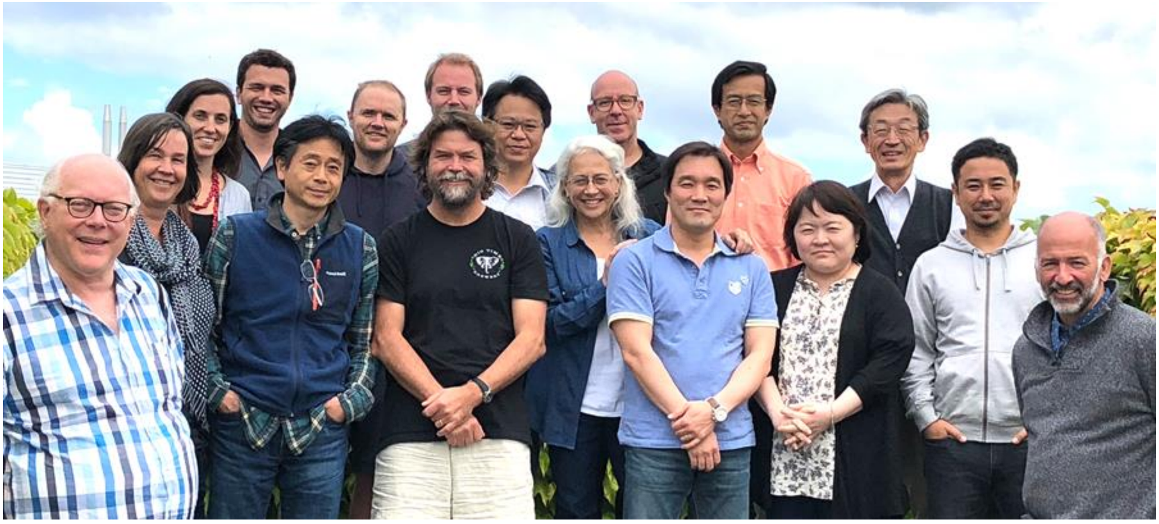
Commission for the Conservation of
Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of the Ninth Operating Model and Management Procedure Technical Meeting



18 - 22 June 2018
Seattle, USA

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Opening

1. The Chair of the Ninth Operating Model and Management Procedure Technical Meeting (OMMP), Dr. Ana Parma opened the meeting and welcomed participants (**Attachment 1**). The Chair noted that the terms of reference are to "Evaluate results of initial MP testing and refine testing protocols".
2. The draft agenda was discussed and amended, and the adopted agenda is shown at **Attachment 2**.
3. The list of documents for the meeting is shown at **Attachment 3**.
4. Rapporteurs were appointed and agreed to co-ordinate the preparation of the report along with the consultant and Advisory Panel members. Subsequent report sections are based on the adopted agenda.

Agenda Item 1. Discuss input from the Strategy and Fisheries Management Working Group meeting in March 2018

5. The Chair reported the outcome of the Strategy and Fisheries Management Working Group meeting in March 2018, which was attended by several scientists from member countries as well as by Dr. James Ianelli and Dr. Ana Parma from the Advisory Panel.
6. The meeting provided a very good opportunity to initiate discussions with CCSBT managers and advisors on long-term goals for SBT, the process for developing a new MP and features desired for new candidate management procedures (CMPs), including a range of tuning levels and probabilities of rebuilding.
7. With respect to tuning levels, scientists expressed their preference to use the median instead of a larger probability (e.g., 70% as used for the Bali MP) and to test only a range of tuning levels while fixing the tuning year to avoid repeating calculations for combinations that were indistinguishable in performance (i.e., a later tuning year with a higher probability may produce similar results to an earlier tuning using the median).
8. Following extensive discussion, the meeting agreed to the following objectives for use in the initial round of CMP testing:
   - Tuning biomass levels of 0.25, 0.30, 0.35 and 0.40 of unfished spawning biomass SSB_0 (here interpreted as initial Total Reproductive Output; TRO_0);
   - CMPs be tuned to a 50% probability of achieving the tuning biomass levels;
   - The tuning year set to 2035, provided the projection period was not too short and did not lead to numerical issues;
   - Projections should be extended to 2045 to evaluate post-2035 performance;

- All CMPs should achieve the current objective of providing at least a 70% probability of reaching 20% of SSB_0 by 2035. Once the current interim rebuilding target of 20% of unfished spawning biomass has been reached, there should be a high probability that the stock would not fall below this level after 2035.

9. The following performance statistics were recommended by the SFMWG:

   - Spawning biomass in medium term relative to SSB_0;
   - Spawning biomass in short and medium terms relative to current;
   - Minimum spawning biomass relative to current;
   - Proportion of runs above the current biomass at the tuning year;
   - *SSB* lower (10th) percentile continuing to increase (no decline over 2013-2035);
   - Lower 10th *SSB* percentile in year t, e.g. in 10 years;
   - Probability of meeting the interim rebuilding target by 2035 (aim to have at least 70% of the simulated trajectories rebuild to higher than 0.2 SSB_0 by 2035);
   - Probability of dropping below 0.2 SSB_0 in any future year beyond 2035;
   - Year at which 70% of simulations reach 0.2 SSB_0;
   - Median year that SSB_{MSY} is reached; and
   - Probability of being above SSB_{MSY} in last 10 years (i.e., after 2035).

10. In terms of features of the CMP, the meeting agreed to conduct the test with the following specifications:

    - Set TACs in 3-year blocks;
    - Set the TAC for 2021-2023 in 2020 as the first TAC decision, noting that the usual lag between TAC setting and implementation will be reduced by 1 year to allow more time for MP development. The usual schedule would be used after that (i.e., in 2022 set TAC for 2024-2026);
    - Set maximum TAC changes of 2,000 t, 3,000 t and 4,000 t, and add 5,000 t if the previous three did not provide sufficient contrast. Each level of maximum TAC change would not necessarily be applied in combination with all tuning levels. The OMMP group would decide on the appropriate scenarios to test each level of Maximum TAC change in this initial round.

11. It was emphasised that the decisions made by the meeting regarding tuning levels and MP constraints were not final but would be revisited after the initial round of trials had been completed, and the Operating Model (OM) had been updated to incorporate new data exchanged before June 2019.

Agenda Item 2. Operating model and data inputs

2.1. Code updates and preparation of OM scenarios

12. Dr. Rich Hillary presented paper CCSBT-OMMP/1806/04 which details the structural changes made to the SBT OM which was now required to simulate the

new data sources: gene tagging, and close-kin mark-recapture (parent-offspring and half-sibling pairs, i.e., POPs and HSPs).

13. The new code for gene-tagging includes a q-factor to allow for potential biases that would affect the gene-tagging absolute abundance estimates, and an over-dispersion factor for inclusion of additional variability in estimates. The code for the OM simulates the adaptive process of choosing to process additional samples at harvest to maintain a reasonable CV for the abundance estimate.

14. The new code for the close-kin simulates new HSP and POP data each year and merges the new estimates with historical estimates. This is required as each new year of data covers many earlier cohorts, including those in the historical data. The code then creates an abundance index from the merged data series. Code updates have been provided via GitHub.

15. The Chair noted that after SFMWG 5, the projection code and control files were updated to:
    - run projections up to 2045;
    - use UAM1 estimates as default for base projections;
    - conduct the first TAC calculation in 2020 for 2021-2022 with no extra lag, and use the standard 2-year lag after that;
    - simulate gene-tagging data; and
    - simulate close-kin data.

2.2. Gene tagging

16. CSIRO presented paper CCSBT-OMMP/1806/06 on results from the pilot gene-tagging project. The SBT pilot gene-tagging program commenced in 2016. The aims of the pilot study were to test the logistics and feasibility of a large-scale implementation of gene-tagging of SBT and to provide a fisheries-independent estimate of the absolute abundance of juveniles. A total of 3,768 fish were tagged and released in 2016. The number of fish tagged did not meet the original target of 5,000 fish, but it was possible to compensate for this by taking extra samples at harvest. A total of 16,490 tissue samples were collected during harvest, well in excess of the design study target of 10,000 samples. The gene-tagging team acknowledge and thank the Australian SBT Industry members, factory Managers and staff, for access to their fish and facilities during the harvest. Protocols were refined for tissue digestion, robotic DNA extraction and quality controls. The DNA extracted was sequenced using specifically designed SNP markers. Fish with incomplete or poor genotype information (too few target SNP markers with good sequencing results) were excluded from the analysis. In total, 3,456 fish were tagged (excluding fish with poor or failed genotyping), 15,391 fish were included in the harvest sample set, and 22 recaptures were detected. The abundance estimate is 2,417,786 with a CV of the estimate of 0.21. The gene-tagging abundance estimate is close to the median estimate of age 2 fish in 2016 (2,102,853 fish in 2016) from the 2017 stock assessment.

17. CSIRO reported that the pilot project has demonstrated the technical feasibility and field logistics of a genetic tagging program for SBT and its potential to provide an absolute abundance estimate for monitoring and management

purposes. The pilot gene-tagging project has demonstrated collection of samples at sea and during commercial harvest from farms, collection of quality DNA, and high through-put processing from tissue to DNA and quality controlled genotypes. The CCSBT has commenced an on-going recruitment monitoring program using the gene-tagging method.

18. Discussion clarified the consideration of sources of bias which had been investigated in the design study.

19. The group concluded that the pilot GT project has demonstrated that an abundance estimate can be provided with good precision, and given the Commission's commitment to the ongoing program, an estimate should be available each year. In the event that an abundance estimate is not available in a particular year, that can be dealt with in the same way that this is handled for other indices in assessments and in the MP (i.e., through meta-rules), noting that methods and code for dealing with missing data in the assessment and current MP already exist.

2.3. Close-kin: POPs and half-sibling indices

20. Details on the simulation of CK POPs and HSPs are described in paper CCSBT-OMMP/1806/04 (see code changes, section 2.1 above). The historical HSP and POP data were updated and integrated into the OMs in 2017.

21. The group recommended that the ESC consider q_{hsp}=1.0 for the Reference Set for reconditioning in 2019 and that it be estimated from the CKMR data as part of regular diagnostic checks.

22. The q_{hsp} parameter accounts for the potential reproductive dynamics that would cause a mismatch between the overall number of POPs and HSPs. An example of this would be where the full range of adults in Indonesia is sampled, but the juveniles sampled in the GAB are spawned by a subset of the whole adult population. This would result in an excess of HSPs, relative to POPs, in the data, which would introduce a bias. The q_{hsp} parameter is there to remove the effect of such a bias if present and would be expected to be greater than one for the example described. Indeed, almost all scenarios that can be envisaged would be expected to introduce a negative bias in *SSB* when including the HSPs with q_{hsp} = 1. In 2017 the median estimate of q_{hsp} in the reference set was around 0.85 with an SD of 0.15 - in the opposite direction that might have been expected and not significantly different from 1. Subsequent analyses showed this estimate was actually being driven by the tagging data, rather than a mismatch between the overall number of HSPs and POPs. When fixing q_{hsp} = 1 both CKMR data sets are consistent with each other and show no preference for a q_{hsp} value different to 1. Since the inclusion of the CKMR data in the assessment (POPs first then HSPs) there has always been some moderate tension between the tag data and the CKMR data; they both observe some of the same cohorts in an absolute sense at different points in time. This tension is worth noting but is not significant in terms of the likelihood or in terms of the fits of both data sets for q_{hsp} fixed at 1 or estimated. It would only take a downward bias of around only 7 to 8% in the conventional tag reporting rates to result in such data tension.

23. The meeting agreed that at the time of reconditioning the OM in 2019, q_{hsp} will be fixed to 1 for two main reasons: (1) the q_{hsp} estimate is not driven by an

inconsistency between the HSPs and POPs (its only reason for being included), and (2) fixing q_{hsp} = 1 does not introduce a significant decrease in the likelihood of the fit to the tagging data or any systematic trends in residuals in the fits to these data.

2.4. CPUE

24. A webinar with John Pope was held during the meeting to examine the base CPUE standardisation used in the OM (CCSBT-OMMP/1806/08 and CCSBT-OMMP/1806/10; see **Attachment 4** for the report of the CPUE webinar).

25. The conclusions of the group were that the 2017 operational pattern of the Japanese longline fishery in terms of catch amount, the number of vessels, time and area operated, proportion by area, length frequency and concentration of operations was similar to recent years. The CPUE of the 2017 Japanese longline fishery can accordingly be regarded as reflecting stock abundance to the same extent as in previous years.

26. The base CPUE standardised with and without Area 7 data does not show the types of differences observed in previous years. This was interpreted to be the result of similar increasing trends that are now observed in Area 9, whereas previously they were only evident in Area 7. The meeting agreed that this (base CPUE without Area 7) would no longer be useful as a robustness test for MPs.

27. The meeting agreed that the base CPUE series can continue to be used as an index of SBT abundance for inclusion in OMs and input to MPs.

2.5. Variability of age 4 CPUE around indices predicted by conditioning model

28. The CPUE webinar with John Pope also discussed methods for generating an age 4 CPUE series (CCSBT-OMMP/1806/09; see **Attachment 4** for the report of the CPUE webinar).

29. The CPUE webinar discussed the two approaches for developing a CPUE index of recruitment. The earlier approach takes the base CPUE series first and then applies the age distributions (via the cohort slicing procedure). The latter approach first disaggregates catches by age and then fits the model to each age. Three approaches were then used for inclusion of effects on the index of estimates of discards/releases reported from fishermen by three weight-classes.

30. The conclusions from the CPUE webinar meeting were that the earlier approach was preferred and that age 3 was not suitable. Comparison of age 4 or age 5 CPUEs with modelled and other observed measures of recruitment would be a good idea. It was noted though that many of the observed measures of recruitment were composites of several ages. Discarding is seen as a potential problem, even though there has been an attempt to take this into account.

31. The OMMP working group noted that the suggestion to examine the potential of age 4 CPUE as an index for CMPs was made when it was unknown whether or not the pilot gene-tagging project could produce an abundance index. The gene-tagging project has recently successfully demonstrated logistics and feasibility of gene-tagging, and has delivered an abundance index with a reasonable CV. The age 4 CPUE is not being considered as an alternative index for use in CMPs

because of the inherent problems of CPUE data in general (e.g., CPUE changes in Area 7), plus the ageing and discarding issues associated with selecting this age-class. Methods for generating these data in the OMs have also not been resolved. The meeting encouraged further investigation of age 4 CPUE as it may have value as a monitoring series, but not for direct use as input to the CMPs at this stage.

Agenda Item 3. Evaluate results from MP testing

3.1. Review results of initial MP trials

32. Japan presented paper CCSBT-OMMP/1806/12. The paper applied simple constant proportion and target-based empirical CMP to the basic grid OM model and a low recruitment robustness test for SBT. The first two approaches, DMM1 and DMM2 respectively, used CPUE index data only, while DMM3 added gene tagging data to the DMM2 approach. The key results were that the DMM2 target-based approach substantially outperformed the constant proportion DMM1 approach in terms of smoothness of the TAC trajectories, and that (at least as far as investigations had been possible to date) the addition of gene tagging data offered little improvement to depletion statistics in instances where low recruitment had occurred. Performance under DMM2 was unusually good, but this approach still needed to be subjected to the other robustness tests, and further attempts needed to be made to seek more improvement in performance when gene tagging data are used.

33. Japan presented paper CCSBT-OMMP/1806/11. This paper provides preliminary results of simulation trials for initial development of new CMPs for southern bluefin tuna. The CMPs considered are all simple empirical ones, called “NT1” and “NT2”. The NT1 CMP utilises CPUE and gene-tagging (GT) indices in their harvest control rules (HCRs) for setting TAC. The NT2 CMP has a HCR that utilises a close-kin mark recapture parent-offspring pairs (POP) index in addition to the same HCRs as incorporated in the NT1. Major findings from the initial test trials are: the NT1 and NT2 CMPs could be tuned to all the tuning points tested; for both CMPs, the tuning results were similar regardless of the values used for maximum TAC change when comparing the results of tuning to the same stock level (30% or 35% of the initial total reproductive output, SSB_0); for both MPs, the tuning results were different between tunings to the stock levels of 30% SSB_0 and 35% SSB_0; when testing the NT1 and NT2 CMPs under the “lowR” (n=10 years) robustness scenario using the existing parameter values tuned based on the reference set, both CMPs did react to 10-year series of low recruitment accordingly.

34. Paper CCSBT-OMMP/1806/05 on potential forms of CMPs and data generation methods was presented to the group. A fairly broad range of data sources (CPUE, gene tagging and CKMR) and general MP structures (trends, targets, limits, and both empirical and model-based approaches) were explored. At the highest level, CMPs with CPUE included, but without CKMR data, performed better when targets, not trends, were used. For the gene tagging, limit-type approaches performed better than trend approaches. For the CKMR data both empirical and model-based approaches were explored, with the latter clearly reducing catch variability. The 25% and 40% tuning objectives required rapid increases and

decreases in future TACs, respectively, and little contrast between CMPs. The 30% and 35% tuning objectives showed much more contrast across CMPs and were the main focus of the presentation of performance statistics. Similar average TACs were seen across the range of CMPs and, for the reference set, the main discriminatory performance statistics were AAV and the 2-up/1-down TAC probability.

35. A summary of the CMPs' characteristics is presented in Table 1.

Table 1. A summary of the CMPs' characteristics.

Paper	Name	CPUE	Gene tagging	CK-POP-HSP	Comment
12	DMM1	Constant proportion			No inertia
	DMM2	Target			With inertia
	DMM3	Target	Target		With inertia
11	NT1	Trend	Limit and trend		With inertia
	NT2	Trend	Limit and trend	POP target	With inertia
5	RH3	Target	Limit		Inertia in trend
	RH7	Trend	Limit	Empirical index, target	Inertia in trends
	RH8	Trend	Limit	Model index, target/trend	Inertia in trends

36. Analysts provided further DMM2 results for a wider comparison of the *Jtarg* and β control parameters in the rule. The current choice for *Jtarg* had been with a view towards a sufficiently large value for the gain parameter β for adequate feedback and hence better ability to provide adequate performance in robustness trials.

37. The working group noted that as *Jtarg* was increased, the β parameter did likewise, leading to greater variability in catches from year to year.

38. The working group reviewed a series of worm plots for stock rebuilding, TAC and total trajectories for a subset of the CMPs (NT1, DMM2, RH7 and RH8) were crossed with tuning levels (0.25, 0.30, 0.35, 0.4) to examine performance and general behaviour. The following points were noted.

39. There appeared to be less substantial differences in the rebuilding trajectories among CMPs for the 0.30 and 0.35 tuning levels.

40. All CMPs consistently decreased TACs rapidly for 0.40 tuning levels, and increased them rapidly for 0.25 levels.

41. There were general differences in the variation and timing of increases in TAC and catch among the CMPs, with DMM2 having larger variation and a later increases in catches, RH8 having the least variation and NT1 being intermediate.

42. The examples with CPUE and CKMR data included (RH7 and RH8) were able to increase catches earlier in response to the higher recruitment, via the CPUE

signal; stabilise catches, via the CKMR target component of the HCR; and then increase catches later in the period, once the CKMR target was achieved.

43. DMM2 and NT1 tended to increase catches more aggressively and generally later in the period.

44. Of the two CKMR examples, the empirical form (RH7) was more aggressive in increasing catches and more variable, while the model based version (RH8) was less aggressive and less variable. It was noted that the "cross-over" behaviour evident for the CKMR was driven by the CPUE component of the HCR and that there was scope to improve this behaviour to reduce TAC variation.

45. DMM2 exhibited a low frequency of up-down behaviour.

3.2. Reconsideration of tuning options and operational constraints

46. The review of preliminary CMP results raised the issue of whether the behaviour exhibited by the CMPs for the 0.25 and 0.40 targets would be considered acceptable, given the guidance provided by the SFMWG. In order to achieve the 0.40 target by 2035, each CMP is required to immediately reduce the TAC to substantially lower levels (e.g. ~10,000 t) than the current TAC over the evaluation period. In the case of the 0.25 target, the situation is the reverse: in the short-term CMPs consistently increased TACs to much higher levels, which then required substantial TAC decreases once the target level is achieved.

47. This behaviour was consistent for each of the preliminary CMPs for the 0.25 and 0.40 target levels. It is predominantly determined by the "starting conditions" in the OMs (i.e., the current SSB, recent high recruitment), stock productivity, the length of tuning period (2020-2035) and the number and maximum size of changes in TAC. Given the general guidance from the SFMWG on the desirability of incremental increases in TAC, the undesirability of large TAC decreases and, in particular, a preference for relative stability beyond the rebuilding target, the group assumed this behaviour for these two tunings was likely to be unacceptable and hence decided to focus attention on the 0.30 and 0.35 target levels.

48. ***Length of tuning period :*** The review of preliminary results for the 0.35 tuning level by 2035 demonstrated that to achieve this target level would require TAC decreases in the short-term; the tested CMP tuned to this level led to continued stock increases above 35% SSB_0 beyond the tuning period. Given the clear direction from the SFMWG to consider target levels above 0.30 and to explore tuning periods beyond 2035 if required, the group agreed to explore the impact of extending the tuning period to 2040 for the 0.35 target. This was run for one of the CMPs (NT1) and the results for the 0.30 and 0.35 targets and 2035 and 2040 tuning periods are shown in **Attachment 5**, Figure 1. The lower panel, middle column shows that the combination of 2035 tuning year and 0.35 target results in progressive TAC decreases to achieve the target rebuilding and an "overshoot" in biomass rebuilding once this has been achieved. The right side panel shows that extending the tuning period to 2040 (for the 0.35 target), removes this undesirable behaviour for both catch and biomass rebuilding, and results in similar trajectories to the 2035 tuning year and 0.3 target combination. In particular, extending the tuning year to 2040 results in a balanced distribution of

individual TAC trajectories (worms) around the median for 0.35 in the 2040 tuning year, relative to 0.35 in the 2035 tuning year.

49. The group agreed that, in refining CMPs for the presentation to the ESC, developers would focus on two combinations of target level and tuning year: i) 0.30 by 2035 and ii) 0.35 by 2040. The other combinations of tuning level and year could be run for a subset of CMPs to provide the ESC and Commission with results for the full range of options to consideration and further guidance.

3.3. Comparison of performance of tuned MPs

50. For comparing across CMPs a dynamic application (shiny app) was developed during the meeting to aid in comparing and contrasting performance measures.

3.4. Consider possible MP adjustments to improve performance

51. The group noted two general areas in which the performance of preliminary CMPs could be improved: i) avoiding low *SSB* and reducing TAC variability. In terms of *SSB* rebuilding, a substantial proportion of trials for all CMPs were below 20% of SSB_0 at the end of the tuning period (2035) (see panel 3, **Attachment 5**, Figure 2). This result was exacerbated for the results of the lowR robustness test. The group considered that this type of behaviour was likely to be considered unacceptable and could be improved by making better use of the GT data as a limit in the HCR.

Agenda Item 4. Reconsideration of robustness trials

4.1. Reconsider robustness trials for final testing prior to ESC

52. The meeting had a range of discussions regarding the number, and priority, of robustness trials to be used in the development and testing of new CMPs. The meeting used Table 3 from SC22 report as a starting point, and considered results from CCSBT-ESC/1708/14 and results from new candidate MPs that were presented at the meeting (both in meeting papers and through the Shiny app).

53. For each element of the original table the meeting assigned a rank of high, medium, low, not needed. The aim was to have a spread of rankings with approximately five high, ten medium, and the remainder low. In addition to those from the original table several additional robustness trials were agreed, relating to additional scenarios about future recruitment (both low and high), together with some further trials relating to the new data sources, i.e., gene tagging and CKMR.

54. The meeting noted that further consideration would be required on robustness trials around gene tagging and CKMR as more data were collected and sources of bias and uncertainty were better understood. It was also noted that the relationship between LL CPUE and abundance could potentially change if abundance increased as predicted, and some robustness trials related to this may need to be considered.

55. The list of proposed robustness trials and their rankings are provided in Table 2 and others not considered further are in Table 3.

56. When selectivity-at-age is not year-invariant, a difficulty arises in specifying the catchability coefficient (*q*) that links CPUE to selectivity-weighted numbers-at-age. Often the most highly selected age is taken to have a constant q, but that is inappropriate (as in the SBT LL1 case) when the selectivity-at-age distribution widens and narrows about this central age, because that in turn implies a change in the effective proportion of effort "targeted" at fish of that central age. This is accommodated in the current reference set grid by averaging over either ages 4-18 or 8-12 in calculating q to subsume this "widen/narrow" effect. However recent information on the LL1 age distribution (see Fig. 3) indicated that for recent years the 8-12 range hardly includes such a central age (which seems to be about 7). The group noted that to fully investigate the causes of observed differences for a new 5-9 age range and the current age range in *SSB* trajectories would require more work than was possible at the meeting. However, given the *SSB* trajectories for the 5-9 age range provided greater contrast than the 8-12 variant currently in the reference set, it was agreed to include the 5-9 range as a robustness test (see Fig. 4).

Table 2. List of robustness test for MP testing by priority.

Test name	Code	Conditioning and projection notes	Priority	Code?
SFOC40	sfo40	40% overcatch by Australian surface fishery: ramps up from 1% in 1992 to 40% by 1999 and onwards to 2016. Adjust the age composition as was done for the 20% method. Continued 40% overcatch in projections	M	
SFO00	sfo00	No historical additional catch in surface fishery. No future additional catch in surface fishery	L	
Corr Sel	selrev	Reversing order of estimates at decadal scale "Corrugated selectivity"	L	Hard
	selalt	Five year blocks of Alternate bimodal and recent selectivity, most extreme case of bimodality should be used (for projections).	M	Hard
lowR10	reclow10	Reduce future recruitment by half during the first n years. For 2018, n was set to 10.	L	
lowR5	reclow5	Reduce future recruitment by half during the first n years. For 2018, n was set to 5.	H	
highR	rechigh	Increase future recruitment by 50% during the first n years. For 2018, n was set to 5.	M	Easy
q_hsp1	hspq1	Set HSP proportionality coefficient to 1, to be moved to reference set, next year	M	
h=0.55	h55	Just check any estimation tweaks that might be required	M	
GT qtrend	gtqtr	1% increase per year, note that an increasing q leads to over-estimated abundance	M	Easy
GT q low	gtql	q=0.85, Specifics and rationale to be determined	M	
GT q high	gtqh	q=1.15 Specifics and rationale to be determined	L	
GT overdisp.	gtod	Use over-dispersion as applied to conventional tagging	M	
GTI	troll	Includes the grid type trolling index as additional recruitment index. Increase CV of aerial survey to preclude aerial survey dominating the fit, given apparent conflicts in the data.	L	
IS20	fis20	Indonesian selectivity flat from age 20+	M	
Const sq. CPUE	cpuew1	Constant squares	L	
Var sq. CPUE	cpuew0	Variable squares	L	
Upq2008	cpueupq	CPUE q increased by 25% (permanent in 2008)	H	
S50CPUE	cpues50	50% of LL1 overcatch associated with reported effort	M	
S00CPUE	cpues00	Overcatch had no impact on CPUE	L	
Omega75	cpueom75	Power function for biomass-CPUE relationship with power = 0.75	H	
Drop q increase	cpuenocrp	of 0.5% yr-1 in future years – no continuous effort creep	L	Easy
High fut. CPUE CV	cpuehcv	Increase the future CPUE CV to 30% (currently 20%)	M	
	cpue59	Age range from 5-9, check connection between OM and projections…seem to be passed through so ok	M	
LL1 Case 2 of MR	case2	LL1 overcatch based on Case 2 of the 2006 Market Report	L	
Aerial2016	as2016	Remove the 2016 aerial survey data point	H	

Table 3. List of robustness test for MP testing by priority.

Test name	Code	Conditioning and projection notes	Priority	Code?
HighaerialCV		In conditioning set process CV to 0.4 Not needed, the Aerial2016 scenario is sufficient to captures this	No	
Updownq		CPUE q increased by 50% in 2009 then returned to normal after 5 years	No	
GamCPUE		Use the "GAM CPUE" series provided from Australia under the 2017, CCSBT data exchange. This is the monitoring CPUE series 3. Not included because it was intermediate of other CPUE series	No	
CPUE w/o area 7		As a sensitivity to note a possible concentration effect on CPUE. Not included as difference minor (Itoh-san paper) but monitoring required	No	
CPUE placeholder		Forward looking scenario about how q and/or selectivity might change if stock abundance and distribution changes significantly	No	
Incomplete tag mixing		Sensitivity to incomplete mixing of tagged fish released in the WA and GAB. Increases fishing mortality of tagged fish by 50% relative to the whole population for the surface fishery (season 1).	No	
Piston line		Includes the piston-line troll survey index as additional recruitment index. Increase CV of aerial survey to preclude aerial survey dominating fit.	No	
Independent C-K		TBD based on independent close-kin stand-alone estimates. Nothing emerged from the stand-alone estimates	No	
Psi		Grid sampling using objection function weighting psi. Objective function weighting instead of uniform for psi.	No	
Noh.8		Change steepness (*h*) preference weighting to 0.5, 0.5, 0.0 to examine impact of excluding *h*=0.8 on projections.	No	
Bimodal select.		The most extreme case shown in Fig. 11 of OMMP8 report	No	
POPs only		Implemented by increasing the variance on other trend data or some other approach	No	
AR-B0		AR process applied to SSB_0 . No, the reference set includes an AR1 process.	No	
Nonstationary SSB_0		Based on historical analysis	No	
Nonstationary stock-recruitment relationship		Based on historical analysis of residuals. No, the reference set already includes an AR1 process.	No	
Missing MP data		No, it is picked up in over-dispersion scenarios	No	

Agenda Item 5. Performance statistics

5.1. Performance statistics, tables and graphics

57. The group considered the list of performance statistics from SFMWG meeting and refined them as shown in Table 4. Those measures bolded were to be included in the OMMP shiny app to provide a fast first screening of CMP performance. There was agreement that tables reporting the performance measures would show medians with 90% confidence intervals.

58. There was agreement to use 90% intervals for the violin plots used to visualise the performance measures in the Shiny app. This was a change from the 80% intervals used previously. The change was proposed to ensure that the distribution of the performance measures would be appropriately represented.

59. The calculation of the catch performance measure 4 was modified to reflect the proportion of realisations which reflected increases for the first two TAC changes followed by a decrease for the third.

Table 4. Agreed performance measures for catch, *SSB* and CPUE. Median and 90% probability intervals to be reported. Bolded text indicates that the measures are already in the shiny app.

Catch	**1. Average short-term (2021 to 2035)** and long-term (2036 to 2050) **catch**. **2. TAC smoothness: (Average Annual catch variability over 2021 to 2035).** 3. Maximum TAC decrease. **4. Proportion of realisations in which the initial two TAC changes were up and the 3rd TAC change was down**.
SSB	**1. Spawning biomass in medium (2035) and long (2050) terms relative to SSB_0.** 2. Spawning biomass in medium (2035) and long (2050) terms relative to current (2018). **3. Minimum spawning biomass (from 2019 to 2035) relative to SSB_0.** **4. Probability of meeting the interim rebuilding target by 2035 (aim to have *at least* 70% of the simulated trajectories rebuild to higher than 0.2 SSB_0 by 2035).** 5. **Probability of *SSB* dropping below 0.2 SSB_0 at least once in the period 2036 to 2050.** 6. Year at which 70% of simulations are above 0.2 SSB_0. 7. Year that SSB_{MSY} is first reached. 8. Fraction of years where *SSB* is larger than SSB_{MSY} between 2041-2050.
CPUE	1. Average relative CPUE in 2021 to 2030 to CPUE2019.

Agenda Item 6. Workplan and timetable

6.1. Update code of OM and associated graphics files

60. Details of this work are addressed in the intersessional workplan discussions in next section.

6.2. Intersessional workplan

61. Some of the robustness tests require some adjustments to the projection code. It was noted that two new repositories were set up on GitHub, one for storing the OM model runs (including for the robustness scenarios; https://github.com/CCSBT/conditioning_outputs) and another for storing CMP results (https://github.com/CCSBT/mp_outputs).

62. An update of the R code is needed for creating the tables of performance statistics; this code needs to be updated to include the list of performance statistics shown in Table 5. The Secretariat advised that funds to cover some time for the consultant to prepare this work would be available. The general workplan was modified slightly (below).

63. A detailed schedule and deadlines for intersessional work in preparation for the ESC is provided in Table 6.

64. Several members will condition the grids for robustness tests and generate the control files and grid files which will be shared via GitHub. This will be coordinated through Dr. Darcy Webber.

65. Developers of CMPs can use the functions in the Shiny app to create plots and figures for their papers. It was suggested to restrict numbers of candidate MPs to reduce the volume of information to be reviewed at the ESC, however, this needs to be balanced with exploration of trade-offs in performance in different formulations of CMPs. The iterative process of MP development and review will see refinements to CMPs as the process continues through to selection of a single MP.

66. The working group strongly endorsed a proposal that the Consultant provide a tutorial that describes how to use the 'shiny-app'. A guide to facilitate how to interpret the figures may also be useful.

67. The meeting agreed that when reconditioning OMs in 2019 with updated data from the CCSBT data exchange, we will not reconsider values in the reference grid unless there are compelling reasons to do so.

Table 5. Slightly modified table of work plan from SFMWG report.

2018		
March	SFMWG5	Initial discussions of rebuilding goals and MP features
June	OMMP9	First presentation of candidate MPs (CMPs) evaluated using 2017 OMs.
September	ESC + 1 day informal OMMP	Evaluation of refined CMPs.
October	EC	Results on CMP performance and trade-offs presented to EC. Consultation with stakeholders. Commission decides or amends broad recovery objectives and longer term performance based on advice from the ESC (and SFMWG).
2019		
June/July	OMMP10	**Recondition the OM** and review initial updated versions of CMPs to develop a limited set to put forward to the ESC. The week of June 17-21st.
September	ESC + 1 day informal OMMP	Review and advice on set of CMPs and a session for interaction with stakeholders.
October	EC	Aim to select and **adopt MP**.
2020		
June	Special ESC/EC meeting	Contingency placeholder in case more time is needed to complete evaluation
September	ESC	Implementation of adopted MP to provide **TAC advice for 2021** (i.e., no standard 1-year lag) (note, this MP implementation will include the 2020 data exchange). **Updated assessments including projections using adopted MP**
October	EC	Agrees TAC for 2021-2023.

Table 6. Detailed workplan and schedule.

Task	Finish by	Notes
OM Code modifications	July 6, 2018	CSIRO
Completion of all robustness test grids	July 10, 2018	Developers, See table for medium vs low priority tests
CMP Tuning/development		Developers
R code for generating tables and plots	July 10th 2018	Consultant
Update shiny applications	July 28th 2018	Consultant, notify group when done

6.3. Identify issues to be discussed at ESC

68. These were covered through the existing agenda items above, except that discussions will be required on accessibility of web-based tools for evaluating CMPs.

<u>Adoption of report and Close of the meeting</u>

The report was adopted and the meeting closed at 1500 hrs, 22 June 2018.

List of Attachments

Attachments

1 List of Participants
2 Agenda
3 List of Documents
4 Report of the CPUE WEB Meeting held during the OMMP 9 meeting
5 Figures

Attachment 1

Draft List of Participants
The Nineth Operating Model and Management Procedure Technical Meeting

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Attachment 2

Agenda
The Ninth Operating Model and Management Procedure Technical Meeting
Seattle, USA, 18 to 22 June 2018

Terms of Reference

Evaluate results of initial MP testing and refine testing protocols.

Agenda

1. Discuss input from the Strategy and Fisheries Management Working Group meeting in March 2018

2. Operating model and data inputs
- 2.1 Code updates and preparation of OM scenarios
- 2.2 Gene tagging
- 2.3 Close-kin: POPs and half-sibling indices
- 2.4 CPUE
- 2.5 Variability of age 4 CPUE around indices predicted by conditioning model

3. Evaluate results from MP testing
- 3.1 Review results of initial MP trials
- 3.2 Reconsideration of tuning options and operational constraints
- 3.3 Comparison of performance of tuned MPs
- 3.4 Consider possible MP adjustments to improve performance

4. Reconsideration of robustness trials
- 4.1 Reconsider robustness trials for final testing prior to ESC

5. Performance statistics
- 5.1 Performance statistics, tables and graphics

6. Workplan and timetable
- 6.1 Update code of OM and associated graphics files
- 6.2 Intersessional workplan
- 6.3 Update on standalone close-kin assessment
- 6.4 Identify issues to be discussed at ESC

Attachment 3

List of Documents
The Ninth Operating Model and Management Procedure Technical Meeting

(CCSBT-OMMP/1806/)

1. Provisional Agenda
2. List of Participants
3. List of Documents
4. (Australia) Data generation & changes to SBT OM (OMMP Agenda Item 3)
5. (Australia) Initial MP structure and performance (OMMP Agenda Item 3)
6. (Australia) Results from the pilot gene-tagging project (OMMP Agenda Item 2)
7. (Australia) Independent assessment model using POPs and HSP (OMMP Agenda Item 2)
8. (Japan) Update of the core vessel data and CPUE for southern bluefin tuna in 2018 (OMMP Agenda Item 2)
9. (Japan) Development of recruitment index of SBT longline for MP input (OMMP Agenda Item 2)
10. (Japan) Change in operation pattern of Japanese southern bluefin tuna longliners in the 2017 fishing season (OMMP Agenda Item 2)
11. (Japan) Initial trials of a new candidate management procedure for southern bluefin tuna (OMMP Agenda Item 3)
12. (Japan) Initial Exploratory Investigations of some Simple Candidate Management Procedures for Southern Bluefin Tuna. D.S Butterworth, M. Miyagawa and M.R.A Jacobs (OMMP Agenda Item 3)

(CCSBT-OMMP/1806/BGD)

1. (Australia) Methods for data generation in projections (*Previously* **CCSBT-OMMP/1609/07**) (OMMP Agenda Item 2)
2. Desirable Behaviour and Specifications for the Development of a New Management Procedure for SBT. Campbell Davies, Ann Preece, Richard Hillary and Ana Parma (*Previously* **CCSBT-SFM/1803/04**) (OMMP Agenda Item 3)

(CCSBT-OMMP/1806/Rep)

1. Report of the Fifth Meeting of the Strategy and Fisheries Management Working Group (March 2018)
2. Report of the Twenty Fourth Annual Meeting of the Commission (October 2017)

3. Report of the Twenty Second Meeting of the Scientific Committee (August - September 2017)
4. Report of the Eighth Operating Model and Management Procedure Technical Meeting (September 2017)
5. Report of the Twenty First Meeting of the Scientific Committee (September 2016)
6. Report of the Seventh Operating Model and Management Procedure Technical Meeting (September 2016)
7. Report of the Twentieth Meeting of the Scientific Committee (September 2015)
8. Report of the Sixth Operating Model and Management Procedure Technical Meeting (August 2015)
9. Report of the Special Meeting of the Commission (August 2011)
10. Report of the Sixteenth Meeting of the Scientific Committee (July 2011)

Attachment 4

Report of the CPUE WEB Meeting held during the OMMP9 meeting at 1100h Seattle 18th June 2018.

Membership: Professor John Pope (Chair), Dr. Jim Ianelli (local-Chair and convener), OMMP9 participants

The Chair opened the meeting and the agenda was agreed. There were two substantive agenda items.

Agenda 1: To check that the base CPUE series continues to provide a good index of SBT abundance and is suitable for inclusion in OM and input to CMPs (Papers 8 and 10).

The chair presented Paper:

- **CCSBT-OMMP/1806/08**. Update of the core vessel data and CPUE for southern bluefin tuna in 2018. Tomoyuki ITOH and Norio TAKAHASHI

This paper summarises the core vessel CPUE which is an abundance index for southern bluefin tuna used in the Management Procedure of CCSBT. It explains data preparation, CPUE standardisation using GLM, and area weighting. The data were updated up to 2017. The index values in 2017, in W0.8 and W0.5 under the base GLM model, are higher than the average over the past 10 years, and are also high in the most recent three years.

It was noted that the data assembly, fitting methodology and area weighting were similar to that used in the previous year. As in past years, in addition to the base model two monitoring series were calculated. These were the reduced base series that fits without the year interaction terms included in the base series and the shot by shot (S*S) version of the base series.

In discussion, it was noted that there is a discrepancy between the AIC measure of goodness of fit that favours the base series and the BIC measure that favours the reduced base series. It was noted though that the year interaction terms with respect to both area and latitude seem to be important (see Figures 4 and 5) and should be included. The difference in time trend between the base and reduced base series was thought to result from the different averaging processes (area based and overall) used by the two approaches. It was agreed this should be confirmed for the 2018 ESC. It would be useful to see just how much each area contributed to the overall index.

In discussion it was further noted that to date the AIC and BIC selection criteria have been used to guide selection between more and less heavily parametrised models for SBT CPUE standardisation. The suggestion was made that the FIC (Focused Information Criterion) should also be considered. Rather than select a “best” model from amongst different models, this concentrates instead on some quantity output from those models which is of primary interest, and then advises on a selection that provides for an optimal bias-variance trade-off for the estimation of that quantity. Thus, for SBT CPUE standardisation, for example, the quantity in question chosen might be the recent average value, or the trend in recent values, of a CPUE-based index of abundance.

A reference to Focused Information Criterion can be found at: https://www.wikiwand.com/en/Focused_information_criterion

In discussion the use of a base series that excluded area 7 as a potential robustness test was considered. It was pointed out (see Figure 7) that while the series that omits area 7 had increased more slowly post 2006 than the full base series, these two series had now converged. This is thought to be due to the stronger recruitments that had driven the rise in area7 now becoming evident particularly in area 9.

The Chair presented paper:

- **CCSBT-OMMP/1806/10**. Change in operation pattern of Japanese southern bluefin tuna longliners in the 2017 fishing season. By Tomoyuki ITOH

This paper examined the change of the operation pattern of the Japanese longline fishing in the most recent year. No remarkable change was found in the 2017 operational pattern in terms of the amount of catch, the number of vessels, the time and area operated, proportion by area, length frequency and concentration of operations. The CPUE of the 2017 Japanese longline fishery can be regarded as reflecting stock abundance to the same extent as in previous years.

It was noted that overall the number of vessels had been fairly stable. There had been some increase in the number of hooks used but the SBT catch had increased by a larger percentage than the number of hooks.

It was noted that the size composition in 2017 had a main peak at 140cm and a lesser peak at 120cm. This latter feature had been missing in the 2016 distribution. It was considered that some descriptive statistics such as the annual standard deviation of the size distribution might be helpful. It was also noted that the size composition is a combination both of the selection pattern and the abundance of the various sizes. (*It was further discussed in the OMMP meeting.*)

It was noted that there did not seem to be any dramatic changes in areas and months fished in recent years (see Tables 1 and 2). The fleet was progressively being renewed and the number of vessels that had fished SBT prior to 2006 was a gradually decreasing proportion of the whole fleet over 12 years. It was considered that it might be interesting to include vessel age in the fitting process, at least for the S*S analysis.

It was noted that since 2007 the number of 5*5 cells fished had decreased. However, there was some tendency for the number of operations per cell to have increased over this period particularly in area 7. It was further noted that the concentration indices in area 7 had shown a marked increase (indicating less concentration of fishing) since 2007. It was suggested that this might be further examined, if possible, in time for the 2018 ESC.

After the presentations of papers 8 and 10 and the resulting discussion, the working group agreed that the base CPUE series continues to provide a good index of SBT abundance and is suitable for inclusion in OMs and input to MPs.

Agenda 2: To examine the proposed LL CPUE based recruitment series. (Paper 9)

The chair presented paper:

- **CCSBT-OMMP/1806/09**. Development of recruitment index of SBT longline for MP input. By Tomoyuki ITOH

This document proposes recruitment indices of southern bluefin tuna, based on longline CPUE as an input data, to be used in developing management procedures in CCSBT. The indices were calculated not only by the suggested method from OMMP Meeting applying a generalised linear model first and then age decomposition, but also by applying age decomposition first and then applying a generalised linear model. It also considers the effect of release/discarded fish.

The paper develops two possible ways to provide a CPUE index of recruitment. The earlier approach takes the base CPUE series and then applies the CCSBT age distributions. The later approach disaggregates catches by age and then fits the model to each age.

In both cases discards/releases were handled in three different ways. The first approach was not to include the discarded/released fish. The other two methods take the available fishermen's estimates of the weight classes of the discarded fish into account. In the first (A) of these methods each of the 3 size classes (<20kg, 20-39kg, 40kg+) was converted to age in the same proportions as seen in the landed catch. In the second (B) of these methods, each weight band of discarded/released fish was assumed to be the effective smallest age in the size group (3, 4 and 5 year olds respectively).

Figure 2 shows the age 4 and age 5 series for the earlier and later approaches, and for the different ways of calculating discards/releases. The series seem broadly similar. This is also the case (Figure 4) when the different approach to estimating discarded/released fish are compared for each method separately at age 4 and 5 but there are marked differences for the different ways of including discarded/released fish at age 3. NB: these are only seen for the later approach.

The chair provided some additional analysis by making regressions between age 3 and 4 and 4 and 5 both within years (to examine the strength of auto-correlation and along cohorts to see the additional signal due to differences in year-class abundance. These are shown in Tables 1 and 2 below for each of the three approaches for estimating discarding/releasing.

Table 1.

correlation coefficients earlier case years 1985-2017

	No		A		B
	4 to 5		4 to 5		4 to 5
year	0.373282		0.414677		0.455289
year class	0.565282		0.616383		0.702766
ratio	1.514358		1.486418		1.543559

Table 2.

corelation coeficients new case

	No	No	A	A	B	B
	3 to 4	4 to 5	3 to 4	4 to 5	3 to 4	4 to 5
year	0.210985	0.47156	0.376366	0.568755	0.433076	0.560547
cohort	0.169133	0.417858	0.354161	0.496752	0.437585	0.56146
ratio	0.801636	0.886117	0.941001	0.873402	1.010412	1.001629

These tables suggest that while the earlier approach provides an additional year-class signal, the second approach does not seem to do so. The Tables also suggest that the B method of estimating discards/releases better identifies most year class signals.

The author suggested to:

- Use the *earlier* method for the MP
- Use *later* method for a sensitivity analysis
- Age 3 was not suitable for inclusion in an index
- Age 5 fish were not affected by releasing

In discussion the WG felt that it would also be a good idea to compare these results with modelled and other observed measures of recruitment. It was noted though that many of the observed measures of recruitment were composites of several ages.

There being no other business the Web meeting concluded at 1220h.

Attachment 5

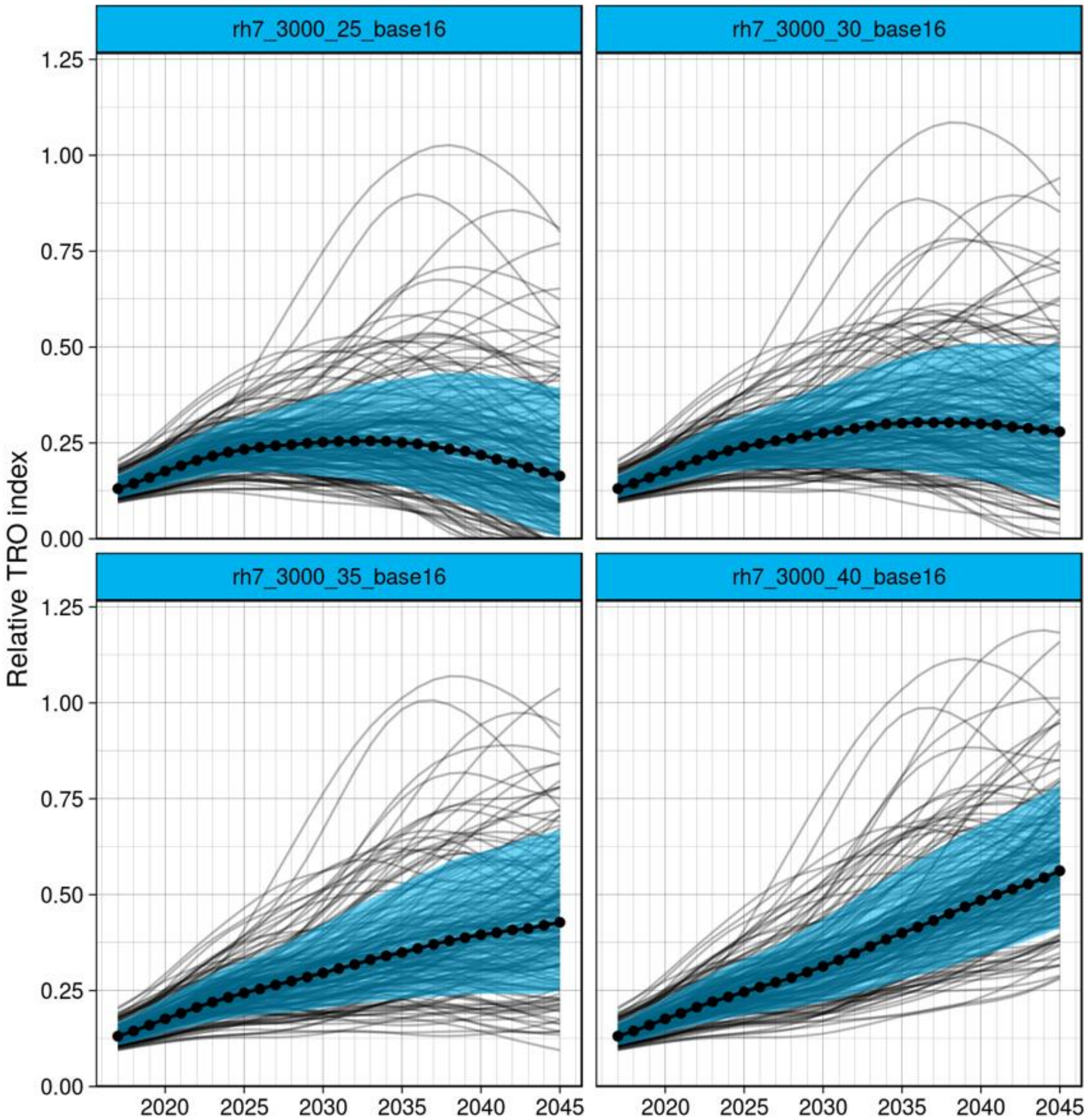

Figure 1. SSB (TRO) trajectories for median SSB tuning levels of 25, 30, 35, and 40% of SSB_0 for CMP RH7.

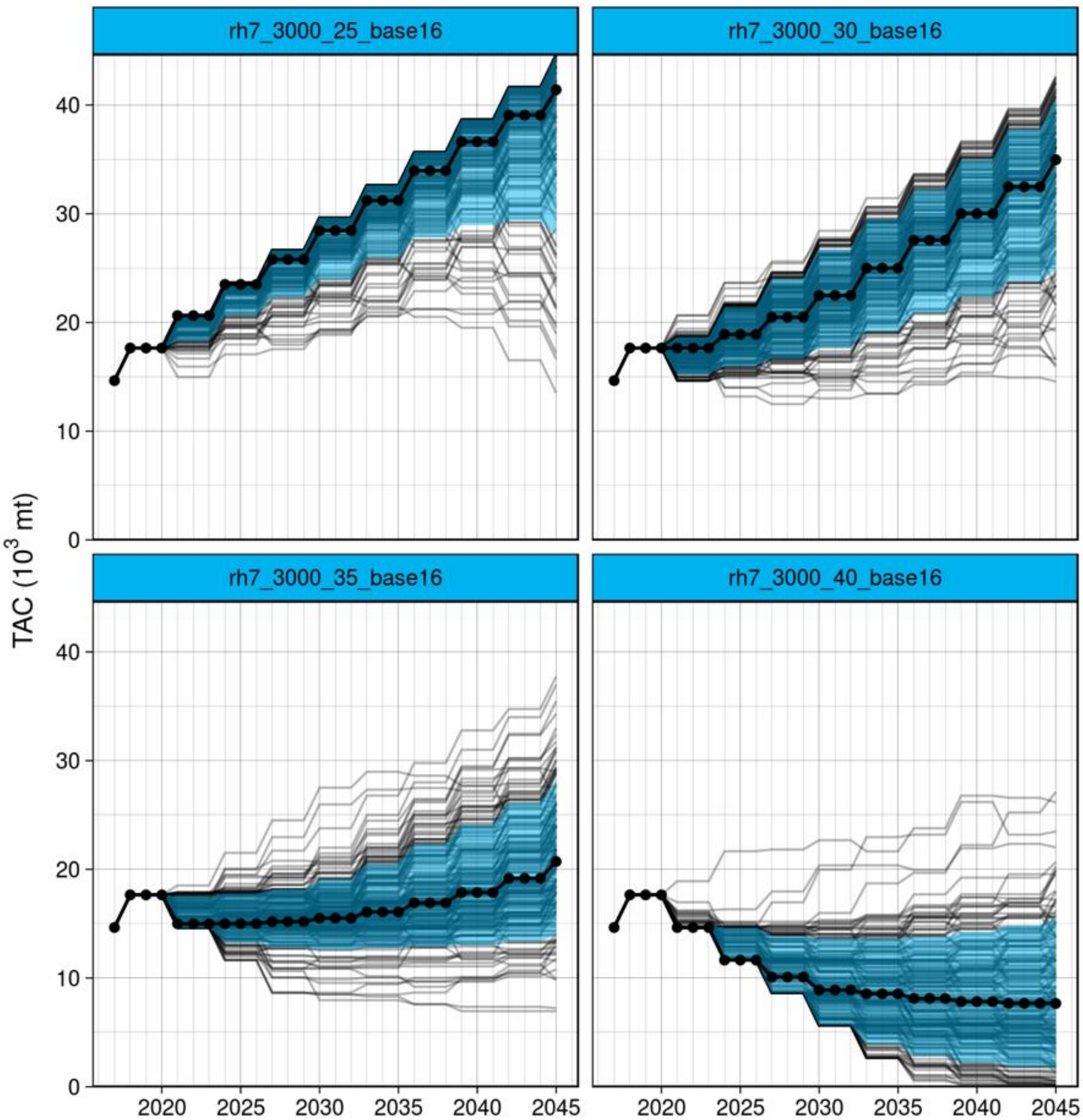

Figure 2. TAC trajectories for median SSB tuning levels of 25, 30, 35, and 40% of SSB_0 for CMP RH7.

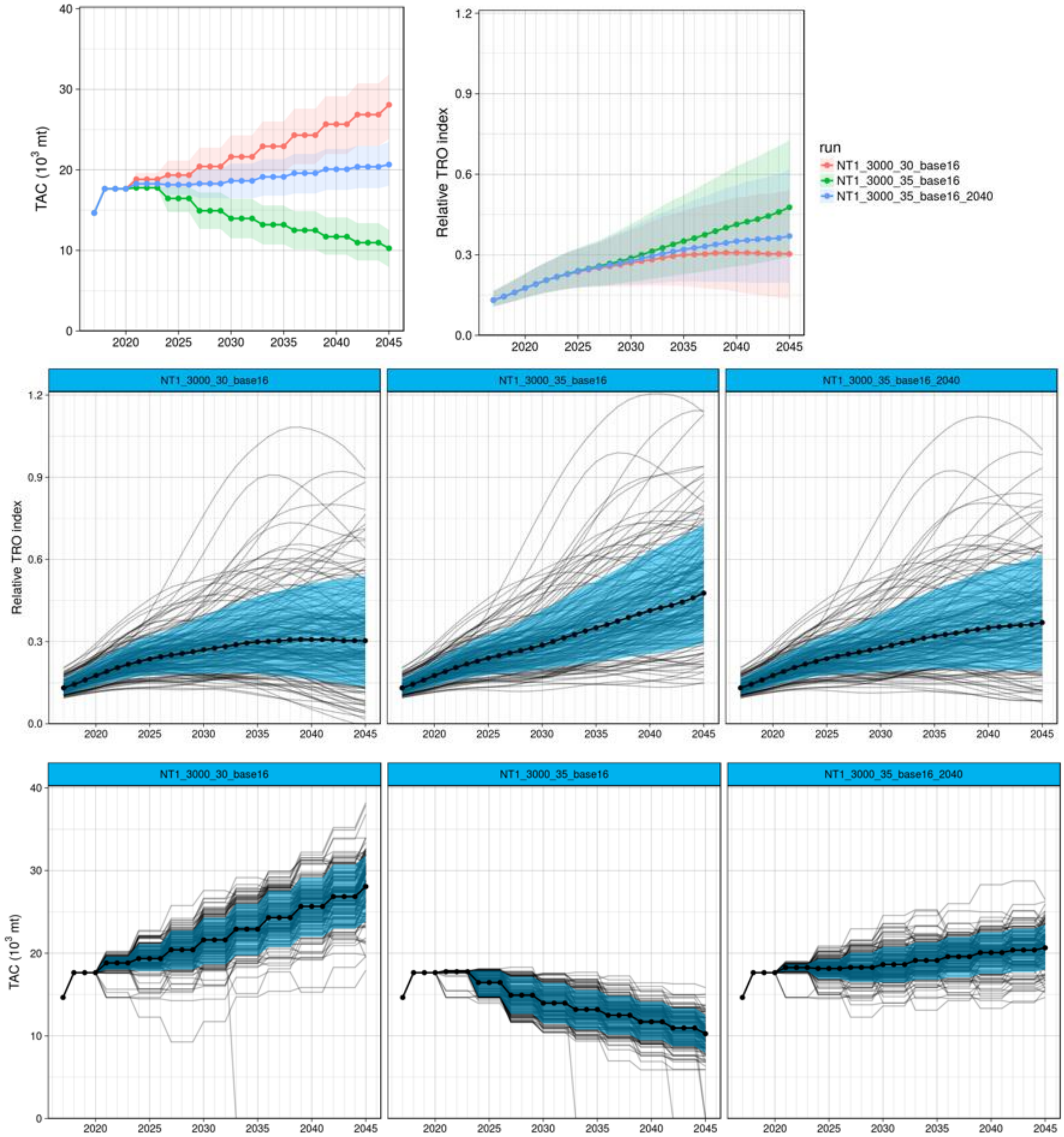

Figure 3. Total reproductive output (TRO) index and TAC for CMP NT1 under 30% and 35% tuning targets (to year 2035) and 35% target tuned to year 2040).

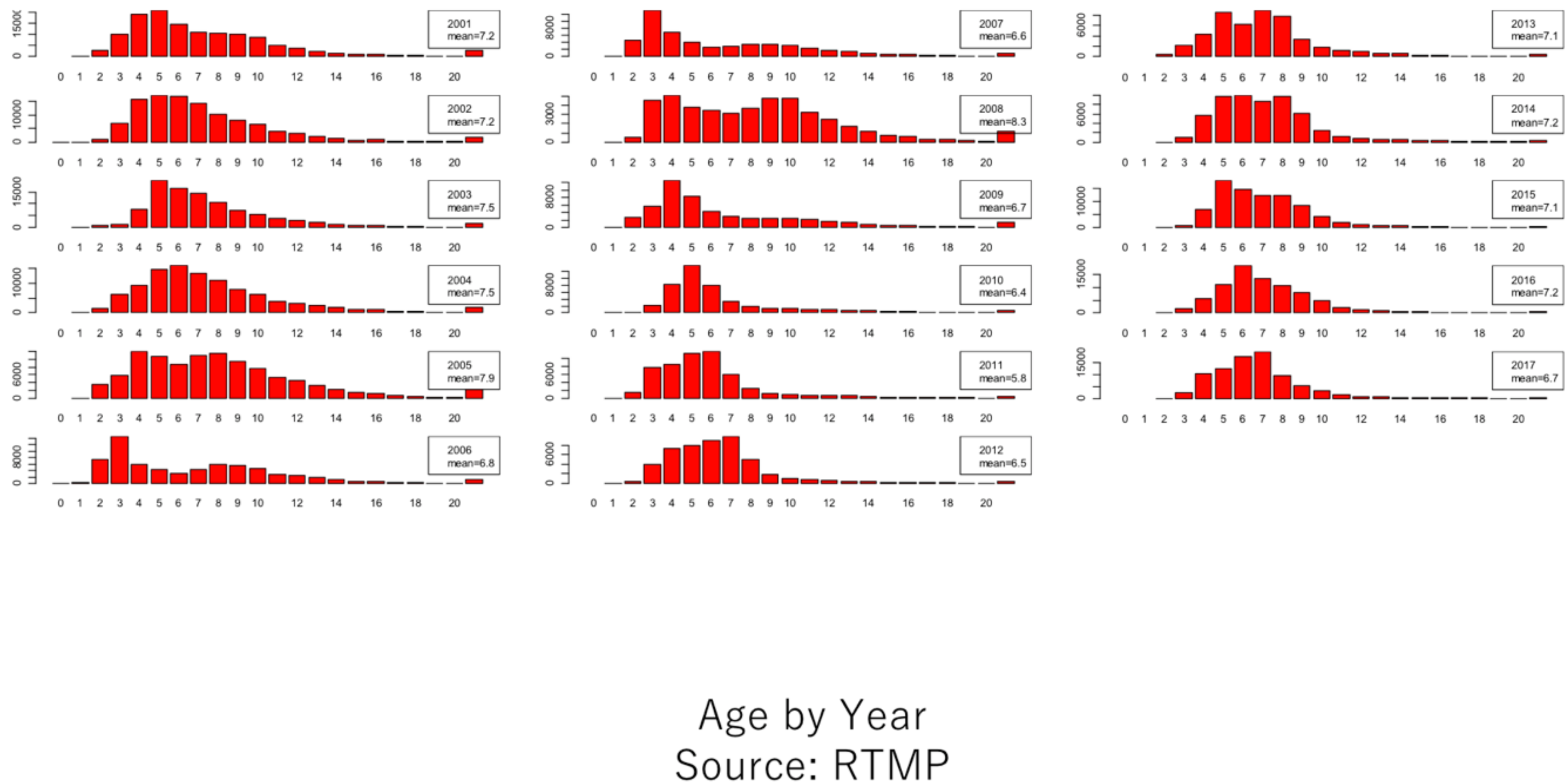

Figure 4. Age compositions by year from the RTMP data, 2001-2017.

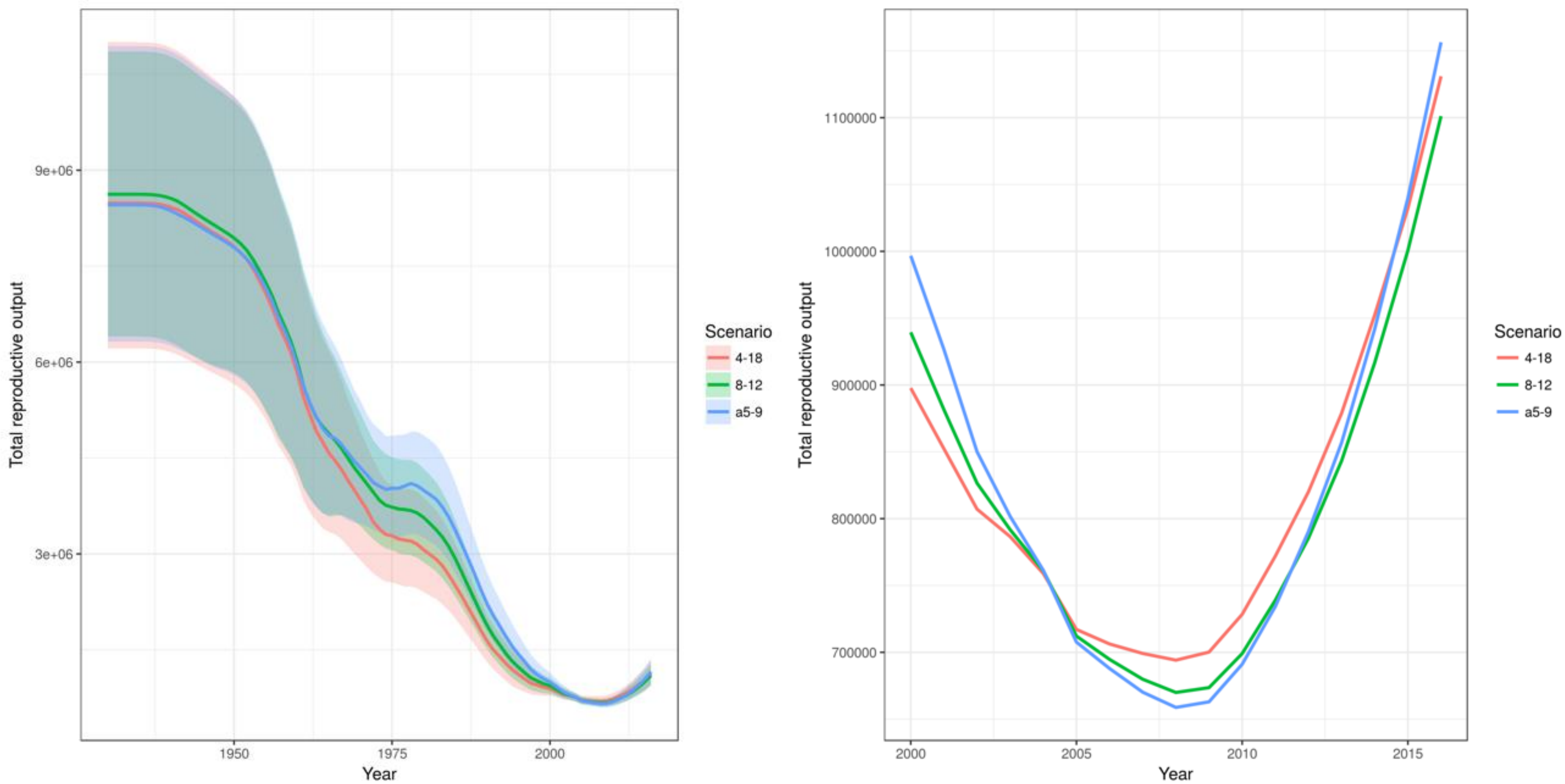

Figure 5. Initial illustration of performance metrics for different CMPs relative to some robustness tests.

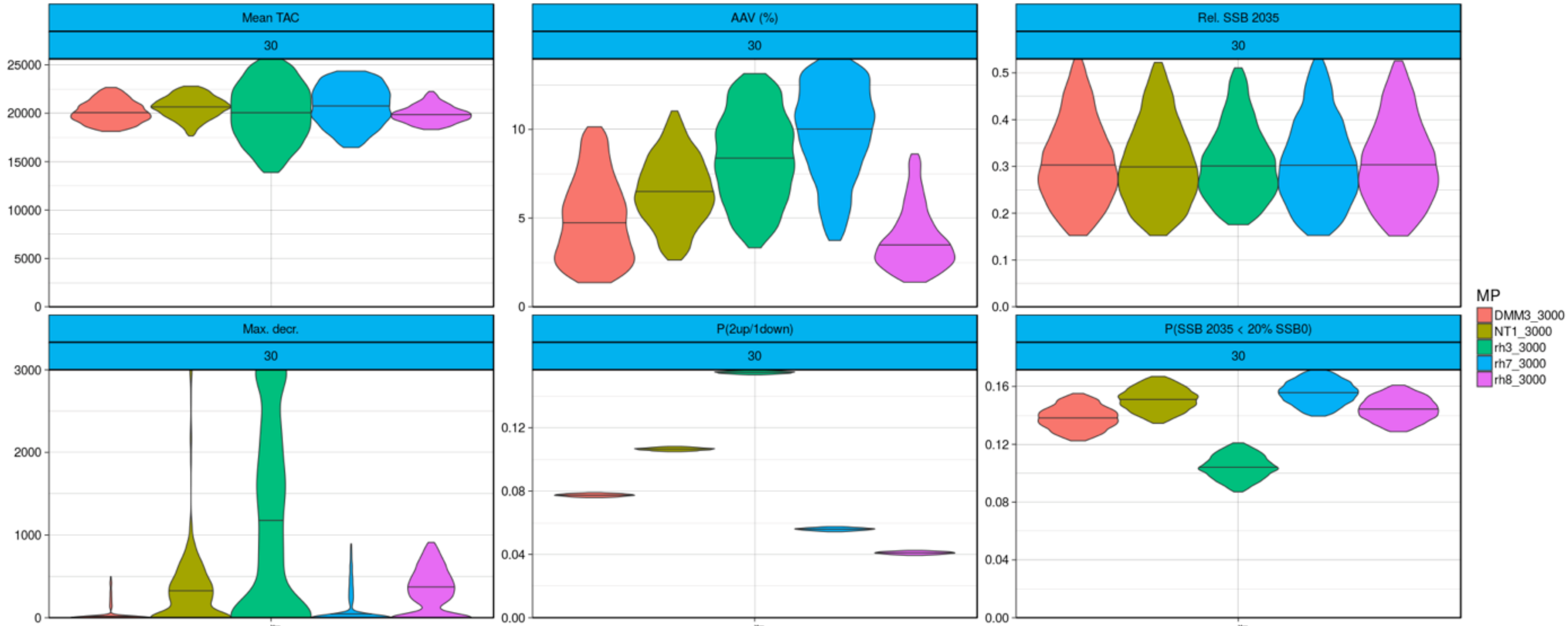

Figure 6. Initial illustration of performance metrics for different CMPs for the reference set.

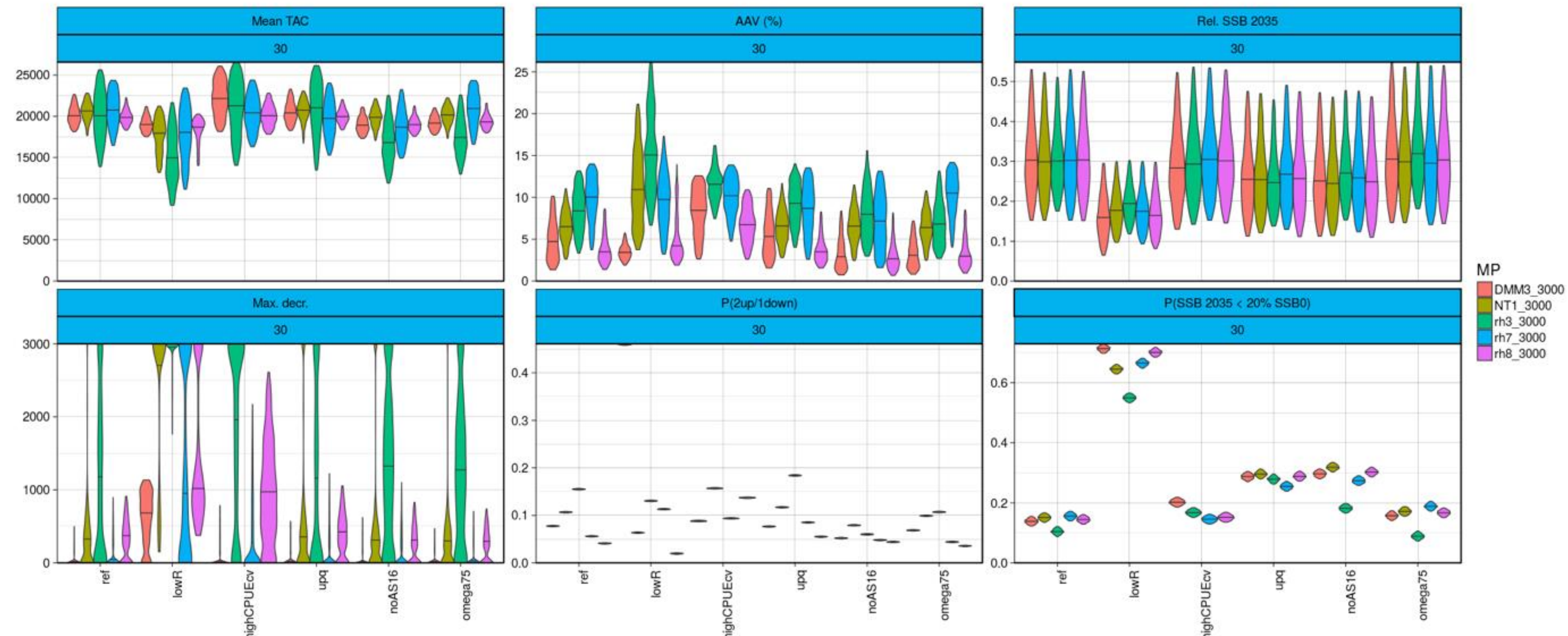

Figure 7. Initial illustration of performance metrics for different CMPs relative to some robustness tests