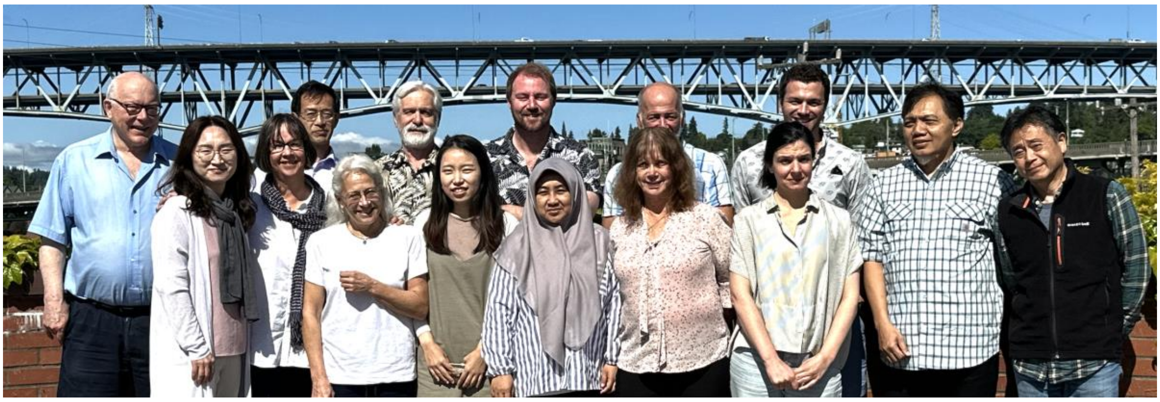
Commission for the Conservation of
Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of the Thirteenth Operating Model and Management Procedure Technical Meeting



26 – 30 June 2023
Seattle, USA

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Opening

1. The Chair of the Thirteenth Operating Model and Management Procedure Technical Meeting (OMMP13), Dr. Ana Parma, opened the meeting and welcomed participants (**Attachment 1**). The Chair noted that the terms of reference are to prepare for this year's full stock assessment and to discuss draft Scientific Research Plans developed by Members.
2. The draft agenda was discussed and amended, and the adopted agenda is shown in **Attachment 2**.
3. The list of documents for the meeting is shown in **Attachment 3**.
4. Rapporteurs were appointed and agreed to co-ordinate the preparation of the report along with the consultant and the Advisory Panel members. Subsequent report sections are based on the adopted agenda.

Agenda Item 1. Review of data inputs

1.1 Gene tagging

5. Ms Ann Preece (CSIRO) briefly presented a summary of the gene-tagging research program which has been operating since 2016. The gene-tagging program provides an estimate of absolute abundance of the age 2 cohort in the year those fish are tagged. Over 5000 fish are 'tagged' and released each year by taking a very small tissue sample. After one year, to allow for mixing with untagged fish, a tissue sample is collected from age-3 fish during the harvest by the Australian purse seine fishery. The DNA genotypes are compared to detect matches, which are equivalent to 'recaptures' in conventional tagging programs. Over 77 million comparisons are made each year. The most recent data provided to the 2023 data exchange were for the 2021 age 2 abundance estimate. The 2020 estimate is missing because the tagging field work was cancelled due to COVID19 border closures in Australia. The five estimates available for use in the stock assessment models are provided in Table 1. In each year, the coefficient of variation (CV) has been better (smaller) than the target level of 0.25.

Table 1. Results of the 2016-2021 gene-tagging programs, which provide an absolute abundance estimate for the age-2 cohort in the year of tagging.

YEAR OF TAGGING (Y)	AGE AT TAGGING	N RELEASES	N HARVEST (IN Y+1)	N MATCHES	ABUNDANCE ESTIMATE (MILLIONS)	CV
2016	2	2952	15389	20	2.27	0.224
2017	2	6480	11932	67	1.15	0.122
2018	2	6295	11980	66	1.14	0.123
2019	2	4242	11109	31	1.52	0.180
2020		Interrupted by Covid-19			-	-
2021	2	6401	10742	41	1.68	0.156

6. The gene-tagging program has continued in 2022 and 2023 with successful tagging and harvest sampling. Changes in the observed length frequency of juveniles is indicating possible changes in growth. The timing of harvest sampling each year (typically June-August) means that genotyping and calculation of the new abundance estimate cannot be provided in time for model preparation or the Scientific Committee meeting in that same year. The next abundance estimate (2022 age 2 cohort) will be provided to the data exchange in March 2024.

1.2 Close-kin: POPs and half-sibling indices

7. Dr Rich Hillary (CSIRO) provided a summary of the close-kin data for use in the stock assessment models, noting that two sets of data are available for detection of parent-offspring-pairs (POPs) and half-sibling-pairs (HSPs). These data inform the estimates of adult population size and adult natural mortality in the assessment models.
8. The data indicate that the average age of adults is 14-15 years, the oldest parent detected is age 26, the main age range of parents is 8-25, and the plus group in the models is age 30. Adults aged over 25 years should be more successful reproductively, but there are fewer of these older fish in the population.
9. The decreasing number of POPs per comparison detected over time is an independent indication of the rebuilding of the parental stock. An increase in the number of samples collected may be needed in future to ensure adequate numbers of matches, but this is not required immediately. CK sampling information will be presented at the ESC.

1.3 CPUE

10. Dr Tomoyuki Itoh presented paper CCSBT-OMMP/2306/04 investigating changes in the operational pattern of Japanese southern bluefin tuna longliners in the 2022 fishing season. The author noted that the Japanese longline data have

been used as the most important scientific data in the stock assessments and Management Procedure (MP) for SBT in CCSBT. The paper found that no clear changes were detected in the 2022 operations of the longline fleet compared to the past 10 years. Variables examined included the amount of catch, the number of vessels, time and area operated, proportion by area, length frequency, release and discards, and the spatial concentration of operations. The increase in catch quotas over the last decade appeared to have had the greatest impact on the increase in CPUE, likely driven by some expansion of operations over space and time, and, to a lesser extent, by the increase in the number of operations.

11. The group thanked Dr Itoh for his work and noted the feature of strong bimodality in the age distribution in 2021 and 2022. A concern was raised about the stock assessment confounding selectivity shifts with changes in the age distribution. The selectivity for the Japanese longline fleet is allowed to vary in 3-year blocks, with the last change in 2020. As this spanned one year (2020) where the bimodality was not yet apparent in the age distribution, the risk for selectivity shifts to be confounded with changes in the age distribution of the stock should be reduced.

12. The group asked about potential reasons behind the discarding of large fish (greater than 40 kg). Dr Itoh noted that large fish might be discarded when they are not considered fatty enough, and that some heavily damaged fish might be discarded as well.

13. Dr Itoh clarified that the concentration indices were based on the distribution of the catch or effort metric of fished cells compared to a central tendency (i.e., a measure of clustering). The group noted these types of index was unlikely to track temporal changes in the distribution of effort as it focused on the distribution of metrics within fished cells only. Suggestions for alternative concentration metrics from the group included the Gini and Gulland indices, noting that these metrics could potentially be modified to capture trends in preferential sampling if nominal CPUE was used instead of effort in the calculation. The group agreed that alternative indices of concentration should be explored to monitor changes in the concentration of fishing effort in the future.

14. The group sought clarification as to the relevance of monitoring concentration indices. It was noted that information was lost about unfished areas with increased concentration of the fishing effort, so that increased concentration was a concern for the generation of unbiased CPUE indices. It was also noted that range contraction of the fishing effort is likely to increase the uncertainty in the value of recent annual indices, and that simulation work has highlighted the potential for hyperstability in CPUE indices.

15. There was a question about whether the source of the data (logbook vs real-time monitoring program; RTMP) might impact the most recent values available to the CPUE model. Dr Itoh replied that data for the most recent year were from logbook, supplemented by RTMP when logbook data were missing. As such, the most recent year of data is preliminary, but no substantial changes were expected in the future because processing of logbook data is now faster than previously, and a substantial amount of logbook data are already included in the current dataset.

16. Dr Itoh presented paper CCSBT-OMMP/2306/05 updating the CPUE abundance index using GAM for SBT in CCSBT up to 2022. The abundance index was computed using the approach agreed at ESC27. The updated index is built from predictions from a generalised additive model (GAM) in a two-step delta log normal approach with area weighting. The index value for 2022 reflected a substantial increase from the previous year as well as the highest value in the series spanning 1969 to 2022. The abundance index was robust to a variety of sensitivity analyses, including model selection, retrospective analysis, inclusion of vessel ID, area range changes, age range changes, and data and model resolution changes.

17. A clarification was sought about the inclusion of vessel identification as a model covariate. Dr Itoh responded that vessel identity records were available from 1979 only onwards, and as such were included as a sensitivity but not in the final model.

18. The group enquired about the steady, slow decline in the binomial index over time given that the factors driving this behaviour were unknown. As this effect was slight, it was agreed that the temporal trend in the standardised index was driven mostly by the trend in the positive component of the delta approach.

19. The group noted that there were only two catchability covariates included in the model, the targeting cluster and the number of hooks per set. Some concern was raised about the ability of a cluster covariate based on species proportion to separate the effect of targeting from a habitat effect, in part due to the signal in the latitudinal distribution of the fishing effort assigned to each cluster. Dr Itoh commented that the index was unaffected by the removal of the cluster effect in a sensitivity analysis in the paper. As such, it was agreed that, while it was not clear whether the cluster factor captured a targeting or abundance effect, the lack of influence of this covariate on the final index was minimal, so that resolving the nature of the cluster effect was of low priority.

20. The group emphasised that, as there was minimal effect from the removal of the two catchability covariates on the final index, the final CPUE index did not standardise for fishing strategy in practice but accounted only for changes in the spatial distribution of the fishing effort over time. The mean-centred standardised index was compared to the nominal CPUE as the ratio of total annual catch to total annual effort (Fig. 1). The group noted that there was little difference between the two indices and that both series showed a steep increase between 2021 and 2022.

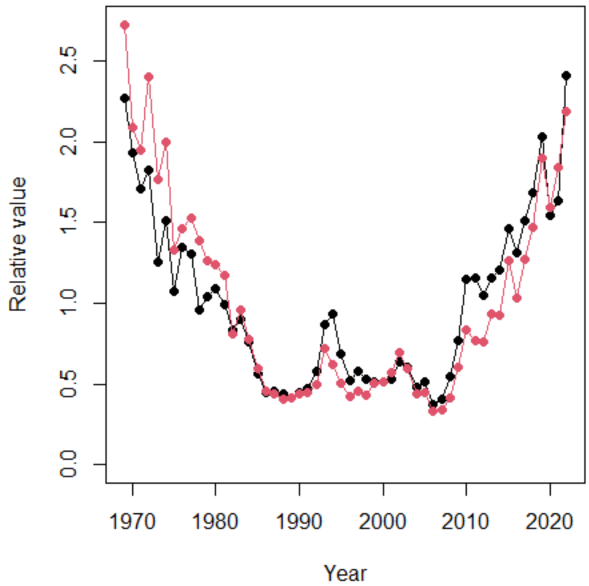

Figure 1. Trends in nominal CPUE (red) compared to CPUE index derived from the GAM model. Source: CCSBT-OMMP/2306/09, Attachment.

21. Dr Itoh presented CCSBT-OMMP/2306/09 which examined the GAM-based CPUE abundance index for SBT further to ensure that high abundance predicted in 2022 was not caused by a similar issue to that identified with the previous GLM-based CPUE standardisation approach. More specifically, the GLM-based core vessel CPUE abundance index generated anomalously high values in 2018 and 2019. Dr Itoh showed a series of diagnostic boxplots comparing the distribution of predicted CPUE values for the GAM-based vs the GLM-based approach aggregated at various levels of resolution. The predictions were also disaggregated by cell fishing status to differentiate unfished cells from low and high effort cells. The paper highlighted that the anomalous predictions from the previous GLM-based approach originated from unfished spatiotemporal strata and that such anomalous predictions were not present in unfished strata for the GAM-based approach including in 2022. From this, the paper concluded that the high 2022 abundance index value from the GAM-based model was not due to a prediction issue for unfished cells as was observed with the GLM-based approach in 2018 and 2019.

22. The group thanked Dr Itoh for this further exploration of the high 2022 value for the standardised CPUE index. The group was reminded that the standardised CPUE index was built by treating predictions over the spatio-temporal domain of the CPUE analysis as a survey of SBT abundance, and that the annual index was generated by summing density predictions across all spatio-temporal strata (also accounting for cell area). There was some concern from the group that the annual index was increasingly driven by predictions from unfished areas.

23. There was some discussion amongst the group as to what alternative approaches might be suitable to build the index. Some Members suggested that a pre-agreed set of criteria could be defined to exclude cells from the index domain. The

constant-square vs variable-square approaches were also discussed, and the group agreed that the current GAM standardisation approach was in between the two approaches. Another option discussed was the possibility of including only a subset of cells that were fished in a recent period.

24. The group noted that the relative contribution of unfished areas to the total index of abundance had increased over time, from about 30% in 1969 at the start of the time-series to about 80% in 2022 (Figure 2, CCSBT-OMMP/2306/09, Attachment). This range contraction in the longline fishing effort should not be a concern unless the density in unfished cells was predicted to be much higher than in fished cells. There was an expectation that under preferential sampling the longline fishing effort for southern bluefin tuna would concentrate towards areas with higher catch rates. As such, model predictions of higher density in unfished areas would be deemed less realistic.

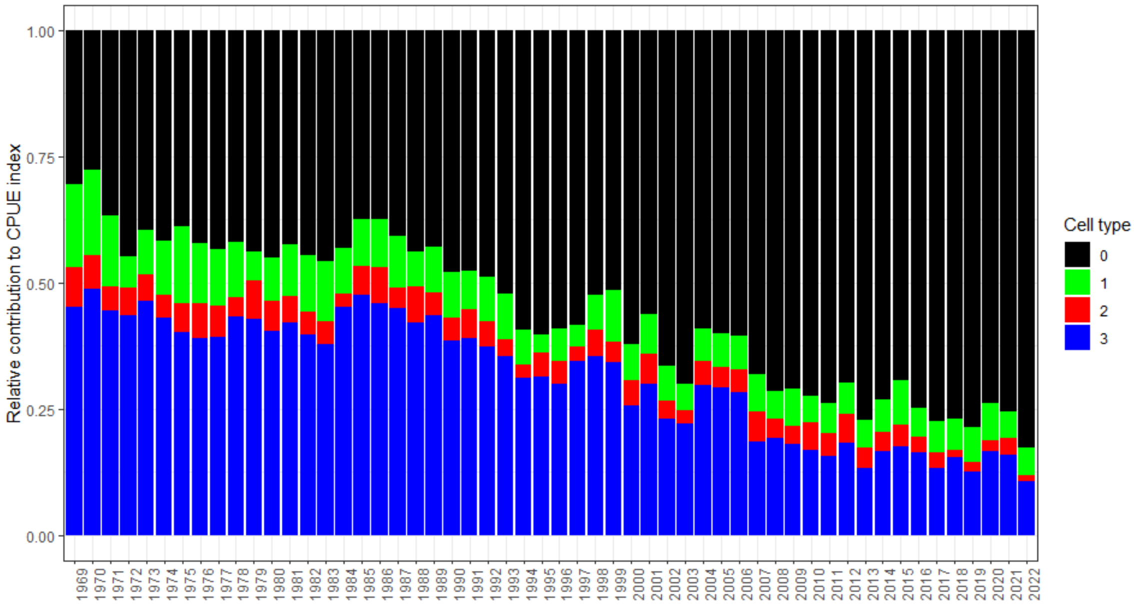

Figure 2. Proportion by cell type (cells where 5x5 by month contain 0:no operations, 1: 1-4, 2: 5-9, 3: $\geq$10 operations), contributing to the CPUE index. Source: attachment to CCSBT-OMMP/2306/09.

25. There was a question as to the range of observed catch rates that would be observed in a normal vs a good fishing set. Dr Itoh indicated that an average catch rate might be around 3-5 southern bluefin tuna per thousand hooks, while a good catch rate would be 10 to 20 southern bluefin tuna per thousand hooks.

26. The group noted that there may be a concern when using complex interaction terms in GAMs that unstable behaviour may occur in areas or combination of times and area that are poorly sampled, or at the edge of 2d or 3d smoothers. Dr Itoh confirmed in the 2022 work, that this behaviour had minimal impact on the index. An examination of maps of the predictions by cell type confirmed that there were no spurious edge effects in the predictions of abundance in unfished cells.

27. To address earlier suggestions by the group about the usefulness of building the index from recently fished strata only, Dr Itoh assembled an alternative set of standardised CPUE series based on the subset of cells fished in each of the years between 2017 to 2022. The resulting six new series were compared to the abundance index built using the full spatial domain, and showed little difference in the index trend (Attachment to CCSBT-OMMP/2306/09). The group concluded that while consideration of the spatial domain to use when building the index was important, it was unlikely to change the main features of the index.

28. A new analysis was presented to the group to explore the contribution of different model terms to the annual prediction of abundance by the GAM-based model. The analysis rebuilt the CPUE index by predicting cell abundance based on the categorical year-effect of the GAM-based model only. A comparison between this index and the overall index showed that both indices were very similar (Fig. 3). The interpretation was that the main driver of abundance through time from the GAM-based model was the year-effect, and that on average spatio-temporal effects by the spline terms contributed little to the overall index. This was consistent with the earlier result showing that the standardised index was robust to the choice of the spatial strata subset used to assemble it.

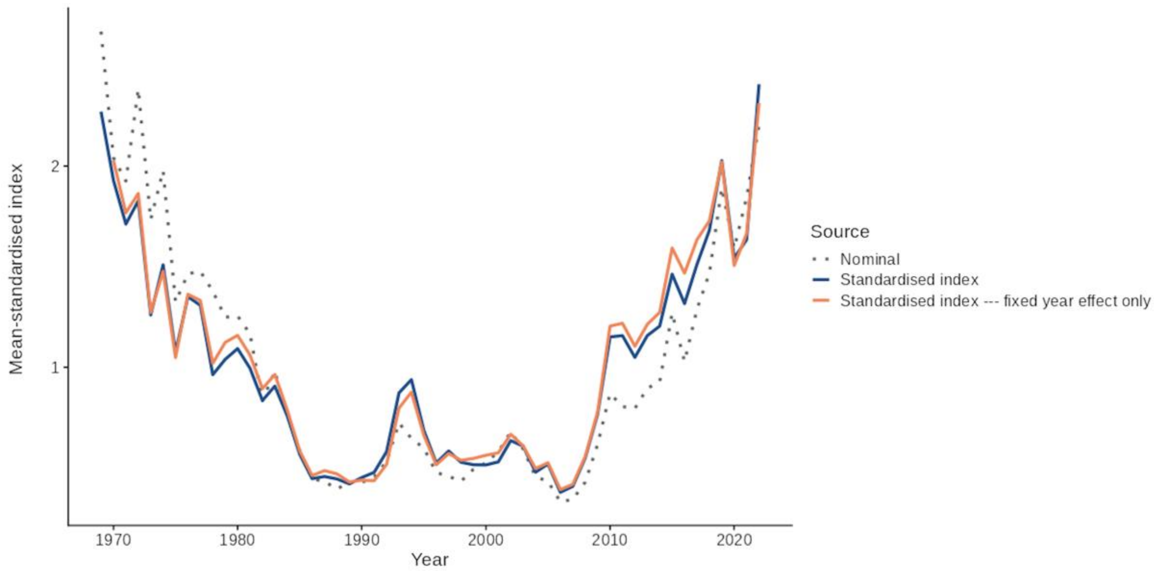

Figure 3. Comparison of nominal CPUE with the new index derived from the GAM model (area weighted predictions) and with the fixed year effect estimated by the same GAM model.

29. Dr Itoh provided further explanation as to the role of cell weighting in index construction. Model predictions for each 5-degree cell were further weighted by the number of 1-degree cells having received at least one fishing set over the period 1969 to 2022. Changing cell area with latitude is also taken into account. Dr Itoh advised that the cell weighting should be included when comparing different versions of the abundance index over the whole spatial domain, but that individual examination of predictions by cell type should not include the cell weighting as it is a step applied separately to model fitting at the final index construction step.

30. A comparison of average predicted density by cell type over time was presented to the group. This showed that average density trends were very similar across all cell types (Fig. 4). This result further confirmed that trends in density over space were mostly driven by the year effect, which itself is informed by catch rates in fished areas only.

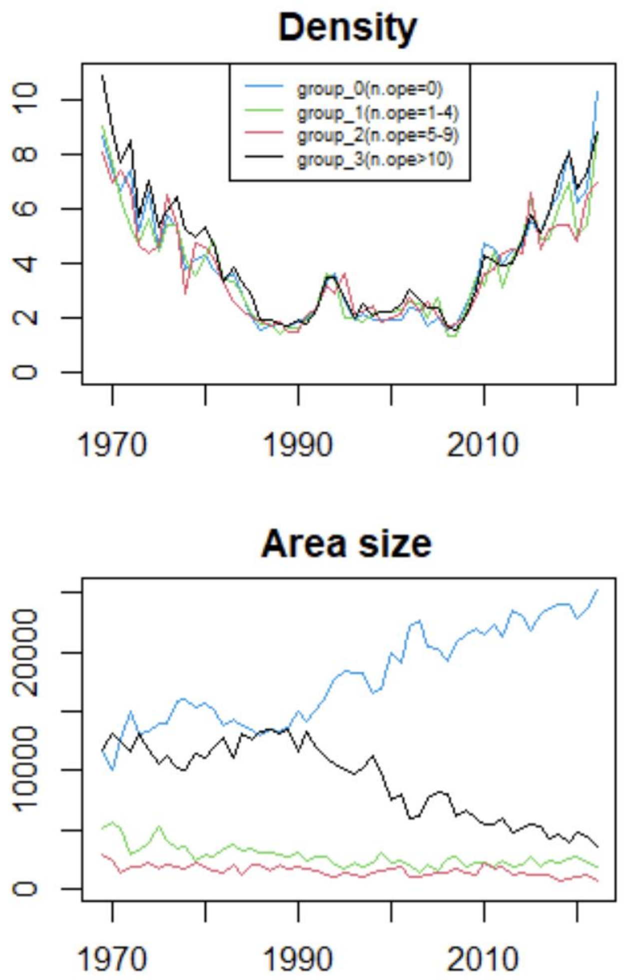

Figure 4. Trends in predicted CPUE divided by area for four groups of cells classified based on the number of operations registered in any given year-month, where group 0 corresponds to cells with no operations. Source: attachment to CCSBT-OMMP/2306/09.

31. There remained concern from the group that the abundance index was mainly informed by trends in catch rates from an increasingly diminished fished area, especially given the lack of standardisation effect compared to nominal catch rates. Suggestions were sought for approaches to refine the spatial domain to only include cells that are likely to have positive southern bluefin tuna abundance. One suggestion was to use the CV from the GAM-based model as a metric to exclude cells from spatial domain whose CV exceeds some to-be-define threshold. It was agreed that the CV from the positive component of the model would be sufficient, given there was little effect contributed by the binomial component. This new index, which is expected to be less extreme than the

"variable squares" index, will be used as an alternative CPUE series in a sensitivity test.

32. Korea presented paper CCSBT-OMMP/2306/06 updating the CPUE abundance index using Generalised Linear Model (GLM) for SBT of Korean longline fishery in CCSBT up to 2022. They applied two alternative approaches, data selection and cluster analysis, to address concerns about target change over time that can affect CPUE indices. Explanatory variables for the GLM analyses were year, month, vessel ID, location (5° x 5° cells), number of hooks, and targeting (HBF and cluster). GLM results suggested that year, month, location, and targeting effects were the principal factors affecting the nominal CPUE. But there was no significant change from the previous year. The standardised CPUEs for CCSBT statistical area 8 and 9 decreased until the mid-2000s and have shown an increasing trend.

33. The group noted Korea's contribution to our understanding of trends in standardised CPUE across fleets.

1.4 Indonesian catches

34. Indonesia advised the group about the COVID-19 interruptions and institutional changes that have had an impact on the Benoa catch monitoring, as well as length, otolith and tissue sample collection for data used in the assessment models and in close-kin analysis. Two years (2021-2022 spawning season) of data and sample collection are missing because the monitoring has not been able to proceed.

35. The group noted that Indonesian catches occur in statistical areas 1 and 2, and that there was a shift to a larger catch from area 2 in 2021. The Indonesian length and age frequency has been recalculated, using the Benoa catch monitoring data for all years. The Benoa catch monitoring data are predominantly from statistical area 1, i.e. fish that are landed fresh not frozen, but there may be some fish that are from area 2 in this data set.

36. In the stock assessment and operating models, the Indonesian catches are placed in fleet 5. Previously, this fishery was assumed to be exclusively by-catch of SBT on the spawning grounds from the Indonesian long-line tropical tuna fishery, though recently there are indications that additional catch from area 2 (south of Area 1) is included in these data. The age frequency used in the assessment for the Indonesian fishery may therefore not be representative of the entire catch.

37. The ESC25 noted the uncertainty in the catch at size data from Indonesia and the conflict between data sources that needs to be investigated further and resolved, because these data are used in the OMs and in the close-kin mark recapture program. A project to review the Indonesian catch monitoring will be discussed further prior to, and at, the ESC.

1.5 Unaccounted sources of mortality

38. New Zealand presented Paper CCSBT-OMMP/2306/07: "Estimates of unreported SBT catch by CCSBT non-cooperating non-Member states between 2007 and 2020" by Dr Charles Edwards and Dr Simon Hoyle. Catches from non-

cooperating non-Member (NCNM) countries have been estimated for several years to inform both the stock assessment and the Management Procedure. Estimated longline effort was based on data from CCSBT, IOTC, WCPFC and ICCAT in areas where SBT are known to occur. High and low estimates of catch rates were estimated from aggregated data from the Japanese fleet (JP, primarily targeted fishing) and Taiwanese fleet (TW, primarily bycatch fishing). The main change made to the estimates of catch rates was the inclusion of an interaction term between CCSBT statistical area and year. The previous (2019) model contained an interaction between flag and year, with flag effectively being used as a spatial proxy. However, this may have been inappropriate, since prediction of the catch from non-Member data requires the estimated flag coefficients for JP and TW to be applied within other spatial strata, i.e., strata different from the strata that predominate in fitting the model. The catches estimated (in mt) for the two catch rate assumptions are shown in Table 2.

Table 2. Updated estimates of UAM (t).

Year	TW (adjusted)	JP (adjusted)
2007	51	126
2008	28	72
2009	62	152
2010	111	271
2011	63	151
2012	112	275
2013	167	432
2014	48	121
2015	133	326
2016	318	756
2017	413	984
2018	645	1511
2019	488	1155
2020	482	1160

39. The NCNM estimates of catch from the global model using JP catch rates, adjusted for unreported non-zero catch, were used in the 2023 stock assessment. Use of JP catch rates may result in overestimates, but this may be countered by the possibility that effort is underestimated due to lack of reporting.

40. The group noted that non-Member effort had approximately doubled from the beginning to end of the period of UAM estimation, and that non-Member (UAM) catch estimates had increased from approximately 100 t to over 1000 t in the same period, indicating that catch rates are making a larger contribution to increases in UAM estimates than non-Member effort.

41. Moving to a spatio-temporal model is likely to improve realism, since catch rates can be more appropriately represented as a function of the underlying biomass density distribution. However, this does not resolve the need to verify the extent to which these potential NCNM catches occur.

42. It was noted that these estimated catches represent potential catches only, and that there is no data to ascertain their relationship to actual catches.

Agenda Item 2. Review of conditioning model runs: diagnostics and likelihood weights

43. Australia presented paper CCSBT-OMMP/2306/08 on initial reconditioning of the CCSBT Operating Model (OM) for the 2023 stock assessment. Updated data were successfully fitted to the OM using the previously agreed uncertainty grid from 2020. The fits to the data, and overall predictive performance of the model given these data, was examined in detail for each of the key data sources. Overall, the data fits and predictive performance appeared acceptable, with no obvious causes for concern or problems requiring potential model modifications. The current uncertainty grid appeared to be reasonably well balanced and is not indicating a need to extend the current range of any grid parameters.

44. The group noted that the data inputs to the preliminary reconditioning are the same as the last assessment, except that a single CPUE series is now used:

- Catch biomass and age (Indonesian, surface) or size (longline fleets) frequency by fishery.
- Longline CPUE (fleet LL1) relative abundance index (1969–2022)
- Aerial survey juvenile relative biomass index (1993–2017)
- Mark-recapture data (1990–1994 & 1–3 release years & ages)
- Gene tagging age 2 absolute abundance estimates (2016–2021)
- CKMR Parent-Offspring Pairs (POPs) (2002–2018)
- CKMR Half-Sibling Pairs (HSPs) (2003–2017)

45. It was noted that there is one year missing in the gene-tagging data (2020 age -2 cohort), one year missing in the Indonesian age frequency (year 2022, season 2021/22), and the New Zealand length frequency has not been fully raised to the total catch.

46. The group agreed with the conclusions in the paper: that the fits to the age and size frequency data are good when levels of sampling are high, with no obvious pathological issues for the major fisheries (LL1, Indonesian and surface). The fits to the revised single GAM-derived CPUE index are satisfactory, but the model struggles to fully explain the high 2022 point. Fits to the aerial survey index and 1990s tagging data are like previous assessments. Fits to the gene tagging data are good. The fits to the CKMR data are good for the POPs and HSPs at the usual aggregation levels, and very good for the overall number of kin pairs.

47. The data weighting in the reference set was considered appropriate. The values in the reference set grid were reviewed and it was agreed that this grid looks appropriate, although some small changes have been made.

48. The range of steepness values was considered in more detail, and the group agreed that this range was appropriate. When considering the impacts of the recruitment penalty on steepness, the results indicated that slightly higher steepness values in the range are preferred in this assessment. The group noted that the lowest value of *h* was already sampled infrequently when weighted by the likelihood. Consequently, no further adjustments to the lowest value in the range was needed. The four steepness values in the reference set were equally weighted and unchanged from the 2020 assessment.

49. The models struggled to fit the high 2022 CPUE point, and the GAM standardisation was further explored (see CPUE discussion). The group agreed to conduct sensitivity tests to explore the impact of the recent increasing trend on the assessment results (see agenda item 4 regarding the sensitivity test Drop_5yrs). An alternative CPUE index, that is a modification of the GAM, is also proposed as a sensitivity test to address concerns related to possible biases associated with the increased effort concentration and predicted CPUE in large areas that have been unfished for a while.

50. The age range used to standardise the selectivity to predict the CPUE was reviewed, and the reference set has been updated to use a single age range of 5-17 (changed from two alternative rages: 4-18 and 8-12 in the old grid) based on the selectivity pattern of LL1 (Fig. 5). The comparison of stock (total reproductive output: TRO) depletion estimated based on the two ranges showed very little impact on TRO performance statistics. The revised age range was considered preferable based on review of the range of ages with higher estimated selectivity over the whole period.

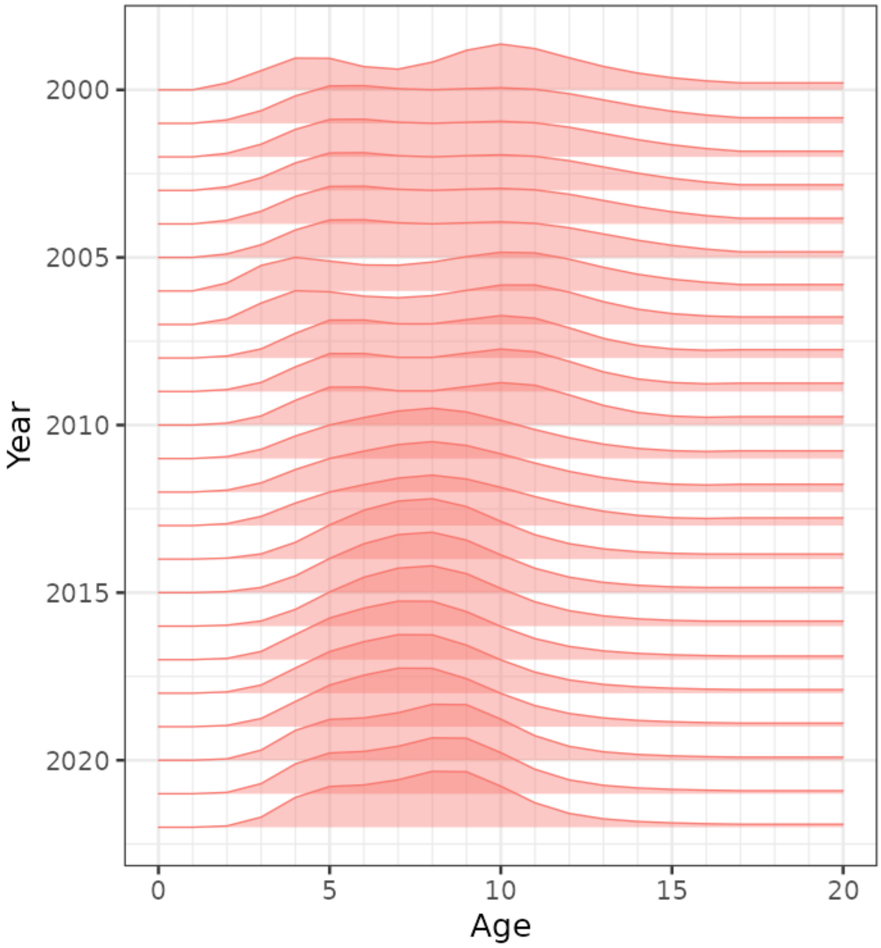

Figure 5. Depiction of the LL1 selectivity over time.

51. The group noted the year-class estimated for 2018 is above average. Unfortunately, this estimate is not directly informed by the gene-tagging juvenile abundance estimates because of the missing gene-tagging data in 2020. This

value is likely informed by the high CPUE value in 2022 and higher catches of aged 3 and aged 4 fish in 2021 and 2022.

52. The group discussed how the LL1 and Indonesian selectivity are being modelled. For LL1 the group agreed to conduct a sensitivity test that allows for more flexibility in selectivity changes in the last 3-year block. For the Indonesian selectivity, the lower age is changed to age 6 in the reference set of operating models, because the current age 8 was not low enough to account for the smaller fish in the Indonesian catch. The Indonesian selectivity had been made more flexible starting in 2013 to accommodate the appearance of younger fish in the catch than had been observed before. For that recent period, the models estimated a selectivity with two peaks that were shifting over time (Figure 6). A sensitivity test that constrains the degree of flexibility allowed since 2013 was agreed.

53. The new reference set is defined under agenda item 4.

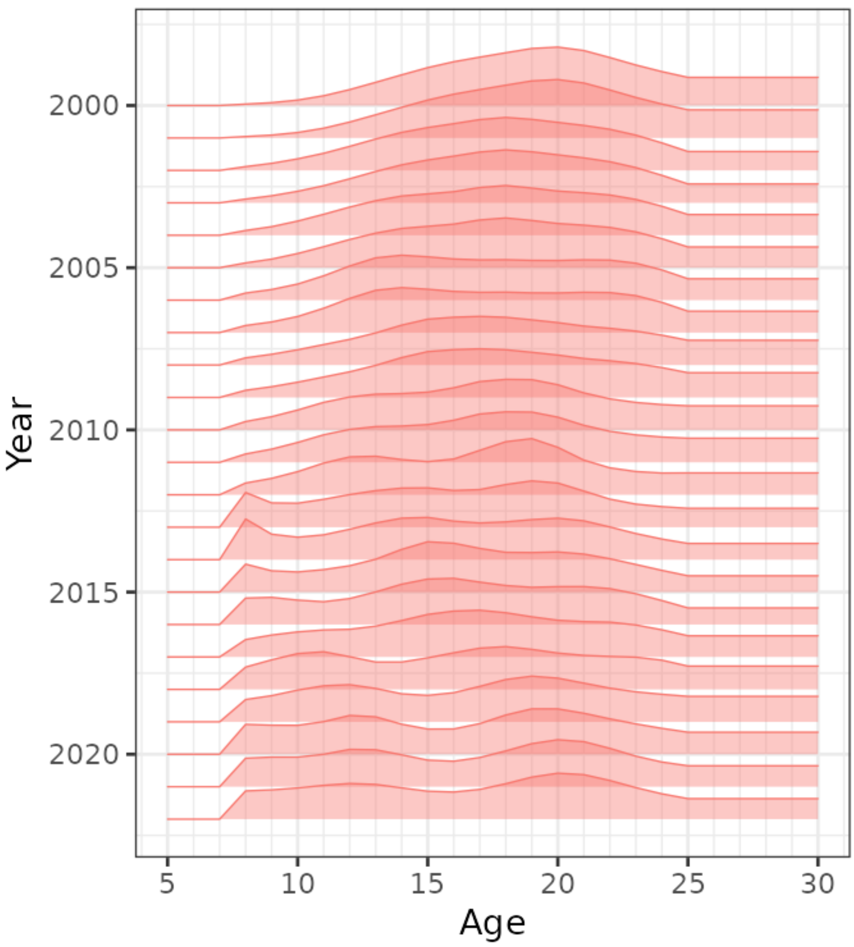

Figure 6. Depiction of the Indonesian fishery selectivity over time.

Agenda Item 3. Discussion of projection results

54. The Chair advised that the control files needed for running stock projections were prepared during the meeting. Projection results for the reference set and some selected sensitivity runs will be presented at ESC.

Agenda Item 4. Specification of reference set and sensitivity runs to be presented to the ESC

55. Based on the review of model runs, the group selected a final grid of OMs to be used as a reference set for the stock assessment (Table 3). The grid comprises 108 cells resulting from the crossing of four values of steepness (h), three values of natural mortality at age 0 (M0), three values of mortality at age 10 (M10), a single value of Ω (implying a linear relationship between CPUE and LL1 exploitable biomass), a single age range used to standardise LL1 selectivity over time, a single CPUE (GAM), and three values of ψ (power parameter for relative reproductive contribution by age).

56. The aim of the reference set of models is to provide stock status advice that encapsulates these key uncertainties.

Table 3 Revised reference set grid for the stock assessment to be presented at the ESC. Sampling weight refers to how the grid of models is sampled to generate a distribution from 2000 parameter draws. Note that the values for h, M0, M10, Omega and Psi are the same as the stock assessment conducted in 2020. A single GAM CPUE series, which has been developed over the last few years, will be used in 2023, and the CPUE age range has been adjusted from 4-18 to 5-17 (see discussion).

Parameter	Value	Cumul N	Prior	Sampling weight
h	0.55, 0.63, 0.72, 0.8	4	Uniform	Prior
M_0	0.4 0.45 0.5	12	Uniform	Posterior
M_{10}	0.065, 0.085, 0.105	36	Uniform	Posterior
Omega (Ω)	1	36	Uniform	Prior
CPUE	GAM	36	Uniform	Prior
CPUE age range	5-17	36	Uniform	Prior
Psi (ψ)	1.5, 1.75, 2.0	108	0.25, 0.5, 0.25	Prior

57. Other assumptions made for the Reference Set of OMs include are described in the previous agenda item.

58. The group reviewed and agreed on priorities for sensitivity tests as provided in Table 4.

Table 4. Priorities for sensitivity tests

Test name	Code	Conditioning and projection notes	Priority
UAMbycatch	UAMbycatch	Replace LL1 NCNM catches estimated using Japanese catch rates by estimates calculated using Taiwanese catch rates.	H
No UAM	noUAM	Remove NCNM catches from conditioning and projections.	H
LL1 Case 2 of MR	case2	LL1 overcatch based on Case 2 of the 2006 Market Report	L
CPUE_Drop5	Drop_5yrs	Eliminate the last 5 years of CPUE Series	H
CPUE_0	DropCells	Set uncertain cells w/o data to zero (based on CV of positive CPUE rates)	H
Omega75	cpueom75	Power function for biomass-CPUE relationship with power = 0.75	H
Upq2008	cpueupq	Estimate CPUE 2008 change in q	H
Q age range	cpue59	Age range for q equal to 5-9	M
LL1_sel	LL1_sel	Allow the terminal 3-years to be flexibly estimated to evaluate impact on year-class uncertainty and magnitude	M
Indo_sel	Indo_sel	Bi-modality in selectivity, more rigid (constrain amount of change) from 2013 on in Indonesian fishery	H
NoPOP&HSP	NoPOPHSP	Exclude both close-kin data (Parent-Offspring and Half-Sibling Pairs)	H
No HSP	NoHSP	Switch off half-sibs	H
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	H

Agenda Item 5. Discussion of SRP project “Operating model specification and software upgrade” and other SRP plans

5.1 Operating Model and Software upgrade

59. The Chair opened a discussion of software upgrades as continued from ESC27 and the OMMP workshop. Criteria for the software include functionality, transparency, and ease of use. The two main candidates discussed were Template Model Builder (TMB) and Stan. Stan has a much larger and more diverse user base (of statisticians), but TMB has been developed more specifically for fisheries applications. Both have institutional support and are likely to be maintained for the foreseeable future. The trade-offs were discussed, and it was noted that TMB can interface with Stan, so that Stan’s functionality can be accessed.

60. The group agreed that the next version of the OM would best be developed within the TMB R package, with possible interfaces with Stan.

5.2 Improved understanding of longline CPUE

61. Dr Simon Hoyle developed the following outline for future CPUE work designed to explore the potential consequences of preferential sampling due to fishing behaviour. He proposed starting with fitted models to represent a plausible historical time series of spatio-temporal distributions of both fish and fishing. Observed data would then be either simulated or resampled with different degrees of weighting towards areas with higher abundance, and GAMs would be fitted to the simulated or resampled data. The following specific cases should be investigated:

    a. Equal weighting for all strata – for completeness.
    b. Weighting that matches the historical pattern (as with parametric bootstrapping).
    c. Weighting that progresses through time to give higher weight to locations with higher abundances.
    d. Weighting that progresses through time to give higher weight to samples with higher catch rates, i.e., representing improved ability to find temporarily good strata, or to find fish within strata.

62. A question was raised whether an aggregated data simulation approach would be adequate or whether operational data should be sought. After discussion, the group suggested developing a prototype with aggregated data, and to decide later whether operational data would be required.

63. The group discussed how to structure the weighting given the potential lack of independence of spatially and temporally individual operations. Examining existing data to estimate the "clumpiness" of operations was suggested. The group agreed that it would be useful to develop metrics that can be used to identify patterns in the simulated data that identify bias, and to highlight issues that may serve as warning signs when the information content of the preferential sampling from fishery data affects the reliability of the CPUE data as a credible indicator of stock trends.

64. The current CPUE project also includes a requirement to analyse aggregated catch and effort data from other longline fleets. Depending on the outcome, it may also be beneficial to redo the analysis using operational data.

5.3 UAM

65. Further work for 2024 has already been identified in the ESC27 report, along with an indicative budget. The authors of the 2023 report (Dr Charles Edwards and Dr Simon Hoyle) suggested that it would be useful to move to a fully spatio-temporal model to more accurately represent catch rates as a function of the underlying biomass density distribution. However, the group suggested that it may be more fruitful to design a monitoring programme to better understand the extent to which the estimated potential catches are being taken. Such a programme could include, for example, market surveys, genetics, or other methods to enhance traceability. A review of all methods for detecting

unreported catch would be useful. It could be designed in conjunction with the Compliance Committee. The Japanese longline CPUE estimates could also be used to inform catch rates for the UAM estimates rather than conducting a separate estimation, although it should be noted that the Japanese CPUE estimates do not cover the entire area included in the UAM estimates.

66. In any case, the next update may not need to be done for three years. This should be discussed further at ESC28.

5.4 Global tagging project

67. The group discussed the concept of developing a global monitoring program involving both conventional and archival tags for the purpose of investigating changes in the spatial distribution and growth of SBT. Results from a new study could be compared to the tagging results from the 1990s and 2000s to determine whether and to what extent the distribution, movements, and growth of SBT have changed. The initial task would be to design and cost the program using information gleaned from the previous tagging study. A project outline should be developed and discussed in the context of the SRP and at an appropriate ESC.

Agenda Item 6. Workplan

6.1 Preparation of stock assessment sensitivity runs

68. The Chair advised that the shiny app will be updated prior to the ESC so that the results from the reference set can be compared with the sensitivity runs specified.

69. The group noted that there are detailed evaluations for the CPUE working group to pursue, including alternatives with a threshold value on the uncertainty (CV) of each cell (and exclude from the calculation of the index cells whose CV exceeds the chosen threshold). Additionally, the CPUE WG is directed to examine a “variable squares” version from the GAM model to better inform the choice of threshold CV for a sensitivity run. In short, the OMMP requests the following:

- Map of CVs
- Indices calculated with different CV thresholds
- Variable squares (omit cells with no recorded operations)
- Figure of CV distribution by number of operations category (groups 0, 1, 2, 3 – see Figure 4 for definitions)
- Proportion of cells retained for different CV thresholds over time
- Analysis of data from other LL fleets

6.2 Other items

70. The group agreed that there were no other items.

Adoption of Meeting Report

71. The report was adopted.

Close of meeting

72. The meeting closed at 100 hrs on 30 June 2023 (Seattle time).

List of Attachments

Attachment

1. **List of Participants**
2. **Agenda**
3. **List of Documents**

Attachment 1. List of Participants

Note that several Members participated remotely either for the 1600hrs check-in or in detailed discussions. The group especially thanked Dr. Simon Hoyle for his contributions to our deliberations.

First name	Last name	Title	Organisation	Email
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Attachment 2. Agenda

Thirteenth Operating Model and Management Procedure Technical Meeting

1. **Review of data inputs**
   - 1.1 Gene tagging
   - 1.2 Close-kin: POPs and half-sibling indices
   - 1.3 Indonesian catches
   - 1.4 Unaccounted sources of mortality
   - 1.5 CPUE
2. **Review of conditioning model runs: diagnostics and likelihood weights**
3. **Discussion of projection results**
4. **Specification of reference set and sensitivity runs to be presented to the ESC**
5. **Discussion of SRP project "Operating model specification and software upgrade"**
6. **Workplan**
   - 6.1 Preparation of stock assessment sensitivity runs.
   - 6.2 Other items

<u>Attachment 3 List of Documents</u>

The Thirteenth Operating Model and Management Procedure Technical Meeting

(CCSBT-OMMP/2306/)

1. Provisional Agenda
2. List of Participants
3. List of Documents
4. (Japan) Change in operation pattern of Japanese southern bluefin tuna longliners in the 2022 fishing season (OMMP Agenda Item 1.3)
5. (Japan) Update of CPUE abundance index using GAM for southern bluefin tuna in CCSBT up to the 2022 data (OMMP Agenda Item 1.3)
6. (Korea) Data Exploration and CPUE Standardization for the Korean Southern Bluefin Tuna Longline Fishery (1996-2022) (Rev.1) (OMMP Agenda Item 1.3)
7. (CCSBT) Estimates of unreported SBT catch by CCSBT non-cooperating non-Member states between 2007 and 2020 (OMMP Agenda Item 1.5)
8. (Australia) Initial exploration of the 2023 stock assessment models (OMMP Agenda Item 2)
9. (Japan) Further examination of CPUE abundance index using GAM for southern bluefin tuna based on predicted values (OMMP Agenda Item 1.3)

(CCSBT-OMMP/2306/Rep)

1. Report of the Twenty Ninth Annual Meeting of the Commission (October 2022)
2. Report of the Twenty Seventh Meeting of the Scientific Committee (August 2022)
3. Report of the Twelfth Operating Model and Management Procedure Technical Meeting (June 2022)
4. Report of the Twenty Sixth Meeting of the Scientific Committee (August 2021)
5. Report of the Twenty Fifth Meeting of the Scientific Committee (August/September 2020)
6. Report of the Eleventh Operating Model and Management Procedure Technical Meeting (June 2020)
7. Report of the Twenty Sixth Annual Meeting of the Commission (October 2019)
8. Report of the Twenty Fourth Meeting of the Scientific Committee (September 2019)
9. Report of the Tenth Operating Model and Management Procedure Technical Meeting (June 2019)