 OMs	Butterworth D.S., and Rademeyer R.A.
SCRS/2020/165	Designing and testing a multi-stock spatial management procedure for Atlantic bluefin tuna	Carruthers T.
SCRS/2020/166	Tuning result of simple candidate management procedure (TN_1) for MSE of Atlantic bluefin tuna	Tsukahara Y., and Nakatsuka S.
SCRS/2020/167	Two classes of multi-model candidate management procedures for Atlantic bluefin tuna	Cox S.P., Johnson S.D.N., and Rossi S.P.

SCRS/P/2020/064	Latest progress on development tuning the EA1 and EA2 index-based cMPs	Andonegi E., Arrizabalaga H., Rouyer T., and Gordoa A.
SCRS/P/2020/065	Summary of Robustness OM Conditioning	Carruthers T.
SCRS/P/2020/066	Preliminary CMP results for reference set operating models	Carruthers T.

Appendix 4

SCRS Document and Presentations Abstracts as provided by the authors

SCRS/2020/154 - We reviewed the behavior of individual OMs form BFT MSE for further consideration and finalization of OM reference grid. Some notable behaviors such as very large west-east stock size difference and seasonal movement which are different from current perception were observed over a range of OMs and BFT WG needs to consider how to treat them in OM plausibility/weighting discussion.

SCRS/2020/158 - In 2016, a fishery-independent index of abundance was developed for Bluefin tuna in the Gulf of Saint Lawrence (GSL) to support the stock assessment. The index was developed by identifying Bluefin tuna in historic acoustic herring data. The GSL acoustic time series has largely been consistent with BFT catch-per-unit-effort (CPUE), however, recent updates suggest a significant decline in BFT that does not appear to be consistent with CPUE. This report provides an update to the index of abundance using 2019 acoustic herring survey data. Bluefin tuna abundance for 2019 is slightly higher than 2018 but is still low (0.015 BFT/km stratum area weighted). While spatial coverage (# of transects) was lower in 2019 than 2018, detection rates are comparable. Herring biomass was notably low (0.083 kg/m2) in 2019, for the second consecutive year, which may cause tuna to forage in other regions of the GSL when herring reach a critically low biomass in the Baie-des-Chaleurs. Future work aims to continue investigating the cause of the decline.

SCRS/2020/160 - Results are reported for a refined MFXP CMP for tunings as specified at the September MSE meeting. The primary improvement compared to the previous version of this CMP is achieved by upweighting the contributions of the US_RR indices to the aggregated index used to calculate TACs for the West area. This leads to an improvement in conservation performance for the Western stock for OMs with a future regime shift, without any obvious associated disadvantages. The reason is that these indices detect the effect of such a regime shift earlier than the others available for the West area.

SCRS/2020/161 - The performance of 18 management procedures was determined across a reference grid of 96 operating models. Performance relative to objectives of stock safety, stability in yield, yield magnitude and state of the population was related to the features of all axes of uncertainty associated with each of the operating models. A GLM approach was used to quantify the fraction of null deviance explained by model predictors, where the final model was determined using stepAIC applied to the data for each management procedure and each of the response variables.

SCRS/2020/162 - Aerial surveys of the bluefin tuna stocks of the Mediterranean were carried out in each of seven years between 2010 and 2019 inclusive. The most recent time series of estimates shows large differences from previous estimates, and high interannual variation both within and between regions. I review the survey design, the field methods, and the methods of analysis. I conclude that spatial and temporal coverage of the survey may be insufficient to yield a reliable time series of estimates, especially if spawning locations and spawning times vary across years. Given the difficulties that observers face in recording reliable data for the line transect method, I suggest that the use of high-resolution imagery be explored, possibly in conjunction with long-distance drones. Video or still images taken from higher altitude provide a permanent record, allowing verifiability. I review the methods of analysis used to date, and suggest more advanced model-based methods to complement the design-based methods used to date. I also note the large inconsistencies in some estimates, which point to problems in the computer code.

SCRS/2020/163 - Aerial surveys with observers have been conducted in the Mediterranean in 2010, 2011, 2013, 2015, 2017, 2018, 2019 to provide indices of the abundance of the spawning population of the eastern stock of bluefin tuna (BFT). The recognized DISTANCE software has been used in the selection of random-systematic transects within subareas annually. Sampling efforts have focused on four subareas that are assumed to represent the main spawning areas. The spatial coverage was extended in 2013 and 2015 to cover the majority of the potential spawning areas in the Mediterranean Sea. According to the Terms of Reference, the focus of this review is the survey design, field methods, and methods employed in the 2019 re-analysis of the whole time series by Cañadas and Vázquez (2020). Several inconsistencies were found in the re-analysis results, suggesting errors in the R-script that needs to be corrected. Based on a review of extensive background material provided through the Center of Independent Experts there is strong evidence that a long-term monitoring program will require a survey design that covers much of the Mediterranean. Recognizing cost-limitations, an option is to continue annual spatial and temporal sampling coverage in the four main spawning areas at current levels,

and to cover the remaining spawning area with less effort. This area outside the main spawning grounds could for example be split into smaller survey regions (blocks) that each can be surveyed with synoptic coverage in a single year, achieving full coverage of all blocks over several years. Model-based methods could be used to combine data from the two survey components. We suggest the use of high-resolution video or digital photography and development of automatic image analysis through machine learning as an alternative to observers for collecting abundance data from standardized strip transects. In particular, such methods could ensure standardized counts of individual animals (and their lengths) within an accurately defined narrow transect width. Such methods could reduce cost and eliminate many of the sources of errors that are identified for the current field data collections with observers.

SCRS/2020/164 - Most instances of poor conservation performance of CMPs over the interim grid occur for OMs for which there is a regime shift in the future (the R3 scenario), and also a low abundance scale is assumed for the West area. To improve that performance would require a considerable sacrifice in catch for the other OMs. As a basis to avoid that, the the IWC approach of an "acceptable with research" CMP is put forward. In this case, this would involve tuning under the R1 and R2 OMs only, with implementation over a short initial period where both the an annual index of the proportion of Western origin bluefin in the West area is put in place to provide a basis able to detect a regime shift in the Eastern stock, and close-kin genetics is developed further to provide an improved estimate of the abundance of the Western stock in absolute terms.

SCRS/2020/165 - The MPx CMP was updated and tuned to three biomass targets for the western stock and then run for both the deterministic and stochastic operating models of the reference set. Yield and biomass metrics showed a linear trade-off in the west among the tuned CMPs. The CMPs provided almost identical performance with respect to eastern stock and East area metrics. Operating models that assumed a single historical and future recruitment regime (recruitment level II) often led to simulations dropping below half BMSY for the Western stock. Stock status outcomes were generally worse under the stochastic operating models in comparison to the deterministic operating models. Two demonstration exceptional circumstances protocols were investigated. The protocol based on the level and slope of the GOM_LAR_SUV index provide a high probability of detecting western stock levels below 50% BMSY.

SCRS/2020/166 - This document consists of mathematical description and its tuning result, which tunes median of Br30 to 1.0 in western stock among 96 operating models and 12 robustness operating models for a candidate management procedure (CMP) for management strategy evaluation of Atlantic bluefin tuna. The basic concept of this CMP is easy to understand and simple to use. TAC from this CMP could be determined by three indices and one tuning parameters for eastern and western area, respectively. Tuning result of CMP are also described in this document. As a result, depletion rate relative to dynamic Bmsy after projection year 30 in western stock is approximately equal to 1.0, which satisfy the development requirements

SCRS/2020/167 - Two classes of multi-model candidate management procedures for Atlantic bluefin tuna were developed and tested. Procedures were based on spawning biomass estimation methods scaled to five operating models selected via cluster analysis from the reference OM grid. For the empirical class, OM catchability and a constant stock mixing distribution were used to estimate area biomass from the larval indices. For model-based CMPs, five delay difference assessment models were scaled to each of the five operating models, matching stock recruit steepness and biomass for the recent historical period from 1965 - 2016. At each time step, estimates of current (empirical) or projected (model-based) biomass were generated from approved management indices and used in harvest control rules to generate area-specific TACs, and the five TACs were averaged to produce harvest advice for the East and West area. Model-based CMPs tuned to median biomass targets across the reference OM grid avoided crashing both east and west spawning stocks in over 97.5% of simulations.

SCRS/P/2020/064 - Latest progress tunning the two index based cMPs (EA_1 and EA_2) already proposed in previous meeting was provided using the latest version of the ABTMSE software available (version 6.6.20). The EA_1 and EA_2 cMPs were combining 4 indices for the Eastern stock (FR_AER_SUV2; MED_LAR_SUV; MOR_POR_TRAP; JPN_LL_NEAtl2) and 4 indices for the Western stock (GOM_LAR_SUV; US_RR_66_114; US_GOM_PLL2; JPN_LL_West2) using a weighted mean and weighted median of those indices respectively for estimating the 'current- observed' state of the two stocks. The two cMPs were tuned to reach different values of Br30 for the Western stock (1, 1.25 and 1.5), following the instructions from the SPSG – BFT meeting in September. Results were submitted to the MSE Contractor and were compared with other cMPs results in a joint presentation (SCRS/P/2020/066).

SCRS/P/2020/065 - This presentation reviewed the conditionings for two of the three primary robustness scenarios: Senescence and Western growth imposed on the Eastern stock. The Brazilian catch scenario has been revised but currently the model does not fit these data satisfactorily. Investigation may require intermediate data sets that were outside the scope of this round. Estimated stock trajectories look broadly similar to reference set counterparts. No obvious indications of residual patterns worse than for interim grid OMs. Fits to indices and length compositions are also comparable.

SCRS/P/2020/066 - This presentation provides preliminary CMP results for reference set operating models. Various comparison figures were provided. This summary showed that most CMPs could be tuned to 1-1.5 Br30 Median for Western Stock, and that relative conservation performance of CMPs varies across recruitment scenarios. It was also shown that recruitment scenarios 2 and 3 are the most challenging in term of Western biomass outcomes. All deterministic results available in the shiny App: http://142.103.48.20:3838/ABTMSE/

Appendix 5

Terms of Reference of the ICCAT BFT Technical Sub-group on Abundance Indices

- Matthew Lauretta (matthew.lauretta@noaa.gov) will serve as Sub-group Chair
- Sub-group members include:
    - Alex Hanke (Alex.Hanke@dfo-mpo.gc.ca)
    - Alex Hansell (ahansell@gmri.org)
    - Ana Gordoa (gordoa@ceab.csic.es)
    - Andre Boustany (aboustany@mbayaq.org)
    - Craig Brown (craig.brown@noaa.gov)
    - David Schalit (dschalit@gmail.com)
    - Dheeraj Busawon (dheeraj.busawon@dfo-mpo.gc.ca)
    - Diego Álvarez (diego.alvarez@ieo.es)
    - Doug Butterworth (doug.butterworth@uct.ac.za)
    - Emil Aalto (aalto@cs.stanford.edu)
    - Grantly Galland (ggalland@pewtrusts.org)
    - Kenny Drake (kendrake@eastlink.ca)
    - Jean-Jacques Maguire (jeanjacquesmaguire@gmail.com)
    - John Walter (john.f.walter@noaa.gov)
    - Karina Ramirez (kramirez_inp@yahoo.com)
    - Kyle Gillespie (Kyle.Gillespie@dfo-mpo.gc.ca)
    - Lisa Kerr (lkerr@gmri.org)
    - Nick Duprey (Nicholas.Duprey@dfo-mpo.gc.ca)
    - Sam Elsworth (sam.fish@ns.sympatico.ca)
    - Steve Cadrin (scadrin@umassd.edu)
    - Taryn Minch (taryn.minch@dfo-mpo.gc.ca)
    - Troy Atkinson (hiliner@ns.sympatico.ca)
    - Walt Golet (wgolet@gmri.org)
    - Yohei Tsukahara (tsukahara_y@affrc.go.jp)
    - Mauricio Ortiz (mauricio.ortiz@iccat.int)
    - Ai Kimoto (ai.kimoto@iccat.int)

- To be included in the Sub-group, please contact the Sub-group Chair (matthew.lauretta@noaa.gov), or individual task leads listed below.

Tasks

1. **US recreational rod and reel**.
   Lead: Matthew Lauretta (matthew.lauretta@noaa.gov).
   A comprehensive evaluation of the fishery survey, with primary focus on the juvenile indices of abundance. Specific tasks include:
    - dialogue between stakeholders/scientists
    - Representativeness of survey spatiotemporal coverage of the fishing,
    - data treatments (characterizing effort and catch of respondents), and models
    - observed spatial distribution of fish,
    - temperature effects on catch rates,
    - fleet regulations timeline and
    - effect of species targeting

2. **Fishery dependent handline indices in the NW Atlantic.**
   Co-Leads: Alex Hansell (ahansell@gmri.org) and Lisa Kerr (lkerr@gmri.org).
   US and CAN scientists will collaborate to evaluate the fishery dependent surveys and indices for the fleets. Specific tasks include:
    - joint dialogue between US and CAN stakeholders/scientists
    - assessing fleet spatiotemporal coverage and overlap,
    - assessing size/age structure of fish across the region,
    - assessing gear configurations of fleets, fleet regulations, and climatology/environmental effects on observations,
    - considering the effect of the market on fishing effort and CPUE.

- In addition, the team will assess the feasibility and appropriateness of a joint fishery indicator or size category specific indicators for the entire region, as well as possible treatments of the existing separate handline (US and Canada) indices for use in the VPA.

3. **Fishery dependent longline indices in the Gulf of Mexico.**
   Co-Leads: Matthew Lauretta (matthew.lauretta@noaa.gov) and Karina Ramirez (kramirez_inp@yahoo.com).
   US and MEX scientists will collaborate to evaluate **fishery dependent longline indices in the Gulf of Mexico**. Specific tasks include:
   - assessing fleet spatiotemporal coverage and overlap,
   - gear configurations, fleet regulatory effects, and climatology/environmental effects on observations.
   - In addition, the team will assess the feasibility and appropriateness of a joint fishery index.

4. **Gulf of St. Lawrence acoustic index.**
   Lead: Kyle Gillespie (Kyle.Gillespie@dfo-mpo.gc.ca) and Alex Hanke (Alex.Hanke@dfo-mpo.gc.ca).
   A comprehensive evaluation of the **Gulf of St. Lawrence acoustic index**. Specific tasks include:
   - Characterization and evaluation of survey spatiotemporal coverage,
   - climatology/environmental effects on observations,
   - vessel type effects,
   - Characterize spatial distribution of BFT and herring fishery catches in the region to assess changes in stock availability in the survey area over time,
   - Characterize spatial distribution of BFT in the region using tagging data.
   - Data treatment and standardization

5. **Japanese longline index.**
   Lead: Yohei Tsukahara (tsukahara_y@affrc.go.jp).
   Evaluation of the Japan longline fishery dependent index for the West Atlantic.
   - assessing fleet spatiotemporal coverage over time,
   - assessing size/age structure of fish across the region,
   - assessing gear configurations of fleets, fleet regulations, and climatology/environmental effects on observations,
   - considering the effect of targeting on fishing effort and CPUE.

6. **Gulf of Mexico larval index.**
   Lead: Walt Ingram, tentative.
   Evaluation of the Gulf of Mexico ichthyoplankton survey and standardization.
   - Characterization and evaluation of survey spatiotemporal coverage,
   - Gear and climatology/environmental effects on observations

7. **Canadian catch and release fishery.**
   Lead: Alex Hanke (Alex.Hanke@dfo-mpo.gc.ca).
   Review of the recently developed catch and release fishery data and suitability for alternative indicator of BFT abundance in the Gulf of St. Lawrence.

The Sub-group will rank deliverables 1-7 and provide timelines for their completion as well as recommendations to the ICCAT BFT Species Group on possible alternative treatments for indices and the selectivity of these indices for use in stock assessment models and the MSE.

Timeline
The list is comprehensive and aspirational, and it is unlikely that all tasks will be accomplished in the time allotted. Therefore, the tasks will be completed by order of priority determined by the Sub-group. Prioritized tasks and data revisions must be completed by the **last week of March 2021** for presentation to the ICCAT BFT Species Group during the April 2021 BFT intersessional meeting.

Appendix 6

Road map for the development of Management Strategy Evaluation (MSE) and Harvest Control Rules (HCR)

Document adopted during the 2019 Commission meeting and revised during the SCRS meetings (changes are underlined)

This schedule is intended to guide the development of harvest strategies for priority stocks identified in Rec. 15-07 (North Atlantic albacore, North Atlantic swordfish, eastern and western Atlantic bluefin tuna, and tropical tunas). It builds on the initial road map that was appended to the 2016 Annual Meeting report. It provides an aspirational timeline that is subject to revision and should be considered in conjunction with the stock assessment schedule that is revised annually by the SCRS.* Due to the amount of cross-disciplinary dialogue that may be needed, intersessional Panel meetings and/or meetings of the Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers (SWGSM) may be necessary. The aspirational nature of this timeline assumes adoption of a final management procedure for northern albacore in 2020 and interim management procedures for bluefin tuna and northern swordfish in 2022 and tropical tunas as soon as 2023, however the exact timeline for delivery is contingent on funding, prioritization, and other work of the Commission and SCRS.

* For 2015 through 2020, road map reflects progress to-date in some detail. For 2021 onward, more general steps for the SCRS and Commission are anticipated pending outcomes of the 2020 Annual Meeting.

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2015	- Commission established management objectives in Rec. 15-04			
2016	- SCRS conducted stock assessment - SCRS evaluated a range of candidate HCRs through MSE - PA2 identified performance indicators			- Commission identified performance indicators (Rec. 16-01)
2017	- SCRS evaluated the performance of candidate HCRs through MSE, using the performance indicators developed by PA2 - SWGSM narrowed the candidate HCRs and referred to Commission - Commission selected and adopted an HCR with associated TAC at the Annual Meeting (Rec. 17-04)	- SCRS conducted stock assessment - Core modelling group completed development of modelling framework	- SCRS conducted stock assessment	- SCRS reviewed performance indicators for YFT, SKJ, and BET - SWGSM recommended a multispecies approach for development of MSE framework
2018	- SCRS contracted independent expert to complete peer review of MSE code - Call for Tenders issued for peer review - SCRS tested the performance of the adopted HCR, as well as variations of the HCR, as requested in Rec. 17-04 - SCRS developed criteria for the identification of exceptional circumstances	- SCRS conducted joint MSE meeting on BFT/SWO - SCRS reviewed but could not adopt reference set of OMs - SCRS began testing candidate management procedures (MPs) - SWGSM considered qualitative management objectives - BFT WG reviewed progress and developed detailed road map - Commission adopted conceptual management objectives (Res. 18-03)	- SCRS conducted joint meeting on BFT/SWO MSE - SCRS contracted MSE technical expert to develop OM framework, define initial set of OMs, and conduct initial conditioning of OMs - SWGSM considered qualitative management objectives	- SCRS contracted with technical experts: start development of MSE framework (phase I) - SCRS conducted bigeye tuna stock assessment

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2019	- SCRS addressed recommendations of the peer reviewer - SCRS updated performance of the interim HCR and variants - SCRS produced consolidated report on MSE 1. COMM: PA2 to consider possible approaches that could be useful in developing guidance on a range of appropriate management responses if exceptional circumstances occur, including those implemented by other RFMOs	- SCRS held three BFT MSE Technical Group meetings with significant progress but advised at least one additional year of work needed - SCRS continued to evaluate candidate MPs - At intersessional meeting, PA2 reviewed and developed initial operational management objectives and identified performance indicators - SCRS to hold December webinar to review OM progress 1. COMM: PA2 to review MSE progress and advise the Commission on next steps, including need for an update of the stock assessment to provide TAC advice for at least 2021	- SWO Species Group meeting - SCRS contracted with technical expert to develop initial MSE framework - Commission to consider, and if possible, adopt conceptual management objectives at the Annual Meeting	- SCRS conducted yellowfin tuna stock assessment
2020	1. COMM (PA2) to develop guidance intersessionally on a range of appropriate management responses should exceptional circumstances be found to occur (5-6, March, PA2 intersessional)	1. SCRS to conduct stock assessment update and develop TAC advice for 2021 and 2022	1. SCRS to continue development of MSE framework, including the finalization of operating model conditioning and the uncertainty grid	1. SCRS to conduct skipjack data preparatory meeting
	2. COMM (PA2) to review interim HCR and recommend MP to the Commission for possible adoption at the Annual Meeting (5-6, March, PA2 intersessional)	2. COMM to set TACs for at least 2021, based on stock assessment update, at the Annual Meeting	2. SCRS to develop example candidate MPs	2. SCRS to continue MSE development.

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2020	3. SCRS to conduct NALB stock assessment (in June)	3. SCRS to continue development of MSE framework including the operating model conditioning and the uncertainty grid		
	4. SCRS to evaluate existence of exceptional circumstances			3. COMM (PA1) to review and provide feedback on MSE progress either intersessionally or during the Annual Meeting *(Alternatively could take place in 2021)*
	5. COMM to: a. review and endorse guidance developed intersessionally on management responses in the case of exceptional circumstances b. review the interim HCR and adopt a long-term MP, including the TAC, at the Annual Meeting			4. COMM (PA1) to recommend initial operational management objectives and to review and revise the performance indicators agreed by the Commission in 2016, either intersessionally or during the Annual Meeting *(Alternatively could take place in 2021)*
2021	1. SCRS to have a data preparatory meeting to prepare inputs for a SS model	1. SCRS to adopt reference grid and decide plausibility weighting	1. SCRS to continue development and testing of candidate MPs	1. SCRS to continue development and testing of candidate MPs
		2. SCRS to propose general criteria for determining exceptional circumstances	2. SCRS to propose criteria for determining exceptional circumstances	2. SCRS to conduct skipjack stock assessment (timing to be determined)
		3. SCRS to initiate independent peer review of MSE code and process	3. SCRS to initiate independent peer review of MSE code	3. SCRS to conduct bigeye data preparatory meeting (timing to be determined)

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2021		4. SCRS to continue development and testing of candidate MPs	4. COMM (SWGSM/PA4) to recommend initial operational management objectives and identify performance indicators either intersessionally or during the Annual Meeting	4. SCRS to conduct bigeye stock assessment (timing to be determined)
		5. SCRS/BFT WG to initiate two additional Sub-groups on: Indices and Modeling to address key issues. Sub-group on growth in farms continues its work.	5. COMM (SWGSM/PA4) to review MSE progress, example candidate MP results, and provide feedback to SCRS, either intersessionally or during the Annual Meeting	
		6. COMM (PA2) – Intersessional Meeting. Dialogue with Chair on MSE progress (March)	6. SCRS to conduct stock assessment	
		7. COMM review candidate MPs at the Annual Meeting (1-day prior). Dialogue with PA2 on CMPs, operational management objectives and performance indicators. At this point the SCRS should have 2-3 candidate MPs and tangible performance statistics values to show trade-offs.	7. COMM (SWGSM/PA4) to review results of performance of initial candidate MPs either intersessionally or during the Annual Meeting	5. COMM (SWGSM/PA1) to review MSE progress, preliminary candidate MP results, and provide feedback to SCRS either intersessionally or during the Annual Meeting
				6. COMM (PA1) to finalize operational management objectives and performance indicators at the Annual Meeting

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2022	1. SCRS to develop a SS model for ALB	1. COMM (SWGSM/PA2) intersessionally to: - recommend final operational management objectives and identify performance indicators - develop guidance on range of appropriate management responses should exceptional circumstances be found to occur	1. SCRS to initiate independent peer review of MSE process	1. SCRS to continue MSE development, including developing and evaluating candidate MPs
		2. SCRS to conduct stock assessment for WBFT and EBFT (based on work conducted by subgroups on models and indices)		2. SCRS to propose criteria for determining exceptional circumstances
		3. Continue Peer-review of MSE process		3. SCRS to initiate independent peer review of MSE code
		4. SCRS to complete MSE, incorporating feedback from Commission through PA2/SWGSM	2. SCRS to provide final advice to the Commission on criteria for determining exceptional circumstances	4. COMM (SWGSM/PA1) to develop guidance on a range of appropriate management responses should exceptional circumstances be found to occur
			3. COMM (SWGSM/PA4) and SCRS to: - refine MP(s) and to review and finalize, as needed, guidance on a range of appropriate management responses should exceptional circumstances be found to occur; - recommend final operational management objectives and identify performance indicators (early in 2022)	5. COMM to review candidate MPs at the Annual Meeting

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2022		5. COMM (SWGSM/PA2) and SCRS to present final CMPs for review.	4. SCRS to complete MSE, incorporating feedback from Commission through PA4/SWGSM	[…]
		6. COMM to: a. review and endorse guidance developed intersessionally on management responses in the case of exceptional circumstances, and b. adopt an MP at the Annual Meeting, including a 2-year TAC	5. COMM to: a) review and endorse guidance developed intersessionally on management responses in the case of exceptional circumstances, and b) adopts an interim MP at the Annual Meeting, including the TAC	[…]
2023 and beyond*	1. Once an MP is adopted, SCRS to conduct assessments to ensure that the conditions considered in MP testing are still applicable to the stock. The first benchmark assessment is scheduled for 2023, where a SS reference case as well as a grid of reference and robustness OMs is to be adopted after reconsidering the main axes of uncertainty.	1. Once an MP is adopted, SCRS to conduct assessments to ensure that the conditions considered in MP testing are still applicable to the stock	1. Once an MP is adopted, SCRS to conduct assessments to ensure that the conditions considered in MP testing are still applicable to the stock […]	1. SCRS to complete MSE, incorporating feedback from Commission through SWGSM/PA1
	2. On the predetermined timescale for MP setting, SCRS to evaluate existence of exceptional circumstances	2. SCRS to provide final advice to the Commission on criteria for determining exceptional circumstances	2. On the predetermined timescale for MP setting, SCRS to evaluate existence of exceptional circumstances	2. SCRS to provide final advice to the Commission on criteria for determining exceptional circumstances
	3. COMM to continue use of the MP to set TAC at the Annual Meeting, on the predetermined timescale for MP setting	3. On the predetermined timescale for MP setting, SCRS to evaluate existence of exceptional circumstances	3. COMM to set TAC based on the MP at the Annual Meeting, on the predetermined timescale for MP setting	3. SCRS to initiate independent peer review of MSE process

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2023 and beyond*		4. COMM to continue use of the MP to set TAC based on the MP at the Annual Meeting, on the predetermined timescale for MP setting		4. COMM (SWGSM/PA1) and SCRS to refine MP(s) and to review and finalize, as needed, guidance on a range of appropriate management responses should exceptional circumstances be found to occur
				5. COMM to: a) review and endorse guidance developed intersessionally on management responses in the case of exceptional circumstances, and b) adopt interim MP(s) at the Annual Meeting, including TACs, where applicable
2024 and beyond*	See 2023 row SCRS to improve Observation Error Model by incorporating statistical properties of CPUE residuals	See 2023 row	See 2023 row	1. Once an MP is adopted, SCRS to conduct assessments to ensure that the conditions considered in MP testing are still applicable to the stock
	SCRS to test the available (i.e. production model) and alternative MPs (e.g. based on Jabba, or empirical)			2. On the predetermined timescale for MP setting, SCRS to evaluate existence of exceptional circumstances
	[…]	[…]	[…]	3. COMM to continue use of the MP to set management measures at the Annual Meeting, on the predetermined timescale for MP setting
				[…]

	Northern Albacore	*Bluefin Tuna*	*Northern Swordfish*	*Tropical Tunas*
2024 and beyond*				[...]
				[...]

*Assumes that the workplan is accomplished as described.

LIST OF ACRONYMS:

BET = Bigeye tuna
BFT = Bluefin tuna
BFT WG = SCRS' Bluefin Tuna Working Group
HCR = Harvest Control Rule
MP = Management Procedure
MSE = Management Strategy Evaluation
OM = Operating Model
SCRS = Standing Committee on Research and Statistics
SWGSM = Standing Working Group to Enhance Dialogue between Fisheries Scientists and Managers
TAC = Total Allowable Catch
TRO = Tropical tunas