

REPORT OF THE 2021 INTERSESSIONAL MEETING OF BLUEFIN TUNA MSE TECHNICAL GROUP
(Online, 5-10 July 2021)

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

The 2021 Intersessional Meeting of the Bluefin Tuna MSE Technical Group (“the Group”) was held online from 5 to 10 July 2021. Dr. John Walter (USA) chaired the meeting. The Rapporteurs for the western Atlantic bluefin tuna stock (BFT) opened the meeting and served as Chair. On behalf of the Executive Secretary, the Assistant Executive Secretary welcomed the participants and thanked the efforts made by all participants to remotely attend the meeting. The Group Chair proceeded to review the Agenda which was adopted after some changes (**Appendix 1**). Due to the time constraints, the Group focused on the main outputs from the meeting in this report. It was noted that this meeting does not have any authority to make final decisions, but rather its purpose is to prepare the material required for the bluefin tuna (BFT) intersessional meeting to be held in September 2021.

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:

<i>Sections</i>	<i>Rapporteur</i>
Items 1, 9	A. Kimoto
Items 2-5, 7	C. Peterson
Item 6	S. Miller
Item 8	J. Walter

2. BFT MSE Consultant’s update on work since April meeting and an informal meeting in June

The MSE Consultant updated the Group on work since the previous meetings, primarily detailing the results of the Operating Model (OM) reconditioning. Updates on outstanding issues (as detailed in SCRS/P/2021/045) will require additional time outside of the meeting to address. These were prioritized as follows. Tasks denoted by asterisks were to be considered of lower priority if they proved to require considerable time.

Priority	Outstanding MSE tasks
1	Catch-at-length graphing
2	Robustness test: intermediate parameter robustness operating models (ROMs) Robustness test: Hyperstability ROMs Robustness test: Brazilian catch (post 1965 correction included)* Robustness test: US_RR_66_144 fit* Robustness test: OM35 fit to seasonal prior*
3	AAVC measure needs coding as a mean by simulator PGT measure revised to quantitative
4	Shiny app OM weighting
5	Investigation of M3 scale estimation

3. Review of the acceptability of the reconditioned OMs

3.1 Review of the reconditioned OMs

The Group noted concerns from the informal webinar regarding the incongruous numbers of length observations between the old and new reconditioning, where the new length compositions with extra years of data contained fewer length observations. The reason for this is that the M3 model fits only to length composition data in cells with corresponding catch data. While the total number of samples used in the fitting in the reconditioning is different, the size composition is very similar.

The reconditioned OMs demonstrated less heterogeneity and more consistency in stock trajectories compared to the previous OMs (SCRS/2021/124). Notably, there was less conflict in the fits to the western indices.

With greater contrast in the data for both the eastern and western stocks, the Group discussed whether the OMs might be more capable of estimating scale. The Group noted that further investigation of scale may be warranted in the future, based on Candidate Management Procedure (CMP) performance.

The MSE Consultant detailed ad-hoc approaches used to correct the lack of fit obtained with two OMs when using the standard approach: OM 29 did not fit the seasonal prior for the Mediterranean while OM 35 did not fit the Mediterranean larval survey index. The problem was solved for OM 29 by doubling the weight assigned to the MED seasonal prior. In the case of OM 35, doubling the weight of the Mediterranean larval survey index, while resulting in a good fit to the index, led to a misfit of the Mediterranean prior. The MSE Consultant proposed to preferentially fit to the index, and presented results comparing example CMP performance to both OM 35 fitting approaches to evaluate sensitivity (SCRS/2021/129). CMP projections for the western stock were similar, while projections differed in the eastern stock. The Group agreed to the MSE Consultant's proposed weighting for OMs 29 and 35, and suggested that the standard weighting approach for OM 35 could be retained as a robustness test, but given competing priorities would not be retained in the ROM set.

3.2 Review *sigma* and AC values for projections of abundance indices

During the previous 2020 intersessional meeting of the ICCAT bluefin tuna MSE Technical Group (BFT MSETG) held in February 2020 (Anon, 2020), a rule was devised and agreed upon to determine which indices would be available for CMP development based on assessment model fits. Using this rule, the CAN_GSL_RR index was excluded from consideration for CMP development given the poor statistical properties of its residuals. Under the reconditioned OMs, the statistical properties of the residuals for both CAN_GSL_RR and US_RR_117 indices failed the requirement to be considered in CMP development. After discussion, the Group agreed to apply the accepted rule and hence to exclude both CAN_GSL_RR and US_RR_117 indices as recommended inputs to the CMPs (see modified Table 7.1 from Trial Specification Document (TSD) below, modifications shown with underlines).

Due to insufficiently long time series, lognormal standard deviation (STD) and levels of lag-1 autocorrelation (AC) were previously hard-wired for five indices in the MSE projections (JPN_LL_West2, MOR_POR_TRAP, JPN_LL_NEAtI2, FR_AER_SUV2, GBYP_AER_SUV_BAR*, noting that the GBYP_AER_SUV_BAR index has zero weighting in OM fitting and must be re-fit to obtain predicted statistics once the reanalysis of the data currently being conducted by an external contractor. Given the additional years of data available in the reconditioned OMs, the Group agreed to use OM-estimated STD and AC for these four indices (JPN_LL_West2, MOR_POR_TRAP, JPN_LL_NEAtI2, FR_AER_SUV2), following the approach used for the other indices; where the estimated AC for an index is negative, it will be set to zero, following protocols applied for the other indices.

With respect to the W-MED_LAR_SUV, the Group agreed to retain the approach proposed at the previous BFT MSETG meeting (Anon, 2020), wherein projection STD and AC values were calculated from the index years ≥ 2012 . The rationale for this was to capture a shift in survey methodology between each period (where a calibration process was used to generate a single index) and specially to capture the more recent behaviour of the index, which had smaller residuals (in log space) compared to the earlier period. While it was recognized that other indices might also suffer from similar differences in performance over time, the Group did not propose similar treatments for other indices.

TSD-Table 7.1. Index selection and simulation for potential inclusion in CMPs.

Index	Details	Selectivity	Recommended for CMPs	STD value*	AC*
CAN GSL RR	1988-2020, Q3, W GSL	14: RRCAN	No	-	-
CAN SWNS RR	1996-2020, Q3, W Atl	14: RRCAN	Yes	OM-estim	OM-estim
US RR 66-144	1995-2020, Q3, W Atl	15: RRUSAFS (50 –150cm)	Yes	OM-estim	OM-estim
US RR 66-114	1995-2020, Q3, W Atl	15: RRUSAFS (50 –125cm)	No***	OM-estim	OM-estim
US RR 115-144	1995-2020, Q3, W Atl	15: RRUSAFS (100 – 150cm)	No***	OM-estim	OM-estim
US RR 177+	1993-2020, Q3, W Atl	16: RRUSAFB (175cm+)	No	-	-
JPN LL West2	2010-2020, Q4, W Atl	18: LLJPNnew	Yes	OM-estim	<u>OM-estim</u>
US-MEX PLL	1994-2019, Q2, W GOM	1: LLOTH	Yes	OM-estim	OM-estim
GOM SUV	1977-2019 (gaps 1979-1980, 1985), Q2, GOM	SSB	Yes	OM-estim	OM-estim
CAN SUV2	2017-2018, Q3, W GSL	14: RRCAN (150cm+)	No**	-	-
MOR TRAP	2012-2020, Q2, S Atl	13: TPnew	Yes	<u>OM-estim</u>	<u>OM-estim</u>
JPN NEAtl2	2010-2019, Q4, N Atl	18: LLJPNnew	Yes	<u>OM-estim</u>	<u>OM-estim</u>
FR AER SUV2	2009-2019 (gap 2013), Q3, Med	15: RRUSAFS	Yes	<u>OM-estim</u>	<u>OM-estim</u>
GBYP SUV BAR	2010-2018 (gaps 2012, 2014, 2016), Q2, Med	SSB	Yes	0.45#	0.2#
W-MED SUV	2001-2019 (gaps 2006, 2007, 2009, 2011), Q2, Med	SSB	Yes	OM-estim (years 2012-2012-2019)	OM-estim (years 2012-2019)

* OM-estim means OM-specific estimates from the index residuals of the corresponding OM fit (Section 7.5). When the estimated AC is < 0, it is fixed at AC=0 for the projections with that OM.

** The Canadian acoustic survey index is simulated in the BFT MSE package, but should not be used in CMPs at this time because of uncertainty about calibration for the change to a different vessel.

*** Not recommended for CMPs but still projected for sensitivity runs.

GBYP AER SUV BAR index will be refit by MSE Consultant and SE and AC re-evaluated with a preference given to using estimated SE and AC values.

3.3 Review robustness tests

The MSE Consultant proposed in SCRS/2021/125 and the Group agreed that to complete fitting to outstanding scenarios amongst the existing Robustness Operating Models (ROMs) (7 nonlinear indices, 10 intermediate parameters).

Given the trend in the US_RR_66_144 index compared to other West area indices over the same period, and its relatively poor fit in the model, the Group proposed an additional robustness test. Similar to other robustness trials where an alternative configuration is applied to four reference OMs, the new ROM will upweight the US_RR_66_144 index to the extent that meaningful improvements in goodness of fit (at the MSE Consultant's discretion) are noticeable (see modified Table 9.3 from TSD below, modifications shown with underlines).

Apart from the comments above, the Group raised no further queries about ROMs. A number of outstanding ROMs will need to be further developed. The Group prioritized incorporation of the plausibility weights into the BFT MSE packages and Shiny app; this will delay completion of the outstanding ROMs for several weeks' time.

TSD-Table 9.3. Robustness tests, including priority and OMs on which the test is to be conducted.

Priority	Robustness test description	Notes	July BFT MSE TG Meeting comments
1	Western stock growth curve for eastern stock.	West: 55% vs East: Growth 45% in plausibility weighting poll.	Relatively negligible impacts on performance across suite of CMPs
2	Catchability increases. CPUE-based indices are subject to a 2% annual increase in catchability in the future.	Simple to do and a fundamental concern.	
3	Unreported overages. Future catches in both the West and East areas are 20% larger than the TAC as a result of IUU fishing (not known and hence not accounted for by the CMP).	Important implications and simple to do.	
4	High western mixing. The old mixing axis factor level 2: 20% western stock biomass in East area on average from 1965-2016.	Demoted from the reference grid, this provides a yardstick for evaluating whether robustness trials are 'consequential'. Important for setting scale, but not necessarily important for 'does it matter'.	
5	'Brazilian catches'. Catches in the South Atlantic, including relatively high takes during the 1950s and 60s, are reallocated from the western stock to the eastern stock.	Important, but for practical purposes this should be developed after OMs priority 1-4 in order to prevent it absorbing disproportionate resources to get it working. If it proves to take inordinate amount of time, then suspend work on this to then move on to others in the list.	
6	Time varying mixing. Eastern stock mixing alternates between 2.5% and 7.5% every three years.	Time consuming. Previously involved fitting two new operating models with 10% and 30% western mixing priors, but that dates back to before the 20% western mixing scenario was demonstrated to be inconsequential to CMP performance. Hence this has been changed to eastern time-varying mixing scenarios.	
7	Non-linear indices. Hyperstability in OM fits to data is simulated in projection years for all indices.	Recondition the four operating models imposing a β parameter of 0.5 in the OM conditioning and maintain this in projections: $I = qB\beta$ (needs change to M3 and M3 input files).	To date, unconverged

TSD-Table 9.3. Continued.

Priority	Robustness test description	Notes	July BFT MSETG Meeting comments
8	Persistent change in mixing. Eastern mixing increases from 2.5% to 7.5% after 10 years.	Was previously a change in western stock mixing before this was shown to be inconsequential to CMP performance. Hence this has been altered to a change in the eastern stock mixing as this will be influential.	
9	Varying time of regime change in R3.	Currently this changes 10 years after management under the MP commences.	
10	Intermediate parameter levels for M, growth, maturity, scale, regime shifts.	The mean of existing high and low scenarios.	Currently these are not implemented for projections.
11	Zero eastern stock mixing. No Eastern stock in the West area.	Zero eastern mixing, will require substantial further discussion regarding the interpretation. Apply only to the projections.	
<u>12</u>	Upweight US_RR_66_144	Upweight US_RR_66_144 until appreciable changes are seen in OM	Newly added to ROM set

3.4 Consideration of any revisions in the reference grid

No proposals for revisions to reference grid beyond those already detailed (in Sections 3.1 - 3.2) were introduced.

3.5 Proposals for finalisation of OMs for the grid and robustness for CMP testing purposes

No proposals for altering the present reference OM grid were made. One additional robustness test (12: Upweight US_RR_66_144) was proposed.

3.6 Consideration of any revisions to plausibility weighting of OMs (if related proposals are submitted)

The Group considered whether specific OMs should be downweighted based on poor OM conditioning fits, particularly with respect to OM 35. The Group considered whether differential weightings would be likely to impact CMP performance ranking as guided by the 'does it matter' analysis outlined in SCRS/2021/129, and considered the challenges posed by the subjectivity of the magnitude chosen for such further downweightings. At this point, the Group did not adjust model-by-model OM weighting of the reference grid OMs based on the conditioning fits.

3.7 TSD

The MSE Consultant, CPC scientists and the Secretariat updated the trial specifications document (TSD) to ensure consistency with the MSE and enhanced clarity. Recommendations arising from the current meeting were included in the updated version of the TSD (**Appendix 5**). Comments from the Group were incorporated in the TSD during the meeting.

The Group agreed to work with the Secretariat to translate the TSD.

4. CMP Development

4.1 Update from CMP developers

CMP developers presented papers and presentations (SCRS/2021/121, SCRS/2021/122, SCRS/2021/126, SCRS/2021/127, SCRS/2021/128, SCRS/P/2021/046) or provided a verbal overview of updates and subsequent performance of each CMP. The summary of CMPs was provided as follows.

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CMP	Status estimator	Indices used		Summary of harvest control rules	References
		EAST	WEST		
AH	Biomass estimate calculated via larval indices and the associated catchability estimates.	FR AER SUV2 JPN LL NEAtI2 W-MED LAR SUV	US RR 66-144, CAN SWNS RR US-MEX GOM PLL	TAC is a product of biomass estimate and F0.1 estimate.	SCRS/2020/144 SCRS/2021/122
AI	Spawning and vulnerable biomass for each stock in each area are estimated by an artificial neural network	All	All	Regional biomass fished at a fixed harvest rate. Uses CAPs, bottoms and variable TAC changes.	SCRS/2021/028
BR	Weighted average of index J is used directly for each area, where weights are inverse variances (adjusted for autocorrelation) for each individual data series	FR AER SUV2 W-MED LAR SUV MOR POR TRAP JPN LL NEAtI2	GOM LAR SUV US RR 66-144 US-MEX GOM PLL JPN LL West2 CAN SWNS RR	TACs set using a relative harvest rate (Catch/J) from a reference year (2018) applied to the 2-year lagged moving average of the weighted index J. Quadratic decline in reference HR multipliers when J is below a nominated level	SCRS/2021/121
EA	Similar to BR, using a weighted average of index <i>Icur</i> .	FR AER SUV2 W-MED LAR SUV MOR POR TRAP JPN LL NEAtI2	GOM LAR SUV JPN LL West2 US RR 66-144 US-MEX GOM PLL	Adjust TAC by ratio between <i>Icur</i> a target value T.	SCRS/2021/032 SCRS/2021/P/046
HA	TAC is based on trend in indicator and biomass of a second indicator	JPN LL NEAtI2 W-MED LAR SUV	US-MEX GOM PLL	Current index value relative mean of recent 3 years represents the harvest rate applied to the biomass estimated for a second indicator.	SCRS/2021/122
LW	No biomass/stock status estimation, larval surveys used directly	W-MED LAR SUV	GOM LAR SUV	Current relative harvest rate (HR) is compared to the reference period relative HR, and TAC is adjusted based on their ratio.	SCRS/2021/127
ND	No estimate used, just trends on indices.	MOR POR TRAP	US-MEX GOM PLL	TAC is updated using recent trend in indicator with restrictions on increase limited to 20%.	SCRS/2021/122
PW	No biomass estimate is used	JPN LL NEAtI2	US RR 66-144	Current relative HR is compared to the reference period relative HR, and TAC is adjusted based on their (delta) ratio.	SCRS/2020/129
SP		W-MED LAR SUV	GOM LAR SUV	model-based MP	SCRS/2020/167
TC	SSB and vulnerable B are estimated by averaging the available indices for the stock/area combination after scaling by 2016 estimates catchability.	MOR POR TRAP JPN LL NEAtI2 W-MED LAR SUV GBYP AER SUV BAR	US RR 66-144	TAC _y =TAC (y-1) but depending on F/F _{MSY} and B/B _{MSY} . Uses CAPs, bottoms and variable TAC changes.	SCRS/2020/150 SCRS/2020/165
TN	Uses ratio Iratio of recent and lagged moving averages of indices to determine relative stock status	JPN LL NEAtI2	US RR 66-144 JPN LL West2	TAC calculated based on the JPN_LL moving average, unless drastic drop of recruitment is detected by US_RR index.	SCRS/2020/151 SCRS/2021/041

4.2 Comparison of results from development tuning

The MSE Consultant presented a comparison of CMP performance as prepared for development tuning (SCRS/2021/130) and highlighted CMP performance within the management objective trade-off space. The Group subsequently began preliminary discussions of performance measures and future refinements for CMP evaluation.

4.3 Discussion of advantages/disadvantages of different CMPs

The Group did not discuss in detail the pros and cons of individual CMPs as the developers are in the process of further refinement and, ultimately, performance across the measures will be the primary determinant for CMP selection.

4.4 Further refinement and harmonization of CMPs – guidance and process

The Group discussed a proposal for new CMP tunings for future refinement. The proposed tunings were identified to explore key trade-offs between higher versus lower exploitation (greater versus lesser resource conservation risk) and trade-offs between greater catches in the West or the East areas. The agreed tunings were as follows:

	<i>Western stock</i>	<i>Eastern stock</i>
<i>Option 0</i>	<i>1</i>	<i>1</i>
<i>Option A*</i>	<i>1.25</i>	<i>1.25</i>
<i>Option B</i>	<i>1.25</i>	<i>1.50</i>
<i>Option C</i>	<i>1.50</i>	<i>1.25</i>
<i>Option D*</i>	<i>1.50</i>	<i>1.50</i>

* Prioritized tunings to demonstrate greater versus smaller resource conservation risks.

In preliminary CMP testing, the 1:1 tuning targets often exhibited unsatisfactory resource status performance and higher targets may be necessary. However, it will be necessary to demonstrate this behavior and hence developers are requested to include Option 0 (1:1) tuning in addition to the higher tuning targets. It was emphasized nevertheless that tuning target Option 0 was not required for every CMP to clearly demonstrate the Group's choice of higher tuning targets. Tuning should desirably be within a tolerance of 0.02 of the Br30 target to facilitate a level playing field for CMP comparison.

The Group agreed to use the plausibility weighted OM grid for tuning the CMPs to ensure that the stated OM plausibilities are taken into account in the CMP refinements and performance evaluation.

The Group noted that stochastic CMP performance should be provided for the September BFT Species Group (BFTSG) intersessional meeting (2-9 September 2021). Because CMP performance may change in unexpected ways under stochastic projections compared to deterministic projections, the Group highlighted that for those CMPs without stochastic performance results by the September BFTSG intersessional meeting, full evaluation will not be possible at that time. CMP developers were encouraged to begin to explore stochastic performance soon, because errors are commonly encountered when converting from deterministic to stochastic projections. The MSE Consultant noted that stochastic projections would take approximately 24 times longer than deterministic projections to run, and the Group discussed sharing computing power, where possible. CMPs should be tuned under deterministic projections (otherwise tuning would become computationally prohibitive) but will be evaluated under stochastic projections.

The MSE Consultant will develop an appropriate aggregate statistic for Br30 for each CMP and stock for the weighted reference grid of OMs. This function would allow CMP developers to start the process of tuning while accounting for OM weights. The MSE Consultant indicated that incorporation of the plausibility weights into the Shiny app would take a bit longer. However, this needs to be completed fairly soon. The Group gave priority to this task, noting that this will delay completion of the remaining ROMs.

Several CMP developers expressed some concerns with the number of additional tunings that have been requested. The Group strongly urges CMP developers to collaborate to share efficient code for development tuning and/or computing capacity if developers have access to clusters. At this point, such collaboration is of mutual benefit to the Group so as to be able to complete the task of CMP refinement and development tuning prior to the September BFTSG intersessional meeting. CMP developers are also encouraged to engage in further ‘refinement’ to achieve improved CMP performance by incorporating aspects of what appears to work in certain CMPs or to discard aspects that perform poorly. CMP developers should focus on performance in the reference grid of OMs but should also pay attention to clear signs of failure in the ROMs which might exclude an otherwise well-performing OM from further consideration.

The MSE Consultant presented an approach for refining CMPs, which involved plotting the trade-offs (e.g. AvC30 vs. lower fifth percentile of Br30) of several CMP variants and identifying refinements that led to improved performance along each axis. The Group discussed goals and example methodologies of CMP refinement.

A proposal to relegate recruitment level 3 to the robustness set was considered, on the basis that indications of overall poor CMP performance for resource conservation for some tunings was being unduly influenced by the inclusion of these scenarios. Subsequent analyses were presented by comparing all results with and without recruitment level 3 to aid in this discussion. Results indicated a general similarity of overall trends, particularly for higher level tunings. The Group decided to keep the three recruitment scenarios in the reference grid, citing the additional analyses, the rationale that led to the original proposal and acceptance of including recruitment level 3 to the reference grid, and the fact that the lower plausibility weight attributed to recruitment level 3 will serve to account to a certain extent for the plausibility of a future regime shift as outlined in this scenario.

The Group discussed the acceptability of TAC caps within various CMPs, particularly focusing on the possibility that TAC caps may be viewed negatively or positively by stakeholders versus the potential necessity to achieve acceptable performance. The Group ultimately suggested that, for the purposes of CMP development, CMP developers be encouraged to explore performance of their CMPs with and without the inclusion of TAC caps, to allow for quantitatively based evaluation of the costs and benefits of caps.

4.5 Process for condensing CMPs into 2-3 top performers for further consideration

The MSE Consultant presented a preliminary CMP decision table, and the Group discussed appropriate decision table performance measures and ranking protocols, as well as approaches to reduce the number of CMPs. Particular items of consideration included the appropriateness of the Br30 statistic, possible transformation of CMP performance to a 0:1 scale rather than raw ranking to preserve relative differences, and introduction of threshold performance levels (either meets or does not meet requirements for a given performance measure). The Group requested that any formal proposals be submitted in writing to the September BFTSG intersessional meeting.

The Group carefully considered the purpose and utilization of the Robustness OMs (ROMs). The MSE Consultant demonstrated the CMP performance across each robustness axis of uncertainty, and noted that the inconsistent performance of the existing CMPs across the ROMs, which emphasizes the value that the ROMs will offer through providing a further basis to reduce the number of CMPs for which results that will eventually be presented to the Commission. The Group noted options for the manner in which robustness tests have been handled in other fisheries science/management fora varies considerably. Four general approaches can be distinguished.

1. **Used only in final CMP selection process:** If, based on performances for the reference set (grid) of OMs, choice from a final culled set of CMPs proves difficult, the choice is then made on the basis of best performance over the robustness trials.
2. **Initial coarse overview:** If at an early stage on the CMP performance process, quick inspection shows a few CMPs to have performances markedly inferior to the remainder in the robustness tests, those few are eliminated from further consideration at that time.

3. **Detailed review:** Robustness test results are reviewed in great detail by a small group, for summary report to the Group as a whole regarding their implications for choice amongst the CMPs. That small group may develop criteria that are specific to (and hence may differ amongst) each robustness test OM in providing their comments, for example as to whether poor performance in a particular test is sufficient to disqualify a CMP from further consideration.
4. **All satisfy some minimal threshold:** A CMP is required to satisfy some criterion in its performance for **every** robustness trial (or the CMP fails) – some marginal flexibility may be admitted. The criterion is usually linked to resource conservation performance, e.g. the lowest depletion distribution is required to reflect no more than an X% probability of being below some selected threshold value. Typically, that threshold would be set lower (i.e. be easier to attain) than would apply to the corresponding reference set (grid) of OMs.

The Group agreed not to support option 3, and that the remaining options would be considered at a future meeting.

5. Performance measures for reporting to September meeting

5.1 Review of existing and of any additional measures proposed

Document SCRS/2021/123 was presented to the Group detailing the alteration in relative CMP rankings based on alternate interpretations of the conservation management objective of achieving “60% probability of healthy stocks over a 30-year period.”. Three different interpretations of a 60% probability of $B > B_{MSY}$ and $F < F_{MSY}$ evaluated were (i) 60% of simulation replicates in the 30th year of the projection period (Year_30) or a 60% probability of the existing Br30 performance measure; (ii) 60% of simulation replicates and years within the first 30 years of the MSE projection period (All_30); and (iii) 60% of simulation replicates in each year within the first 30 years (Each_30). The paper found that the performance measure All_30 had the counter-intuitive result of leading to more aggressive fishing as the models had to meet conservation criteria for only 60% of the years. Performance of the other two measures (Each_30 and Year_30) was more similar given that it is more likely that a stock will be kept in good health for the first 30 years if it must be healthy with a higher probability at the end of the 30th year, though the results are highly dependent on the context the BFT stocks. These results provide a useful context that use of the current Br30 performance measure sufficiently captures the conservation management objective regarding stock status.

The Group considered presenting results in terms of management objectives as specified by the Commission. The Group noted that thorough explanation of probabilities should be presented prior to presenting to the Commission, to clearly distinguish between probabilities associated with single stock assessment results and those associated with MSE (which generally were more pertinent structural uncertainty in models than with estimation imprecision in a best assessment). This topic will merit further discussion at the September BFTSG intersessional meeting.

The Group particularly distinguished between performance ‘measures’ and ‘statistics’ of the distributions of those measures to be used in summarizing CMP performance. The Group agreed to elevate the lowest depletion (LD) measure to the higher-priority list of measures, and to a proposal to convert the ‘Probability good trend’ (PGT) measure from a binary (0,1) metric to a continuous metric (e.g., like SSB slope). These decisions are reflected in the modified TSD-Table 10.1 (modifications shown with underlining). A proposal to replace PGT with an alternative (OFT: Overfished Trend) that allows this measure to be a continuous metric was provided and will be included in the updated package. The details will be further discussed at the BFTSG intersessional meeting in September 2021.

TSD-Table 10.1. Performance measures calculated as part of the MSE outputs for each OM and CMP.

Performance measures in bold text indicate the key Z ones.

Measure	Measure Description	Statistics*
AAVC	Average annual variation in catches (AAV) among CMP update times t (note that except where the resource is heavily depleted so that catches become limited by maximum allowed fishing mortalities, catches will be identical to TACs) defined by: $AAVC = \frac{1}{nt} \sum_{t=1}^{nt} C_t - C_{t-1} / C_{t-1} \quad (13.1)$	Median
AvC10	Mean catches over first 10 projected years. Required to provide short-term vs long-term (AvC30) yield trade-offs.	Median
AvC30	Mean catches over first 30 projected years	Median
AvgBr	Average Br (spawning biomass relative to dynamic SSB_{MSY}) over projection years 11-30	Median and 5 th percentile
Br30	Depletion (spawning biomass relative to dynamic SSB_{MSY}) after projection year 30	Median and 5 th percentile
PGT	'Probability Good Trend', 1 minus the probability of negative trend (Br31 – Br35) and Br30 is less than 1. Probability of 1 is biologically better. In cases where all simulations are above Br30, PGT = 1 regardless of trend. This allows further discrimination between CMPs that have comparable fraction of simulations below Br30.	Median
LD	Lowest depletion (spawning biomass relative to dynamic SSB_0) over the 30 years for which the CMP is applied.	Median
C20	Mean catches over projected years 11-20	Median
C30	Mean catches over projected years 21-30	Median
D10	Depletion (spawning biomass relative to dynamic SSB_0) after the first 10 projected years	Median
D20	Depletion (spawning biomass relative to dynamic SSB_0) after projection year 20	Median
D30	Depletion (spawning biomass relative to dynamic SSB_0) after projection year 30	Median
DNC	D30 using the MP relative to D30 had no catches been taken over the 30 projected years	Median
LDNC	LD using the MP relative to LD had no catches been taken over the 30 projected years	Median
POS	Probability of Over-Fished status (spawning biomass < SSB_{MSY}) after 30 projected years.	Median
OFT	'Overfished Trend': Average trend (in log space) of SSB over projection years 31 - 35 when $Br30 < 1$. $OFT = \begin{cases} 0.1 & SSB_{30} \geq dynSSB_{MSY} \\ m(\log SSB_{31:35}) & SSB_{30} < dynSSB_{MSY} \end{cases}$ <p>Where $m(\vec{x})$ is the gradient of a line of best fit through the vector \vec{x}, estimated by least squares.</p>	Median

* For each of these distributions, 5%-, 50%- and 95%iles are to be reported from 200 replicates. The choice of these percentiles may need further exploration with stakeholders.

5.2 Trimming performance measures

Performance measures and associated statistics were prioritized as highlighted in TSD-Table 10.1 (where bold measures are of higher priority). The MSE Consultant ranked preliminary CMP results using AvC30, AAVC, and fifth percentile Br30 which capture three of the highest priority performance measures regarding yield, variability in yield and safety. While the Group removed only C10 as it was duplicative of AvC10 and did not formally trim further performance measures, it is unlikely that all 20 measures and their associated statistics will be necessary to evaluate CMP performance and certainly not all measures will be necessary to present. The measures will, however, remain available in the package and can be reported upon if desired by Panel 2 or the Commission.

5.3 Plotting

The Group prioritized including trade-off plots (AvC30 versus fifth percentile Br30), because a fundamental decision of the Commission will be to identify where they would like to manage BFT within the allowable trade-off space. The Group previously discussed plotting for each recruitment scenario versus across recruitment scenarios. The Group also highlighted that projected trends in biomass must also be presented in addition to tables and plots of summary statistics. Furthermore, visual representation of CMP ranking through the color-coded decision table should be presented in the September BFTSG intersessional meeting. Consideration was also given towards presenting plausibility weighted results within the violin plots as used to present summary statistics of performance measures; the MSE Consultant will explore this possibility further.

6. Messaging on MSE (material for SCRS and Commission, and other stakeholder groups)

The Group noted the importance of developing clear, concise and consistent messaging on the MSE in preparation for the exchanges with Panel 2 late in the year. There are two Panel 2 intersessional meetings (13-15 September and 12 November 2021), as well as the Annual Meeting of the Commission (15-22 November 2021). The November Panel 2 meeting is dedicated entirely to the BFT MSE, and the September Panel 2 meeting includes a brief MSE update.

The Group conducted a walkthrough of a new website, www.harveststrategies.org, that functions as a clearinghouse of communication materials related to harvest strategies and MSE. These materials include factsheets, animations, videos and an interactive of harvest strategies in action and in development. There are versions available in twelve different languages, including all three official ICCAT languages. There are also resources available for visualization of MSE results, including a package of plots, a template slide presentation, and a Shiny app which already includes preliminary results from the BFT MSE as a case study. All materials on the website are open access and available for modification and use. The Group agreed that many of the resources can be employed directly, extracted, or tailored to the specific BFT MSE process for use in the communications with the Commission described below.

The Group noted that the last substantive exchange with the Commission on the MSE was the March 2019 Panel 2 intersessional meeting (Anon. 2019). Management objectives (in the context of the conceptual objectives adopted in Rec. 18-03), performance measures and reference points were among the focal points of that discussion. The Group discussed whether it would be appropriate to seek Panel 2's input on such matters during its forthcoming meetings. However, the Group agreed to rather focus on the trade-off space for now, in part because it may be difficult for the Commission to understand the different function and meaning of e.g., a limit reference point in the MSE context as compared to in traditional best assessment. In addition, the concept of dynamic B_{MSY} may be new to managers and difficult to comprehend, especially since ICCAT's current target reference point for bluefin management is $F_{0.1}$.

6.1 Plots

The Group emphasized that the most important results to show the Commission at this stage should be those which demonstrate the key trade-offs, including the primary trade-off between catch and stock status. This will facilitate feedback from the Commission on which trade-offs matter most to managers and stakeholders. Highlighting projected time series of future catch and biomass is also a priority.

The Chair of the Albacore Species Group, Dr. Arrizabalaga, shared the plots which they had used to present the Northern Albacore (NALB) MSE results to Panel 2. The Group agreed that similar data displays (i.e., spider plots, summary tables) should be used for BFT, since the Panel 2 is already familiar with those. Importantly, the NALB MSE results were not subject to tuning. Therefore, it will be important to dedicate some time in the Panel 2 discussions to explain the rationale behind and implications of the tuning process, as well as the additional complexities related to the two-stock nature of BFT, including the reason why asymmetric tuning may be more desirable.

The Group recognized the intention of the Working Group of Stock Assessment Methods (WGSAM) to develop a consolidated package of plots to be used for all ICCAT MSEs, and acknowledged that the eventual bluefin package could become the basis for that standardized package. The NALB plots and harveststrategy.org plots will be used as a basis for developing the plots for BFT, likely with the addition of the violin plots. All plots will be annotated and include text to guide the reader through viewing and understanding the visualizations.

6.2 Presentations and Executive summaries

The Group agreed to develop three types of communications materials for these coming Panel 2 meetings: a) a one-page summary, b) an Executive summary (~4 pages), and c) slide presentations, with one version for the September Panel 2 meeting, one for the November meeting and one for the webinars (see Section 6.3). The primary target audience is the Commission decision-makers, through Panel 2. Individual CPCs can modify the materials, if necessary, for outreach to their domestic stakeholders. All CPCs are strongly encouraged to engage their stakeholders at this point, so that these stakeholders can develop a basic understanding of the status of the MSE, including the next steps planned, and are better placed to provide input. It was also considered essential to show Commission members the expected heavy schedule involving Commission-SCRS dialogue to complete the MSE process.

A small group was formed to develop the draft communication materials. The small group includes the BFT Co-Chairs (Drs Walter and Rodríguez-Marín), the SCRS Chair, the MSE Consultant, and some CPC scientists (Dr. Andonegi, Dr. Rouyer, S. Miller, and D. Schalit). This small group will present the draft materials prior to the September BFTSG intersessional meeting for feedback and endorsement.

The materials will present only the essential ideas that need to be conveyed to the Commission at this point, most importantly on tuning targets, tradeoffs, and multi-stock implications. Ideally, all materials will be produced in English, French, Spanish, Arabic, and possibly Turkish.

When developing materials, any feedback solicited from the Commission (e.g., TAC caps, management cycle interval, tradeoff prioritization) will include a few specific options rather than be an open-ended request for input. This will help to prevent requests for impossibilities, such as record high catches and a $Br30 > 1$.

6.3 Creation of 'MSE - ambassadors' (people who are able to speak about the MSE to various CPCs, groups, etc.)

Recognizing the need for additional dialogue with managers before the November Panel 2 meeting, the Group established a team of 'MSE ambassadors' who can serve as regional, language-specific contacts (Dr. Andonegi – Spanish, Dr. Rouyer – French, Dr. Walter – English, TBD – Arabic). Dr. Die, the former SCRS Chair, may also be enlisted as an ambassador as well as members of the Communications Team, as needed.

Pending approval of Panel 2, the Group's intention is to hold a series of informal webinars to describe the BFT MSE process. The ambassadors' chief responsibility in the near-term will be to speak on at least one webinar (2 maximum) in October to provide an overview of progress to date on the MSE. The specific details of how the webinar will be hosted will be developed in consultation with the Secretariat, the BFTSG and Panel 2. The primary objective will be to instill a background understanding of the process, and sufficient results to convey fundamental concepts such as tradeoffs, so delegates will be prepared for a substantive exchange at the November Panel 2 meeting. The webinars will feature a common set of materials, as outlined in Section 6.2. All sessions will be recorded and posted on ICCAT's website MSE page, so that they can be viewed on-demand.

The Group suggested that the webinars function like an educational ICCAT side event, and not be a forum for the Commission to provide formal feedback to the SCRS. Open discussion will be encouraged, and participation will be open to all CPCs and accredited observers, pending dialogue with Panel 2 on the best audience. The BFT Co-Chairs hope to be able to attend every webinar as experts on the MSE and technical assistants to the ambassadors.

The BFT Co-Chairs will partner with the Secretariat and SCRS Chair to determine the best method for advertising and hosting the webinars, as well as for prompting CPC outreach to their domestic stakeholders. One option would be for the Panel 2 Chair to provide a letter that could be distributed as an ICCAT Circular. The Group also intends to take advantage of the Commission's email correspondence system employed as a preparatory tool during this era of virtual meetings. An online discussion forum is another potential means that could be used to prepare for the November Panel 2 meeting.

The Group agreed that it is critical to convey the timing of upcoming decision points to the Commission, noting that the MSE framework is nearing completion (prior to the stage of iteration with stakeholders) and there are already a number of CMPs with good performance. As a result, MP adoption is possible on schedule in 2022 if sufficient time for both formal and informal dialogue with the Panel 2 is scheduled.

7. Code review progress

The contract for MSE code review has finalized and is underway. The MSE Consultant has prepared for the MSE code review following the expected preparation timeline. The expected timeline for the MSE Code Review Contractor deliverables are as follows:

Initial report	22 August 2021
Presentation of initial report to BFT intersessional	2-9 September 2021
Draft final report	November 2021
Final report	1 December 2021

8. Workplan

2021 Workplan

The year 2021 has proceeded quite well. The BFTSG and BFT MSETG have accomplished or in the process of accomplishing a series of key milestones:

1. SCRS adopts reference grid and decide plausibility weighting
2. SCRS initiates independent peer review of MSE code
3. SCRS continues development and testing of candidate MPs
4. SCRS commissions two additional sub-groups on Abundance indices and Assessment models to address key issues.
5. Sub-group on growth in farms continues its work
6. BFTSG conducts West BFT assessment

The remaining MSE tasks are for the Communications team to prepare the communications materials in advance of the September BFTSG intersessional meeting, and for the developers to refine and retune their CMPs. The BFTSG will also complete the West BFT assessment.

The major remaining MSE meetings are the September BFTSG intersessional meeting, the Species Group meeting, a series of communication webinars and the November meeting with the Panel 2.

2022 Workplan

The year 2022 will be a pivotal year for BFT as it will have a series of 3 iterative meetings with the Panel 2. The first meeting will be in February, a second in May/June and a third and final in October/November to finalize the CMPs submitted to the Commission. The BFTSG anticipates that such a series of iterative meetings will be necessary to be able to adopt a CMP in November of 2022. The BFTSG requests the necessary time be devoted to holding such meetings. The need for iteration is so that the Panel 2 can provide guidance for the CMP developers to incorporate, then to allow time for new calculations and their new results to be presented at the next meeting. Meetings can be held remotely or in person, though at least several in person meetings would be preferable. If a good rapport can be developed, together with a degree of common understanding of the material, and several of the meetings could conceivably be conducted remotely, and it is likely that several of the meetings could rather be short check-ins by webinar. During the same period, the BFTSG will conduct an assessment (data preparatory and assessment meeting) of East and Mediterranean BFT.

Detailed proposed workplan

Note that this is a proposal from the BFT MSETG to the BFTSG and represents the BFT MSETG's view of the necessary meetings and tasks for 2021 and 2022.

Date	Milestone/meeting	participants / meeting type
July 8, 2021	MSE Consultant completes adding weighting to BFT MSE package	MSE Consultant
Early August 2021 TBD	Informal CMP developer/Communications team check in (2-hour webinar)	BFT MSETG
July 8 / August 24, 2021	CMP developers refine, retune (on deterministic), and provide both deterministic and stochastic results of CMPs to the MSE Consultant (due August 24). Priority for stochastic results should be given	BFT MSETG
July 8 / August 24, 2021	Communications team develops products (drafts due 8/24)	BFT MSETG
Ongoing	Webinars of the BFT Technical Sub-group on Assessment models (East and Mediterranean BFT) to develop models	BFTSG
August 30 / September 1, 2021	West BFT assessment meeting	BFTSG
September 2 - 9, 2021	BFTSG intersessional meeting (Focus on MSE and responses to the Commission). The BFTSG will focus on choosing 2-3 representative CMPs, for illustration purposes but not as the final selections. It may not be possible to categorically choose the best CMPs as further refinement will need to occur. It may, be possible to exclude very poorly performing CMPs or ones that do not have stochastic results.	BFTSG
September 13 - 15, 2021	Panel 2 meeting (short presentation on MSE progress (SCRS Chair/West BFT Chair))	Panel 2
September 20 - 25, 2021	Species Group meeting (1 day for BFT), focus solely on Executive Summary and responses to the Commission	SCRS
September 27 - October 2, 2021	SCRS	SCRS
October 2021	Offer Informal webinars in October	SCRS/Panel2 /Commission /others

December 11, 2021	Panel 2 MSE meeting. Dialogue with the Panel 2 on CMPs, operational management objectives and performance indicators. At this point the SCRS should have 2-3 CMPs and tangible performance statistics values to show tradeoffs.	Panel 2
December 2021	Webinar to integrate Panel 2 advice	BFT MSETG
December 1, 2021 - February 1, 2022	CMP Developers incorporate Panel 2 advice	BFT MSETG
March 2022	Panel 2 meeting (second iteration of CMP refinement) - recommend final operational management objectives and identify performance indicators - develop guidance on range of appropriate management responses should exceptional circumstances be found to occur - to further incorporate recommendations and further refine CMPs to meet operational management objectives - begin guidance on a range of appropriate management responses should exceptional circumstances be found to occur. 1-day on MSE.	Panel 2
April 2022	BFTSG intersessional meeting (EBFT Data prep + MSE, possibly separate meetings). This meeting would incorporate an essential milestone to agree upon the top 2-3 CMPs for consideration.	BFTSG
April 2022	BFTSG to initiate independent peer review of MSE process (Terms of Reference and timing TBD)	BFTSG
May/June 2022		BFT MSETG
May/June 2022	Panel 2 meeting (third iteration of CMP refinement to incorporate further recommendations). This meeting could likely be remote and 1-day.	Panel 2
June/September 2022	BFTSG intersessional meeting (EBFT Assessment + MSE, possibly separate meetings) BFTSG completes MSE, incorporating feedback from Commission through Panel 2/SWGSM	BFTSG
September 2022	Species Group meeting/SCRS (finalize CMPs)	SCRS
October/ November 2022	Panel 2 meeting, SCRS presents completed MSE to Panel 2, Panel 2 selects CMPs to present to the Commission.	Panel 2
November 2022	SCRS presents to the Commission CMPs, the Commission adopts an interim MP at the Annual Meeting, including a 2-year TAC	Commission

9. Adoption of the report

The Report of the 2021 Intersessional meeting of Bluefin Tuna MSE Technical Group was adopted. Drs Walter, Rodríguez-Marín and the SCRS Chair thanked the participants and the Secretariat for their hard work and collaboration to finalize the report on time. The meeting was adjourned.

References

- Anonymous. 2019. Report of the 2019 Intersessional meeting of Panel 2 (Madrid, Spain, 4-7 March 2020). 137pp. https://www.iccat.int/Documents/Meetings/Docs/2019/REPORTS/2019_PA2_ENG.pdf
- Anonymous. 2020. Report of the 2020 Intersessional Meeting of the ICCAT Bluefin Tuna MSE Technical Group (Madrid, Spain, 24-28 February 2020). ICCAT Collect. Vol. Sci. Pap. 77(2): 1-74.

Agenda

1. Opening, adoption of agenda and meeting arrangements
2. BFT MSE Consultant's update on work since April meeting and an informal meeting in June
3. Review of the acceptability of the reconditioned OMs
 - 3.1 Review of the reconditioned OMs
 - 3.2 Review sigma and AC values for projections of abundance indices
 - 3.3 Review robustness tests
 - 3.4 Consideration of any revisions in the reference grid
 - 3.5 Proposals for finalisation of OMs for the grid and robustness for CMP testing purposes
 - 3.6 Consideration of any revisions to plausibility weighting of OMs (if related proposals are submitted)
 - 3.7 TSD
4. CMP Development
 - 4.1 Update from CMP developers
 - 4.2 Comparison of results from development tuning
 - 4.3 Discussion of advantages/disadvantages of different CMPs
 - 4.4 Further refinement and harmonization of CMPs – guidance and process
 - 4.5 Process for condensing CMPs into 2-3 top performers for further consideration
5. Performance measures for reporting to September meeting
 - 5.1 Review of existing and of any additional measures proposed
 - 5.2 Trimming performance measures
 - 5.3 Plotting
6. Messaging on MSE (material for SCRS and Commission, and other stakeholder groups)
 - 6.1 Plots
 - 6.2 Presentations and Executive summaries
 - 6.3 Creation of 'MSE – ambassadors' people able to speak about the MSE to various CPCs, groups, etc.
7. Code review progress
8. Workplan (with deadlines where appropriate)
9. Adoption of the report and closure

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List of Papers and Presentations

Number	Title	Authors
SCRS/2021/121	Refinements of the BR CMP as at July 2021	Butterworth D.S., and Rademeyer R.A.
SCRS/2021/122	Specifications for ABTMSE management procedures	Hanke A.R., and Duprey N.
SCRS/2021/123	Sensitivity of CMP rankings to conservation targets for Atlantic bluefin tuna	Johnson S.D.N., Rossi S.P., and Cox S.P.
SCRS/2021/124	Overview of Atlantic bluefin tuna Operating Model reconditioning data and results	Carruthers T. R.
SCRS/2021/125	Overview of Robustness OM specification and conditioning	Carruthers T. R.
SCRS/2021/126	A 'Model-based' multistock CMP for Atlantic bluefin tuna based on an efficient state-space surplus production assessment model	Carruthers T. R.
SCRS/2021/127	A reconfigured a multi-stock spatial management procedure for Atlantic bluefin tuna following Operating Model reconditioning	Carruthers T. R.
SCRS/2021/128	A retrained A.I. CMP for Atlantic bluefin tuna following Operating Model reconditioning	Carruthers T. R.
SCRS/2021/129	Ad-hoc weighting for Operating Model #35: 'does it matter' analysis	Carruthers T. R.
SCRS/2021/130	A summary of preliminary candidate management procedure performance for the reconditioned reference grid Operating Models	Carruthers T. R.
SCRS/P/2021/045	BFT MSE Consultant's update on work since April meeting and an informal meeting in June	Carruthers T. R.
SCRS/P/2021/046	"EA" CMPs - updated progress	Andonegi E., Arrizabalaga H., Rouyer T., Grodoa A., and Rodriguez-Marin E.

SCRS Document and Presentations Abstracts as provided by the authors

SCRS/2021/121 The BR CMPs first advanced by Butterworth and Rademeyer (2021) are first refined, and then their tuning parameters are adjusted to meet the development tuning options specified at the April 2021 meeting of the Bluefin Tuna Species Working Group for the reconditioned OMs. Discussion focuses primarily on the results from the stochastic runs of these CMPs, as ultimately any MP eventually adopted will need to show satisfactory performance for such scenarios, which better reflect reality as regards future data. The lower tuning target levels yield results that would likely be considered unacceptable because of a fair number of OMs for which especially the lower percentiles of Br30 distributions are rather small. For this reason, future CMP options considered should probably be restricted to tuning targets for the eastern and western stock median (over the grid OMs) Br30 values which do not extend much below 1.5 and 1.25 respectively. The resource conservation performance for some of the robustness tests is open to question, more so for the western stock, though note must be taken that these tests are themselves based on the least productive of the OMs in the grid.

SCRS/2021/122 Two candidate management procedures for the Eastern and Western Atlantic Bluefin tuna stock are described and performance relative to Br30 and C20 measures provided.

SCRS/2021/123 This paper investigates how the choice of conservation targets influence relative rankings of candidate management procedures (CMPs) for Atlantic Bluefin Tuna (ABT). Three CMPs from different development teams are each tuned to three interpretations of the stated ABT conservation goal to achieve “60% probability of healthy stocks over a 30-year period”, where healthy is defined via a Kobe plot where both $F/FMSY \leq 1.0$, and $B/BMSY \geq 1.0$. The probability calculation for this objective differs among interpretations, being calculated as healthy status in (i) 60% of simulation replicates in the 30th year of the projection period; (ii) 60% of simulation replicates and years within the first 30 years of the MSE projection period; or (iii) 60% of simulation replicates in each year within the first 30 years. Tuning each CMP to the desired probability is performed via an iterative grid search over tuning parameter values.

SCRS/2021/124. A new reference grid of operating models (OMs) was reconditioned using historical data to 2019. The reconditioned OMs are a reduced grid that no longer includes a factor for western stock mixing. Some new OMs also now include senescence (high M for older fish). Several indices were updated substantially, including historical values. The length composition data were generally comparable in their distribution, but the number of observations was generally lower and substantially so for some fleets. In general, the new reconditioned OMs spanned a narrower range of scenarios for stock status and trajectory. The new OMs estimated increasing recent trends in western stock status where previously the old OMs could estimate flat or slightly decreasing trends. The new OMs no longer include scenarios where Eastern spawning stock biomass (SSB) relative to dynamic SSBMSY very high (e.g., above 2.5). The addition of senescence for the low M scenarios appears to have reduced the estimation of large accumulated spawning stock biomass in the ‘plus group’ (age 35+) fish.

SCRS/2021/125 A total of 44 robustness operating models were specified that cover 11 robustness tests applied to four reference grid OMs. These tests include scenarios for western stock somatic growth, increasing catchability, unreported catch overages, high western stock mixing into the East area, the ‘Brazilian catch’ scenario, time varying stock mixing, hyperstable relative abundance indices, persistent changes in mixing, varying timing of future regime shifts, intermediate parameter values and zero eastern mixing in to the West area. Not all robustness operating models could be specified exactly as the group described them. The hyperstable index robustness test did not converge when conditioned and needs to be revisited.

SCRS/2021/126 A new multi-stock model-based CMP was developed for Atlantic bluefin tuna using a state-space surplus production model. The approach allows varying eastern and western index trends to alter the reconstruction of catches by stock, hence allowing the model to account for variable mixing in the West Atlantic. The CMP currently shows some promise but has not been subject to refinement and performed relatively poorly compared to an existing index based empirical CMP that has been subject to greater refinement.

SCRS/2021/127 Following operating model reconditioning, the multi-stock CMPs ("TC") were updated. When tuned to development targets Br30 1.00 – 1.00 (eastern stock – western stock) (TC1) and 1.25 – 1.25 (TC2) the CMP could extirpate the eastern stock in at least one operating model. The CMP contains parameters that could prevent the problematic extirpation in some OMs for the eastern stock and it should continue to be developed. Western biological outcomes were less of a concern than the previous operating models prior to reconditioning.

SCRS/2021/128 CMPs (AI) that set East and West area catches using a fixed exploitation rate and predicted biomass from an artificial neural network were retrained on simulated projected data from the reconditioned reference grid of operating models. Eastern development tunings of Br30 = 1.5 were required to achieve eastern biomass outcomes consistently above dynamic SSBMSY levels across the reference grid OMs. The minimum eastern TAC of 10kt was too high to prevent extirpation of the eastern stock in some recruitment factor level 2 operating models.

SCRS/2021/129 During reconditioning, an ad-hoc weighting of operating models #29 and #35 was necessary to improve their fits the Mediterranean seasonal prior and the MED_LAR_SUV index, respectively. In the case of operating model #35, fitting the MED_LAR_SUV led to a misfit to the seasonal prior. Index and constant harvest rate CMPs were projected to evaluate whether there are substantive differences in the MSE outcomes of OM #35 as initially reconditioned and the version that was subject to ad-hoc weighting. In general, CMP performance measure values were similar among initial and ad-hoc weighted OMs, particularly for constant harvest rate CMPs. In most cases, the ranking of CMPs was the same for projections of catches and biomasses regardless of ad-hoc reweighting. The reweighted OM is a more defensible candidate for the reference OM grid since it provides a much better fit to the MED_LAR_SUV index.

SCRS/2021/130 Preliminary CMP results are presented for the deterministic reference set of operating models. CMPs are more similar in their performance than for the operating models before reconditioning. Eastern stock extirpation was now generally a larger issue than western stock extirpation which was the primary issue prior to operating model reconditioning. Eastern stock extirpation was much harder to avoid with eastern development tunings of Br30 = 1.00, 1.25. CMPs may obtain substantially better performance given greater time for refinement. The recruitment axis of the reference grid remains the most important in determining CMP performance outcomes.

SCRS/P/2021/045 The work conducted by the MSE Consultant since the April BFTSG intersessional meeting and an informal meeting in June were provided. The summary of outstanding features and arising issues was also provided.

SCRS/P/2021/046 This document showed the latest progress on development tuning the index-based EA cMP already proposed for BFT in previous meetings and defined in document SCRS/2021/032. It was provided using the latest available version of the ATBMSE R package (version 7.1.3). The EA cMP used for indices for estimating the status of both stocks, the East and the West, and the TAC in a certain year is defined as the TAC for the previous year but re-scaled depending on the value of that status estimator in relation with a certain target that was modified to achieve the different management objectives agreed by the BFT Group.

**Specifications for MSE Trials for Bluefin Tuna in the North Atlantic
Version 21-2: 19 July 2021**

Specifications for the MSE trials are contained in a living document that is under constant modification. The most recent version of the document (Version 21-2: 19 July, 2021) can be found [here](#).