Commission for the Conservation of
Southern Bluefin Tuna

みなみまぐろ保存委員会

Report of the Twenty Sixth Meeting of the Scientific Committee

31 August 2021
Online

Report of the Twenty Sixth Meeting of the Scientific Committee
31 August 2021
Online

Agenda Item 1. Opening of meeting

1. The independent Chair, Dr Kevin Stokes, welcomed participants and opened the meeting. The Chair advised that the meeting this year is held as a video conference due to the COVID-19 pandemic.
2. The list of participants is at **Appendix 1**.

Agenda Item 2. Approval of decisions taken by the Extended Scientific Committee

3. The Scientific Committee endorsed all the recommendations made by the Extended Scientific Committee for the Twenty Sixth Meeting of the Scientific Committee, which is at **Appendix 2**.

Agenda Item 3. Other business

4. There was no other business.

Agenda Item 4. Adoption of report of meeting

5. The report of the Scientific Committee was adopted.

Agenda Item 5. Closure of meeting

6. The meeting was closed at 10:42 am (Canberra time), on 31 August 2021.

List of Appendices

Appendix

1. List of Participants
2. Report of the Extended Scientific Committee for the Twenty Sixth Meeting of the Scientific Committee

Appendix 1

List of Participants
The Twenty Sixth Meeting of the Scientific Committee

First name	Last name	Title	Position	Organisation	Postal address	Tel	Fax	Email
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Commission for the Conservation of
Southern Bluefin Tuna

みなみまぐろ保存委員会

Appendix 2

Report of the Extended Scientific Committee for the Twenty Sixth Meeting of the Scientific Committee

23 – 31 August 2021
Online

Extended Scientific Committee
for the Twenty Sixth Meeting of the Scientific Committee
23 - 31 August 2021
Online

Agenda Item 1. Opening

1.1 Introduction of Participants

1. The independent Chair of the Extended Scientific Committee (ESC), Dr Kevin Stokes, welcomed participants and opened the meeting. The Chair advised that the meeting this year is held as a video conference due to the COVID-19 pandemic, and that discussion for some agenda items had commenced in advance by correspondence. The Chair thanked participants for their cooperation with this special arrangement.

2. Delegations introduced their key speakers. The list of participants is included at **Attachment 1**.

1.2 Administrative Arrangements

3. The Executive Secretary announced the administrative arrangements for the meeting.

Agenda Item 2. Appointment of Rapporteurs

4. Australia, Japan and New Zealand provided rapporteurs to produce and review the text of the substantive agenda items.

Agenda Item 3. Adoption of Agenda and Document List

5. The agreed agenda is provided at **Attachment 2**.

6. The agreed list of documents is provided at **Attachment 3**.

Agenda Item 4. Review of SBT Fisheries

4.1. Presentation of National Reports

7. The majority of discussion for this agenda item commenced by correspondence in advance of the ESC.

8. Australia submitted its national report CCSBT-ESC/2108/SBT Fisheries-Australia. Australia's allocation as agreed by the Extended Commission (EC) was 6,165 t for the 2019–20 fishing season. However, this was adjusted to account for overcatch in the previous fishing season, so the effective TAC was 6,125 t. A total of 39 commercial fishing vessels landed SBT in Australian waters in the 2019–20 fishing season for a total catch of 5,429 t. A total of 84.1% of the catch was taken

by purse seine with the remainder taken by longline, pole-and-line, rod-and-reel and trolling. Seven purse seiners fished off South Australia for the Australian farming operations during the 2019–20 fishing season, with live bait, pontoon-towing and feeding vessels also involved. Most of the purse seine fishing commenced in mid-December 2019 and finished in mid-March 2020. Length frequency data from the purse seine fishery from 2005–06 to 2006–07 indicated a shift to smaller fish compared to previous years, but this trend has showed signs of reversal since 2007–08, possibly due to the targeting of larger fish. The average length of southern bluefin tuna (SBT) transferred to farms in South Australia in 2019–20 was 87.8 cm. In the 2019–20 fishing season, observers monitored 9.9% of purse seine sets where fish were retained for the farm sector and 10.3% of the estimated SBT catch. In 2020, e-monitoring covered 11.0% of longline hook effort in the Eastern Tuna and Billfish Fishery during the months and in the areas of the SBT migration through that fishery. E-monitoring coverage of longline hook effort in the entire Western Tuna and Billfish Fishery was 12.1% in 2020.

9. In response to questions on its national report, Australia advised that:

- The low average fork length in the South Australian area was a reflection of the size classes available and was not due to operational changes in the fishery.
- It does not consider the purse-seine CPUE to be indicative of stock size given the nature of the fishery, which uses bait vessels and spotter planes to capture schools of SBT. Similarly, the Australian longline fishery is a mixed fishery, targeting SBT only at a certain time of the year. Historically the longline catch has been a very small proportion of the total catch of SBT. However, as the longline catch increases it may be possible in the future to explore using the CPUE index further.
- Australia conducts in-port sampling in a number of locations on the east coast of Australia (Ulladulla, Bermagui, Eden, Coffs Harbour, Mooloolaba). SBT makes up a small component of the program as it only occurs in some areas seasonally. In the current season Australia has collected 50 otoliths from a range of SBT lengths. Further collection is anticipated however this will be dependent on access to ports currently locked down due to the COVID-19 pandemic. Further detail on port sampling will be provided in next year's update.

10. Australia also submitted paper CCSBT-ESC/2108/09 which described Australia's data preparation and validation process. On behalf of the Australian Government, the Australian Bureau of Agricultural and Resource Economics and Sciences compiled aggregated catch and effort, catch by fleet, raised catch, catch at size, and non-retained catch for submission to the CCSBT. This was compiled from a number of databases including daily fishing logbooks, catch disposal records and fisheries observer reports, collected and managed by the Australian Fisheries Management Authority. The Australian catch of southern bluefin tuna from the surface (purse seine) fishery was also sampled by contracted field staff prior to release into farm cages. The sample data include size and weight measurements that were used to calculate representative size distributions and average weights. Relational databases, spreadsheets and query scripts were used to integrate and process the source data sets and create the data files required for the CCSBT data

exchange. This paper provided copies of data collection forms, as well as flow charts illustrating the data integration procedures. The paper also described the data validation procedures.

11. The European Union submitted its national report CCSBT-ESC/2108/SBT Fisheries-European Union. The EU did not participate in the pre-meeting discussion by correspondence and advised the Secretariat that it would not be attending the ESC. One Member asked the following question of the EU during the pre-meeting discussion, but the question was not answered:

    - "*In page 2, it is mentioned that "The EU fleet does not target SBT and there were no incidental catches of SBT by EU vessels that entered in the SBT distribution area." Is this supported by observer data collected in the SBT distribution area?*"

12. Indonesia submitted its national report CCSBT-ESC/2108/SBT Fisheries-Indonesia. SBT is seasonally caught as a by-catch from Indonesian tuna longline fleets operating in the Indian Ocean. This report provides scientific information on the Indonesian tuna longline fishery related to SBT for the 2020 calendar year, from 1 January to 31 December 2020. The total number of active longline vessels recorded was 155 units, whereas the total reported SBT catch was 1,298 t, or 13,577 individuals. The size of SBT ranged from 50-231 cm fork length (FL) (mean=173.8 cm FL) for Area 1 and 64-205 cm FL (mean=156.1 cm FL) for Area 2. Due to the COVID-19 pandemic, only two successful scientific observer trips were deployed in 2020, covering at least 0.37% in Area 1 and 0.20% in Area 2 in terms of total hooks.

13. In response to questions on its national report, Indonesia advised that:

    - The monitoring described in Section 6.1.3 of its report is intended not only for sharks and rays but also for other retained species, such as SBT.
    - Indonesia currently does not have sufficient data to estimate the SBT mortality from hand line and artisanal longline fisheries.
    - From 2015, Indonesia's national fisheries SBT catch statistics (Table 3 of its report) are derived from the CDS. Prior to this, they were estimated based on a port sampling program.

14. Indonesia also submitted paper CCSBT-ESC/2108/Info02, which provides updated information about the reproductive studies of SBT being undertaken in Indonesia. The standard reproductive classification was used to assess the ovaries of 254 females collected by Indonesian scientific observers and the port landing monitoring program in Benoa, Bali. Samples were collected in 2017-2020 from scientific observers and port landing monitoring programs. All samples were from Indonesian tuna longline vessels. The length of SBT caught ranged between 134 and 194 cm FL. Gonad samples were fixed in 10% buffered formalin and then embedded in paraffin and standard histological sections were prepared (cut to 5 µm and stained with H&E). Histological sections were classified using criteria for SBT and south Pacific albacore tuna. All samples were classified as mature fish. The development class were identified as spawning, spawning capable, regressing-potentially reproductive, regressed 1, regressed 2 and regenerating. Based on its reproductive activity, from 122 fish that were at spawning stage, 44% of them were small fish (<155 cm FL). Further ovary

samples are required (and are currently being collected) from Statistical Areas 1 and 2 to further examine the reproductive activity of SBT.

15. Indonesia submitted paper CCSBT-ESC/2108/Info03, which presents a summary of progress of the Indonesian scientific observer program on the tuna fishing vessels operating in the Indian Ocean. The observer data is the most detailed information associated with catch, effort, fishing practices, gear configuration, and environmental conditions. Only low fleet coverages were available from this data set. Hence this could be expanded to get robust abundance indices from the fishery.

16. Indonesia submitted paper CCSBT-ESC/2108/Info04, which provides updated information about the SBT monitoring program in Benoa port, Bali Indonesia 2020, presented in CCSBT-ESC/1909/Info 03. The sampling coverage has fluctuated monthly; however, a decreasing trend was observed annually from 44.63% in 2019 to 36.74% in 2020. The number of observed SBT also declined in 2020, with only 1,187 individuals compared to 2019 (1,662 individuals). The length measurement of SBT ranged between 91 and 203 cm FL indicated smaller sizes were caught compared to last year (ranged from 108 to 200 cm FL).

17. Japan submitted its national report (CCSBT-ESC/2108/SBT Fisheries-Japan), which described the Japanese commercial longline fishery for SBT in terms of catch, effort, nominal CPUE, length frequency, number of vessels and geographical distribution of fishing operations in 2020. In 2020, 79 vessels caught 5,929 t and about 95,000 individual SBT. Scientific observers were deployed on 5 vessels and covered 6.4 % of the number of SBT caught by all vessels.

18. Japan submitted paper CCSBT-ESC/2108/26, which summarises activities of Japanese scientific observer program for SBT in 2020. Scientific observers were dispatched on 5 vessels that operated in the main CCSBT Statistical Areas (Areas 4－9). Observer coverages were 6.4% in the number of vessels, 10.4% in the number of hooks used, and 6.4% in the number of SBT caught. When considering the actual observation time during hauling, the coverage in the number of hooks observed was estimated as 7.4%. The main reason for the low coverage rate was that the planned distribution of observers was not possible due to the COVID-19 pandemic. The length frequency distributions of SBT reported by the observers and those reported from all vessels in RTMP were generally consistent to each other. Observers retrieved CCSBT conventional tags from two SBT.

19. Korea submitted its national report CCSBT-ESC/2108/SBT Fisheries-Korea. In the 2020 calendar year, the SBT catch of the Korean tuna longline fishery was 1,226 t (1,226 t in fishing year) with 9 vessels active. In general, fishing occurs between 35°S-45°S and 10°E-120°E, in Statistical Area 9 from April to July/August and in Area 8 from July/August to December. However, since 2014 SBT fishing vessels moved further westward than in previous years, and mainly operated in the area between 20°W-35°E (Area 9). Until the early 2010s the CPUE was low and since 2012 it has increased, but there was no fishing in Area 8 during 2017-2019. In 2020, no scientific observers were placed onboard Korean longline vessels targeting SBT due to the COVID-19 pandemic.

20. New Zealand submitted its national report CCSBT-ESC/2108/SBT Fisheries-New Zealand. For the 2019/20 fishing year, within New Zealand's national allocation of 1,088 t, there were the following allowances: a total allowable commercial catch (TACC, which is the commercial allowance) of 1,046 t; a recreational allowance of 20 t; a customary non-commercial allowance of two tonnes; and an allowance for other sources of fishing-related mortality of 20 t. Commercial removals of SBT were 856.6 t, taken entirely by the domestic fleet which is predominantly longline vessels, discard mortality was estimated at 17.9 t, recreational removals were estimated at 48.9 t, and there were no customary removals reported. Total removals were therefore 923.4 t. Standardised CPUE showed a marked decline from 2017 to 2019, including a particularly large drop from 2018 to 2019, but in 2020, standardised CPUE increased substantially to near 2018 levels. In the 2000s, there was a reduction in the range of sizes of SBT taken in the New Zealand fishery. There is evidence of growth (shown by progression of modes) over this period, but little evidence of recruitment of smaller fish to the New Zealand fishery. However, more recent data show a change, with smaller recruits appearing in the fishery. New Zealand has continued to closely monitor both the commercial and recreational catch, and to pursue its gamefish tagging programme.

21. Taiwan submitted its national report CCSBT-ESC/2108/SBT Fisheries-Taiwan. Since Taiwan became a member of the EC of the CCSBT in 2002, all SBT fishing vessels are required to be authorised to access this fishery, and the authorisations are reviewed and renewed by the Fishery Agency of Taiwan (FA) annually. In 2020, 70 fishing vessels were authorised to fish for SBT, which consists of seasonal target vessels and bycatch vessels, and the SBT catch was 1,116 t for both the calendar year and the quota year. Observers were sent onboard SBT fishing vessels for collection and recording of detailed information on catch and effort of fishing operations. In the 2019 calendar year, 16 observers were deployed on 16 of the 44 fishing vessels authorised to target SBT seasonally, and 2 were deployed on 2 of the 28 fishing vessels authorised to bycatch SBT. There were 3,018 fishing days with 2,747 days observed. 10 observers were deployed on 10 of the 38 fishing vessels authorised to target SBT, and 1 was deployed on 1 of the 32 fishing vessels authorised to bycatch SBT in 2020 with 1,957 days observed out of 2,336 fishing days. In 2019, the coverage rate of observation was 25.0% by vessels, 15.2% by hooks and 14.1% by catch. The coverage rate accounted for 15.7% by vessels in 2020, 10.9% by hooks, and 10.0% by catch. In 2020, the deployment of observers was hindered by the COVID-19 pandemic, thus there was a great decrease in observers dispatched on fishing vessels. In recent years, Taiwanese SBT fishing vessels mainly operate in the IOTC area, and partial SBT bycatch vessels operate in the ICCAT area. Therefore, the Fisheries Agency has adopted the conservation management measures/resolutions/recommendations of all tuna RFMOs into domestic fishery regulations, and which become mandatory obligations for Taiwan's fishing fleet.

22. In response to questions on its national report, Taiwan advised:

- The difference in reported effort in Statistical Areas 4 and 5 between Taiwan's report to the WCPFC and Taiwan's report to the CCSBT are because these reports were based on the different data sources of various fisheries within different basins. The fishing data of National Report of Taiwanese tuna fisheries of the WCPFC were composed with the Taiwanese tuna longline and distant-water purse seine information. The National Report of Taiwan for CCSBT was based on the fishing data from the Taiwanese seasonal targeting and bycatch SBT fisheries.

- 101 SBT were bycaught by non-authorised SBT vessels as part of the effort reported to WCPFC. However, this catch of SBT was reported and discarded due to those vessels not being authorised for SBT.

23. Taiwan submitted paper CCSBT-ESC/2108/19 which described preparation of Taiwan's SBT catch and effort data submission for 2021. SBT fishery data submitted to the EC from Taiwan includes total catch by fleet, aggregated catch and effort, catch-at-size, catch-at-age, and non-retained catch data. The data submitted is compiled from the electronic logbook (e-logbook) data and catch documentation scheme (CDS) data collected from authorised SBT fishing vessels with cross checking against VMS data, observer data and traders' sales records. No discrepancies were found among datasets on catch.

24. The ESC noted that South Africa did not submit a national report to the ESC and that South Africa did not participate in the pre-meeting discussion and is not present at the ESC.

25. It was noted that the ESC is not receiving all the required information in relation to releases and discards specified in the template for national reports to the ESC. Australia, Japan and Korea revised their national reports prior to the meeting to provide improved information. During the pre-meeting discussion, Taiwan advised that according to paper CCSBT-ESC/2008/31, it estimated the discards of SBT from the Taiwanese longline fishery using the discard information recoded by scientific observer program and fishing efforts from commercial longline vessels. Since there was no obvious change in Taiwanese fishery scale and the discard information was reported continually in recent years. Therefore, Taiwan reported the records of discard information in 2020 and will continue to improve the quality of discard information collected from both scientific observers and Taiwanese commercial longline vessels.

26. It was agreed to further discuss information on releases and discards at agenda item 11 on the update of the Scientific Research Program.

4.2. Secretariat Review of Catches

27. Discussion for this agenda item commenced by correspondence in advance of the ESC.

28. The Secretariat's paper CCSBT-ESC/2108/04 provides an update of the reported SBT global catches, the spatial distribution of catch and effort, exports from CCSBT Members and Cooperating non-Members, and the distribution of reported non-Member effort in areas near where SBT are caught. It shows that the reported total catch for the 2020 calendar year was 15,660 t, a decrease of 1,442 t or 8.4% from the 2019 calendar year. The global reported SBT catch by flag is shown at **Attachment 4**. The paper also included comparisons of global adjusted TAC against reported catch by fishing season, which showed that reported catch was less than the adjusted TAC by 475 t for the 2020 fishing season. Indonesia exceeded its Total Available Catch for the 2020 fishing season by 456.6 t. Indonesia agreed (and the EC accepted) that Indonesia will repay its

overcatch by reducing its Total Available Catch by 91.8 t for each of the 2022-2026 fishing seasons (Report of CCSBT 27, Attachment 8).

Agenda Item 5. Progression of CPUE analyses

29. A brief summary of the CPUE modelling group's intersessional work was given to the ESC. The CPUE modelling group identified some remaining technical issues requiring a small group meeting to clarify the Constant Squares (CS) *vs.* Variable Squares (VS) and data aggregation questions. These questions require resolution before calculation of the CPUE indices used in the Operating Model (OM) and Management Procedure (MP) can proceed.

30. The previous ESC report (Report of ESC 25, 2020) details the specifics of the current CPUE modelling problem: the previous GLM-based CPUE standardisation model produced a very high estimate of predicted CPUE in 2018, apparently being driven from spatial cells with no observed effort. Given the CS algorithm predicts across all previous spatiotemporal strata, the estimated CPUE index was high even in strata with no fishing effort. The effect primarily emerged from Area 8 and the 2018 shift in effort combined with the CS algorithm. ESC25 recommended that high priority be given to the further examination of the GAM-based analyses presented at that ESC meeting with those explorations discussed intersessionally and any analyses refined for the 2021 ESC.

31. The CPUE modelling work has pivoted towards Generalised Additive Models (GAMs) over Generalised Linear Models (GLMs) or Generalised Linear Mixed Models (GLMMs). Aside from this being a noticeable change in direction for CPUE modelling in general, there are clear motivating reasons why this has happened in the CCSBT CPUE modelling work. Using categorical variables in GLMs and GLMMs results in problems with both patchy and systematic missing data scenarios. Generally speaking, GAMs can better accommodate both spatiotemporally patchy and missing data, as well as complex trends in the distribution of effort over time and space. GAMs can smooth over time and space – and current software packages have a diverse array of possible smoothers for different situations – so do not rely on the data being suitably consistent enough in time and space, which categorical variables do tend to require to work well.

32. Paper CCSBT-ESC/2108/35, which reports on work to improve the primary CPUE index of SBT abundance, was presented. Generalised additive models with spatiotemporal smoothers were used to compare approaches for fitting CPUE data from the non-confidential aggregated dataset. Data aggregation caused some problems with model fits by introducing an inverse correlation between the expected catch rate and residual variance, which resulted in poor fits of the non-zero catch for all error distributions. Delta lognormal models were selected as the preferred approach to replace the previously-used lognormal(CPUE+k) model. The extreme value diagnostic was improved to account for the sizes of the extreme values. Models with different components were compared using maximum likelihood (ML) and final smoothers were fitted using restricted ML (REML). Final models used ti() smoother terms to specify model components, and a gamma parameter of 2 to reduce the effective sample size in the Generalised Cross-Validation (GCV). Indices were adjusted to account for differences in the ocean areas of spatial strata. A group of final models was

selected that fitted the data better than previous approaches and generated plausible values for strata without observations. As well as paper 35, additional material was considered during the meeting to give a full and up to date summary of the CPUE modelling work to the ESC.

33. Given that the successive removal of strata explored in paper CCSBT-ESC/2108/35 appeared to make little difference to the overall estimated CPUE trend, the question was asked as to why there was so little difference? The cases with removed strata were renormalised, with the trends in those areas being very similar; as a result, the effects were very similar across the candidate standardisation models. The Akaike Information Criterion (AIC) assumes a correctly specified likelihood, but the likely dependence across strata – especially when using aggregated catch and effort data – violates the assumption of independence made in the standardisation models. The issue was raised as to whether this would mean using the AIC as the main model selection criterion would tend to result in more complex models being selected more often than if dependence between strata was being accounted for. It was noted that, while this was possible, there is some down-weighting done in the revised models via the gamma parameter, which can mitigate some of the problems related to between strata dependence.

34. Another suggestion was to use the percentage of the overall deviance that a particular model term explained as another model selection criterion. If the main goal is to obtain a "best predictor" for the CPUE data it was suggested that, given the exploration of some aspects of stratum non-independence using the gamma parameter, the AIC-driven approach to model selection would perform reasonably adequately. Given the differences between the datasets used in paper CCSBT-ESC/2108/35, and those in paper CCSBT-ESC/2108/27, which will form the basis of the model or suite of models that is ultimately recommended, the meeting questioned whether the model selection approach would transfer robustly between the aggregated and operational datasets and models explored in the two papers. It was noted that, ideally, the model selection process would be undertaken using the dataset that will be used in the actual model(s) selected, but that some properties – specifically the best model – would likely be transferable between datasets with minor model differences.

35. Paper CCSBT-ESC/2108/27 was presented to the ESC. It summarises the core vessel CPUE which is an abundance index of SBT used in the MP. It explains data preparation, CPUE standardisation using GLM, as well as the GLMM and GAM models used in the 2020 ESC, and area weightings. The data were updated up to 2020. The index values for 2020 assuming W0.8 and W0.5 for the base GLM model, are higher than the average over the past 10 years. Additionally, the author of paper 27 presented key findings from the intersessional CPUE work alongside those of paper 27. The suite of new models explored in this work are based on those explored in both the previous CPUE modelling work and summarised in (CPUE WG report) and outlined in more detail in paper CCSBT-ESC/2108/35. Due to computational challenges, not all of the GAM models could be fitted in a timely fashion using the less aggregated (1x1 and shot-by-shot) datasets.

36. It was put to the ESC that the key question to answer in the CPUE work was the reason for the divergence between the previous GLM-based core CPUE driven

models, and the most recent suite of GAM-based models. The work on CPUE in papers CCSBT-ESC/2108/27 and CCSBT-ESC/2108/35 have confirmed the answer originally outlined in the previous ESC report (Report of ESC 25, 2020): effort shifts in Area 8 in 2018 combined with the particulars of the factor-based GLM model and the CS algorithm produced very high **predicted** CPUE in strata where no fishing effort had occurred. With the use of the spatial smoothing capability of the suite of candidate GAM models this effect has essentially been removed.

37. Some of the candidate models (negative binomial, Tweedie) require modelling catch not CPUE, with effort included as a covariate, so there is some potential inconsistency across model structures that are necessitated by the different underlying distributional assumptions in the models explored. The observation error properties of catch (with effort as a covariate used to predict catch) are likely to differ to those of CPUE.

38. An overall summary of the current trajectory of the CPUE modelling was described as both progressing and narrowing the field of candidate models and data aggregation scenarios, balancing statistical model exploration and selection with pragmatism. In addition, while no final model has been selected, a process for model selection has been identified. The use of models with operational data should be preferred in principle, but there are still a number of issues to be resolved with the analyses using the operational data.

39. The main questions still remaining were: (i) is the CPUE modelling group in a position to provide a recommendation for an appropriate and possible-to-implement GAM to run on the relevant Japanese dataset(s)?; (ii) if not, is there agreement on the way to reach that point?; and (iii) can the CS *vs.* VS problem be resolved to enable progression towards the construction of the accepted indices/index that will be used in the OM/MP? There was also acknowledgement of the work done by both Korea and Taiwan in relation to the generation of additional CPUE indices for use in future relevant contexts.

40. Given the long run times and other problems Japan experienced with fitting the GAM models to the less aggregated datasets (1x1 and shot-by-shot data), the question was raised whether high-performance computing (HPC) hardware could be used to ameliorate this issue, given the Working Group’s strong interest in examining how models perform when run on disaggregated data. Workable initial suggestions included using Microsoft Open R or explicitly using the parallel processing option in the bam() package used to fit the GAMs. The latter needs explicit instructions to do this at run time using R’s parallel() package. The group was reminded that the model referred to as deltapos15s uses model shrinkage and, therefore, would be in principle the model to choose as it automatically selects the most parsimonious model.

41. The additional shrinkage option used in model 15s makes use of a modification to the cubic spline smoother’s penalty structure. The normal version has a specific smoothness penalty structure and an associated penalty weighting parameter, β. When this parameter approaches infinity the penalty will effectively enforce linear behaviour on the smooth term. The change for the shrinkage model is that this has now been modified to effectively force the smoother’s linear coefficient to zero as β approaches infinity. This, when using REML or cross-validation methods to optimise the parameter β, can result in

particular terms essentially disappearing entirely from the suite of linear predictors, as happens for some terms in model 15s. This could be considered an extension of the LASSO (**L**east **A**bsolute **S**hrinkage **S**election **O**perator) penalised regression model approach used in GLMs for example.

42. If it is possible to work with less aggregated datasets (1x1 or shot-by-shot), it will likely become increasingly important to develop an objective basis for defining the gamma parameter that controls the scaling of the effective sample size (ESS) in the fitting of the GAM. It was suggested that it might be possible to use model residuals to obtain a *post hoc* estimate of the gamma parameter - this also strengthens the model selection process given that the AIC criterion is being heavily used. There are apparent technological challenges at present to working on the less aggregated datasets, but it was suggested this could be done on a subset of either the 1x1 or shot-by-shot data – suitably abstracted in the sensitive data fields – for use on the full datasets. Another alternative would be a simulation study, but this has attendant issues relating to the reality of the on-water dynamics embedded in the data and the difficulty of conditioning any useful model on the available data so as to make it reflective of reality.

43. Given that a suite of models has similar diagnostics and gives similar predictions, the issue of pragmatism was raised as to whether the focus should be on choosing something sensible from this model suite rather than trying to find the perfect model? The group was informed that the entirety of the shot-by-shot data is confidential and cannot be suitably abstracted so as to be shared with key scientists in the group. The follow-on question to Japan was whether the 1x1 data would be categorised as confidential. The group was informed that the 1x1 data could be used in this context.

44. The main statistical issue is how the dependence across strata strengthens as data are disaggregated and how an estimate of this (in terms of an over-dispersion or gamma factor for the GAM) is obtained and readily applied in the models. Along with correct specification of the gamma factor, the question was put to the group as to what the best, or at least the most appropriate, method is for estimating the initial degrees of freedom (the *k* parameter) in the smoothing terms. To avoid overly technical discussions dominating the goal of obtaining an acceptable suite of candidate models from the GAM options – which have all been shown to solve the over-arching problem in the previous CPUE series of high predictions in cells with no data – the suggestion was to take discussions of the technical details still needing resolved offline.

45. With regards to the question of whether the CS vs. VS problem is addressed by the GAM methods, ESC25 concluded that the GAM11 model used for the 2020 stock assessment "would still result in an upward bias if the contraction in the area fished was in part a reflection of a contraction of area occupied by the stock". On this basis, an average of CS and VS indices was retained as in previous years but a reduced weight was given to the VS index, which was considered too extreme, given the increased contraction of the area fished in recent years. It was noted that the current GAM15s model included additional year interactions, which improve the ability to account for changes in the distribution of abundance over time. In addition, several scenarios explored the removal of strata with very low recent effort and, with renormalisation, did not appear to strongly diverge in terms of trends. Given the minimal effect seen when

removing strata, it was asked whether this implied that the VS version of the CPUE index was still needed. A counterpoint to this view was raised: what is the sensitivity of the results to leaving out (possibly) increasing numbers of strata (by year) on the periphery of the data, rather than removing all strata without data (as in standard VS), including ones located inside the time-varying empirical distribution? The corollary for CS vs VS is whether it is possible to fully account internally for a range of distribution changes (specifically range contractions) in the current suite of models.

46. To further test the effects of strata elimination on the index, a suggestion was made for "block removal" of sets of strata (in preference to using simulations), corresponding to more peripheral strata around the core fishing areas over time and assessing the sensitivity on the CPUE index. A clarification was whether a block removal approach requires clearly specified criteria for the removal of a given strata, if the core background hypothesis is of range contraction of the stock and the fishery adapting – at some level – to that contraction. A suggestion to perhaps use the relative prediction uncertainty in strata – likely to be higher in the more marginally fished strata – could be used as a basis for the blocking criteria. That is, removing from the annual CPUE calculation strata whose prediction error exceeds some selected threshold. An alternative was also proposed to produce some form of weighted stratum sum that can be used to create a form of "least biased" index.

47. A point was also made that, given the fleet cannot know the exact distribution of the stock and is driven by numerous other factors (often related to economics), fleet contraction cannot be simply conflated with range contraction – or indeed potential re-expansion – of the stock.

48. The ESC chair asked whether there was a need to have additional time within the CPUE subgroup to fully specify the type(s) of "block removal" that would be expected to elucidate how well (or otherwise) the GAMs are accommodating the CS and VS-type scenarios. A workplan for the required CPUE activities was developed and is provided at **Attachment 5**.

49. The CPUE chair suggested using focussed intersessional working meetings for key and interested parties to continue the progress made both before and at this meeting on the CPUE modelling. This was endorsed by the group as a useful and workable model for future intersessional work. It was agreed that one major achievement of the recent advances in CPUE modelling is that the main problem of high predicted CPUE in strata with no fishing effort outlined in the 2020 ESC report has been broadly solved with the current suite of models developed. The EC should be assured that the refinements to the CPUE modelling approach is in the best interest of the MP and OM developments for providing management advice.

50. The ESC highlighted the importance of ensuring the process for adopting the new CPUE index was transparent and well defined. As in the past, the index work done intersessionally by the CPUE working group will be available to all and consensus is expected on the selection (along with rationale). Timing wise, the planned intersessional work (presently four web meetings, two work sessions and two less technical working group meetings) will be sufficient to make the selection prior to the first of May. This will provide time for the OMMP work to incorporate the selected values for the assessment and MP.

51. The ESC expressed its appreciation to the CPUE consultant for his excellent work on the CCSBT's CPUE modelling.

Agenda Item 6. Review of results of the Scientific Research Program and other intersessional scientific activities

6.1. Results of scientific activities

52. Paper CCSBT-ESC/2108/06 provided an update on the SBT close-kin tissue sampling, processing and kin-finding. In 2020/21, muscle tissue samples were collected from 1,500 SBT landed by the Indonesian longline fishery in Bali and from 1,600 harvested SBT at tuna processors in Port Lincoln, Australia. Samples collected in Indonesia in the 2019/20 and 2020/21 seasons will be transported frozen to Hobart when COVID-19 restrictions allow. Muscle samples collected from juveniles in 2019/20 were subsampled and DNA extracted. A portion of the DNA was sent to DArT for genotype sequencing. DNA extracts from the 2018/19 muscle tissue samples selected for genotyping last year were processed by DArT and the sequencing data sent to CSIRO in 2021. The kin-finding analyses to identify parent-offspring pairs (POPs) and half-sibling pairs (HSPs) were updated to include these data, and the identified POPs and HSPs were provided to the CCSBT in April 2021. The total number of POPs to date is 95, and the total number of HSPs for which we have high confidence is 174, with a false negative rate estimated at 0.25. In order to keep the risk of false positives very low (e.g., to minimise the number of less-related pairs, in particular half-thiatic pairs (HTPs), incorrectly identified as HSPs), we limited our HSP comparisons to pairs of juveniles born less than 9 years apart. This greatly reduces the number of comparisons between fish that are potentially HTPs (since HTPs are likely to be further apart in age), while not excluding too many potential HSPs. While this was an adequate solution for this year, in future, we will make use of a new genome assembly for SBT to improve the separation and "reclaim" some of the HSPs currently being excluded.

53. Paper CCSBT-ESC/2108/07 provided a preliminary review of the SBT size data collected in Indonesia and the effect of the dataset choice on estimates of the age distribution of the spawning population. To monitor changes in the SBT spawning population, it is important to obtain length data from a random sample of the Indonesian longline catch in CCSBT Statistical Area 1 only. Until recently, the primary source of size data for SBT caught by Indonesia was from the catch monitoring program in Benoa. Recent investigations, however, suggest that a proportion of the fish monitored are likely to have been caught south of the SBT spawning ground. To improve the SBT length frequency data analysed, the DGCF provided SBT length and weight data from the CDS for SBT caught in Area 1 for the last five spawning seasons. The size data from the two sources analysed (catch monitoring and CDS) provide different age composition results for the five years compared. There could be several explanations for these differences and further work in needed to examine the uncertainties identified and to refine and improve the quality control of the data. The authors recommend this work be considered as an immediate priority under the Scientific Research Plan.

54. Paper CCSBT-ESC/2108/08 provided an update on gene-tagging. The CCSBT gene-tagging program provides an estimate of the absolute abundance of the age-2 cohort, for use in the Cape Town Procedure (CTP) and stock assessment models. The 2019 abundance of age 2 fish is calculated from the number of fish tagged and released in 2019, the number of 3-year-old fish sampled during harvest in 2020, and the numbers of matches (analogous to a tag recapture) detected from genotype analysis of DNA from the tissue samples. The analysis found 31 matches from over 47 million comparisons across the tagging and harvest data sets. The estimate of abundance of the age 2 cohort in 2019 is 1.52 million fish (CV 0.18). This abundance estimate is higher than the estimates of abundance of age 2 fish in 2017 and 2018, and well above the estimates from the years corresponding to very low recruitment in the stock assessment models (1999-2002). There will not be an estimate of abundance provided next year, because the 2020 tagging field work was cancelled due to COVID-19 restrictions, poor weather and difficulty finding fish. The 2021 tagging work has, in contrast, been very successful with over 7100 fish tagged and released. The completed data sets and 2019 abundance estimate have been provided to the CCSBT scientific data exchange. The 2016-2019 abundance estimates will be used in the CTP in 2022 for recommending the total global allowable catch for the period 2024-2026.

55. Paper CCSBT-ESC/2108/10 describes research on rapid epigenetic age estimation for southern bluefin tuna. DNA methylation is an epigenetic modification in DNA and is commonly used as a molecular method for age prediction for humans and other vertebrates. Age prediction by DNA has the potential to reduce cost and time, making it advantageous with large sample sizes. Importantly, in the cases of SBT and other highly migratory pelagic species, it would increase the potential for large-scale collection of direct age data by reducing the logistic challenge of sample collection at sea relative to otoliths. This has the potential to substantially improve the spatial and temporal coverage of catch-at-age data by fleet. To date, we have developed a DNA based method to predict the age of SBT. Our method was found to have a median absolute error rate of 1.7 years. This work suggests DNA methylation in SBT is predictive of age consistent with our previous work with other fish species. There is also the potential to improve the model through additional DNA sequencing to identify other biomarkers of age that may refine the accuracy and precision of the method for SBT.

56. In response to a question about the highly skewed distribution of ageing errors and the presence of some individual large errors, CSIRO clarified that the overall error rate was quite low (1.7 years), and that additional planned work will improve the performance of the model. Additional work will include obtaining a larger sample size, particularly for older age classes, and additional DNA sequencing to identify other candidate biomarkers in the SBT genome to improve the model.

57. In response to a question about errors in both otolith and epigenetic age estimates, CSIRO clarified that the current analysis only considers ageing error in the epigenetic age estimates, but future analyses will consider error in both otolith and epigenetic age estimates.

58. Paper CCSBT-ESC/2108/11 provided an update on the SBT otolith collection and ageing activities in Australia in the 2018 to 2020 fishing seasons. Otoliths from 580 SBT caught in the Great Australian Bight (GAB) by the purse seine fishery were received and archived into the CSIRO hard-parts collection. Age was estimated for 298 of these fish and the age data were provided to CCSBT during the 2021 data exchange, together with age data from 35 otoliths collected during CCSBT gene tagging operations in 2018. A comparison was made of age estimates (zone counts) from otoliths and vertebrae collected from the same fish. A difference in age was detected, which was essentially the result of counting different zones in the hard parts. The difference in zone counts among structures highlights the need for further work to understand the formation time of the zones counted in each structure throughout the year and from across their core geographical range. This year we developed a preliminary algorithm to estimate decimal (biological) age from otoliths using the zone counts and otolith measurements, which is more precise than whole years (zone counts). Further work is needed to refine the algorithm. Quality control of age data is extremely important to ensure high quality age estimates are generated for assessment and management needs. An SBT age determination workshop was proposed in 2014 to standardise approaches for converting increment counts to age estimates amongst Member laboratories. Paper CCSBT-ESC/1509/15 reiterated the requirements for an ageing workshop, including the need for a pre-workshop inter-laboratory otolith exercises to estimate precision and bias.

59. Paper CCSBT-ESC/2108/20 provided updated information and analysis for gonad samples of SBT collected by Taiwanese scientific observer program. There were 872 gonad samples of southern bluefin tuna collected during the period of April to September from 2010 to 2020. All the gonad samples were collected by the Taiwanese scientific observer program. According to the biological information of the females and males, the range of fork length were concentrated between 90 and 150 cm. For the monthly GSIs, the females' GSI showed higher values from April to July than other months, and the trend revealed a decline after July. The monthly males' GSIs stayed high from March to May and then decreased gradually. It reached the lowest value in September. Based on the results of the histological sections, a total of 665 gonad samples in the collection period of 2010-2019 were analysed for the sexual maturity stages determination. The majority of these samples were determined as an immature stage, and about 12.2% samples were designated as mature. However, the mature samples were at reproductively inactive status. Most mature females were in regressed or regenerating stages during April to August, and most mature males were in regenerating stages during June to August.

60. Paper CCSBT-ESC/2108/21 provided an updated report of direct ageing of the SBT caught by Taiwanese longliners in the most recent 5 years. In this report, the age-length key method was used to estimate the age compositions of the SBT caught by Taiwanese longliners in 2015-2019. The estimated age compositions in 2015-2016 that were converted from the same age-length key showed highly consistent patterns, however, the fork-length distribution of total catch varied between years 2015 and 2016. A year specific age-length key was developed in 2017 and 2018, which showed year specific pattern of the age composition. So far, the otolith samples are still insufficient to develop an effective age-length key

every year. However, the successive 5 years data suggested that the SBT caught by Taiwanese longliners were mainly fish of age 3-5 years.

61. Paper CCSBT-ESC/2108/23 provided an update on Korean SBT otolith collection activities in 2020. To investigate the age and growth of southern bluefin tuna 185 otolith samples were collected in 2020, totalling 930 otoliths since 2015. The relationship between fork length and total weight was $TW=6.4E\text{-}05 \times FL^{2.757}$ ($R^2=0.907$). The von Bertalanffy growth parameters estimated from the non-linear method using length-at-age data were $L_\infty=175.8$ cm, $K = 0.179$/year, and $t_0 = -1.435$ years.

62. Japan submitted paper CCSBT-ESC/2108/29. It reported that the trolling survey that provides the data for recruitment index of age-1 SBT was carried out in February 2021. Due to the global epidemic of COVID-19, the survey was forced to make major changes from the plan, and the number of survey days, the survey area, and the number of survey items was reduced. It was reported that the survey was carried out in eight days off Esperance, and a total of 96 SBT individuals, 94% of them were presumably age-1, were caught.

63. Japan submitted paper CCSBT-ESC/2108/30. It provided an updated recruitment index of age-1 SBT (TRG) from the trolling survey conducted on the southwestern coast of Australia for more than 20 years from 1996 to 2021. The data used contained a total search distance of about 57,278 km and a total number of age-1 SBT schools of 957. The index is the number of age-1 SBT per trolling search distance on the grid by latitude and longitude 0.1 degrees, date, hour, and area. These were standardised by delta log-normal GLM because there were many zero catch data. In the 2021 survey, the survey area was limited due to a temporary change of the survey method due to COVID-19, so the author confirmed that the index was consistent with that calculated including off Esperance only. The paper stated that the trends of TRG were in good agreement until the 2016 year class with those estimated by OM, and the standardised CPUEs of Japanese longline for age-4 and age-5 SBT, however, TRG were lower than that of the OM after the 2017 year classes. The paper suggested that recruitments in recent years may be low and emphasised the need for careful monitoring of them.

6.2. Updated analysis of SBT catch by non-Members

64. No papers were provided for this agenda item. Discussion of this topic was deferred to agenda item 11.

6.3. Verification of all Members' catch by product distribution in markets

65. Japan recalled that it submitted a comprehensive proposal on markets to last year's EC meeting and the proposal was endorsed by the EC. The proposal item "A Verification of all Member's catch in Japan" plans to hire an external expert to develop a detailed methodology for verification of all Members' catch in markets (focusing mainly on the Japanese market). After the proposal was endorsed by the EC in 2020, the terms of reference (ToR) describing the expert's tasks, schedule and budget were intersessionally drafted under Japan's lead. This draft ToR was formally adopted by the EC under the intersessional decision-

making procedure. Japan further reported that the nomination process of experts is underway and expressed its appreciation for contributions by other Members and the Secretariat.

66. Members recognised the work done by Japan to date and the ESC noted Japan's update and that this matter will be further considered by the EC.

6.4. Update on progress made to address the recommendations from the independent review of the Japanese market analysis presented and discussed at the ESC in Cape Town in 2019

67. Japan recalled that it submitted the market proposal to the ESC25 for its review and comments, prior to discussion in the EC. In ESC25, as described in paragraph 56-57 of the report, it was generally agreed that the proposal captured the intent underlying the previous discussions including recommendations from the ESC in 2019. Japan reported that it is drafting a working document to further discuss other proposal items than the expert hiring described in agenda 6.3, for submission to the Technical Compliance Working Group (TCWG) and the Compliance Committee (CC) meetings in October.

68. The ESC noted Japan's update and that this matter will be further considered by the TCWG, CC and EC.

6.5. Update on progress made to address the recommendations from the independent review of the Australian farm analysis presented and discussed at the ESC in Cape Town in 2019

69. Australia noted it had made significant progress with stereo-video trials. Research has been undertaken to identify potential suppliers of the technology and Australia is currently testing the market to find suitable providers to test the technology in Australian conditions. However, as much of Australia is currently in lockdown due to the COVID-19 pandemic, any testing of the system will be subject to Australian regulations around the pandemic. Further information on the trial will be provided at the EC meeting.

Agenda Item 7. Evaluation of Fisheries Indicators

70. The ESC considered the updated indicators (**Attachment 6** – summary table of recent trends in all indicators of the SBT stock), and the results were summarised as follows:

- Compared to the previous year, the indicators are mixed (some increased, some decreased, and others were neutral); however, there were no unusual signals nor suggestions of any reasons for concern. Overall, the longer term trends in the indicators are consistent with the most recent assessment that indicated a resource that is expected to continue increasing.
- Two age-1 abundance indices are derived from the trolling survey. The TRG recruitment index shows a somewhat decreasing trend from 2011 to 2021, and the TRP recruitment index recorded zero values in 2018 and 2019, suggesting some concern about potential low recruitment in recent years.

- The gene-tagging age 2 abundance estimate for 2019 increased compared to the estimates for 2017 and 2018.
- The Japanese longline nominal CPUE decreased in 2020 but was still above the 10-year mean. In contrast, the Japanese standardised CPUE series (for all vessels and for core vessels) increased.
- The standardised CPUE from the New Zealand domestic longline fishery increased.
- The Korean standardised CPUE in Areas 8 and 9 showed an increasing trend since the mid-2000s.
- For the standardised Taiwanese CPUE, the trends remained similar as in past but increased slightly in both areas (central-eastern and western) with updated data in 2020.

71. Australia summarised its paper CCSBT-ESC/2108/12 (Rev.1). The 2020–21 update of fishery indicators for the SBT stock includes indicators in two groups: (1) indicators unaffected by the unreported catch identified by the 2006 Japanese Market Review and Australian Farm Review; and (2) indicators that may be affected by the unreported catch. Given the time since these reviews, the recent trends for some of these indicators are unlikely to be affected by unreported catches. In this paper, interpretation of indicators is restricted to the subset considered to be unaffected by the unreported catch. Overall, there were mixed results in the indicators. Only one indicator of juvenile (age 1–4) SBT abundance was updated as the piston-line trolling survey did not take place in 2021. The gene-tagging abundance estimate increased. Indicators of age 4+ SBT exhibited mixed trends. The age and size data from the Indonesian spawning ground were not updated this year. The standardised CPUE from the New Zealand domestic longline fishery increased while the Japanese longline nominal CPUE decreased in 2020, but was still above the 10-year mean. In contrast, the Japanese standardised, normalised CPUE series for all vessels and core vessels increased.

72. There was a question on the trend in the close-kin mark recapture (CKMR) index which did not appear to support the large increase in the Japanese longline CPUE index. Australia noted that: (i) the CKMR data are not directly comparable to the Japanese CPUE index, and (ii) the index presented in Figure 3 of paper CCSBT-ESC/2108/12 (Rev.1) should not be interpreted as an abundance index due to the complexity of the data (e.g., overlapping years and age-classes and resultant lags in information), rather the data need to be incorporated into a population model to enable a more comprehensive understanding. A potentially better indicator of stock status is whether the detection rate (or "hit rate") of POPs is increasing or decreasing, which would be consistent with the spawning population going down or up, respectively. The detection rate data for the most recent year (2016) suggests an increase in spawning abundance, in contrast to the potentially misleading index in Figure 3 of paper CCSBT-ESC/2108/12 (Rev.1), which shows a decline.

73. The ESC recommended that the CKMR index in paper CCSBT-ESC/2108/12 (Rev.1) be more clearly explained and agreed that inclusion of detection rate information would a more useful indicator of stock status than the index shown in Figure 3 of that paper.

74. Taiwan summarised its paper CCSBT-ESC/2108/22. The CPUE standardisation analyses were processed with the data of Taiwanese longline fleets operated in the waters of the south of 20°S of the Indian Ocean from 2002 to 2020. Cluster analysis was conducted to explore the targeting of fishing operations and also to produce the data filter for selecting the data for the CPUE standardisations. Instead of set-by-set data, the cluster analyses was conducted with the weekly-aggregated data to identify various targeting of fishing operations. For CPUE standardisations, a simple delta-lognormal model without interactions was adopted to avoid the confounding from interactions. The cluster analyses was applied for central-eastern area (Area E) and western area (Area W) separately. The pattern of the CPUE trends remained similar as the past but slightly increased in both areas with updated data in 2020.

75. Korea summarised its paper CCSBT-ESC/2108/24. CPUE standardisation for SBT was conducted using Generalised Linear Models (GLMs) with set by set (operational) data of Korean tuna longline fisheries (1996-2020). The data used for the GLMs were catch (number), effort (number of hooks), number of hooks between floats (HBF), fishing location (5° cell), and vessel identifier by year, quarter, and area. Two alternative approaches were applied, data selection and cluster analysis, to address concerns about target change through time which can affect CPUE indices. Explanatory variables for the GLM analyses were year, month, vessel identifier, location (5° cell), number of hooks, and targeting (HBF and cluster). The standardised CPUEs for Areas 8 and 9 decreased until the mid-2000s and have shown an increasing trend since that time.

76. Japan summarised its paper CCSBT-ESC/2108/31. In this paper, fisheries indicators along with fisheries-independent indices were examined to provide information for overviewing the current stock status of southern bluefin tuna. The Japanese longline CPUE indicators for the 4, 5, 6 & 7, and 8-11 age groups are well above the historically lowest levels observed in the late 1980s or the mid-2000s. CPUE indices for these age groups have more or less fluctuated in an aperiodic way and showed no clear increasing or decreasing trend over the past 10 years. Gradual declines of the indices for age class 12+ observed from 2011 appear to cease in recent years while the current levels for this older age group are still low. Other age-aggregated (age 4+ group) CPUE indices that have been used in the OM and/or MP show increasing trends over past 10 years. The current levels of these indices are well above the historically lowest observed in the mid-2000s. Various recruitment indicators inspected suggest that recruitment levels in recent years have been similar to or higher than those observed in the 1990s (before markedly low recruitments of 1999 to 2002 cohorts occurred) but the levels of recruitment have varied from year to year. It should be noted that among the two indices derived from the trolling survey for age-1 fish, the TRG recruitment index shows somewhat a decreasing trend from 2011 to 2021 and the TRP recruitment index recorded zero values in 2018 and 2019, suggesting some concern of potential low recruitment in recent years. A high recruitment level of the 2013 and 2014 cohorts estimated from the OM in the 2020 stock assessment (directly pertained to the highest value of the 2016 AS index) is not supported by longline CPUE indices by age (ages 4 to 7) from 2017 to 2020, and is not supported by the TRG value in 2014.

77. Japan noted that paper CCSBT-ESC/2108/30 compared the trolling indices with other indices of recruitment in paper 30 and suggests that recruitment for the 2016-2020 year classes may be lower than in previous years.

Agenda Item 8. SBT stock status

78. The current status of the SBT stock (Table 1) is based on the results of the stock assessment completed in 2020 (Report of ESC 25, paras 105-109, 158-159). The table includes updated information on current catch from CCSBT-ESC/2108/04, and the catch management measures from the adopted Management Procedure (Report of CCSBT 27, paras 70, 73).

79. ESC25 noted from the 2020 stock assessment that:

- The stock, as indicated by relative Total Reproductive Output (TRO), is estimated to be 20% (16-24%; 80% P.I.);
- The stock remains below the level estimated to produce maximum sustainable yield (MSY);
- There has been improvement since previous stock assessments conducted in 2017 which indicated that relative TRO was at 13% (11-17% 80% PI);
- The fishing mortality rate is below the level associated with MSY; and
- The stock has been rebuilding by approximately 5% per year since the low point in 2009 (Figure 1).

80. The 2020 assessment also indicated that the stock has increased from a low of 10% of initial TRO in 2009.

81. In addition to the 2020 stock status advice, the ESC reviewed the updated indicators (**Attachment 6** and paragraph 70 of this report). Overall, the longer term trends in the indicators are consistent with the most recent assessment that indicated a resource that is expected to continue increasing.

82. Reported catch in 2020 was below the catch limit recommended by the management procedure.

Table 1: Assessment of stock status from the 2020 and current catch and management measures.

Southern Bluefin Tuna Summary of 2020 Assessment of Stock Status[1]	
Reported 2020 catch	16,441 t
Current (2020) Total Reproductive Output (TRO)*	1,546,180 (1,397,040-1,759,312)
Current (2020) biomass (B10+)	204,596t (184,272-231,681)
Current status relative to initial	
TRO	0.20 (0.16-0.24)
B10+	0.17 (0.14-0.21)
TRO (2020) relative to TRO_{MSY}	0.69 (0.49-1.03)
Maximum sustainable yield	33,207 (31,471-34,564) tonnes
Current management measures	Effective catch limit for Members and cooperating non-Members: 17,647 t /yr for the years 2018-2020 and 2021-2023.

*TRO is the total relative reproductive output summed over all age classes weighted by their relative individual contribution to reproduction

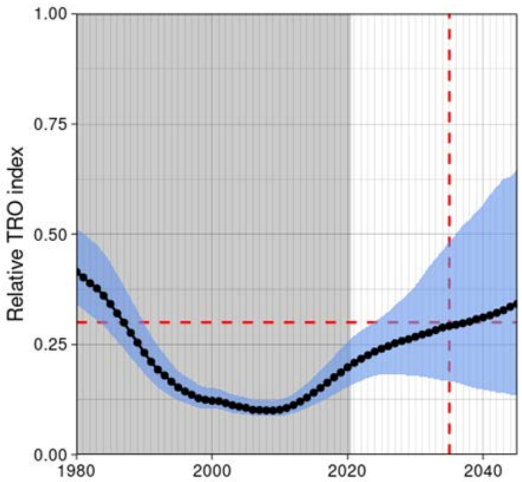

Figure 1: Recent and projected trends in the relative TRO index (median and 5^{th}-95^{th} percentiles) where a value of 1 corresponds to the unfished level (TRO_0). Red lines correspond to the rebuilding target of 0.30 TRO_0 (horizontal) and the tuning year (2035) for the CTP (vertical).

83. The ESC updated the annual report on biology, stock status and management of SBT that it prepares for provision to FAO and the other tuna RFMOs. The updated report is at **Attachment 7**.

[1] Values in parentheses are 10_{th} and 90_{th} percentiles.

Agenda Item 9. SBT Management Advice

9.1. Evaluation of meta-rules and Exceptional Circumstances

84. Paper CCSBT-ESC/2108/13 presented a summary of the role of the meta-rules in MP implementation and a review of Exceptional Circumstances for 2021.

- The meta-rules adopted with the CCSBT MP provide processes to determine whether Exceptional Circumstances exist and for action to be taken to address issues when they are identified. The aim is to identify Exceptional Circumstances where stock or fishery indicators, the MP input data, population dynamics or fishing operations are evidently substantially different from the conditions under which the MP was tested, or if catches are meaningfully greater than the recommended TAC. If there is evidence for Exceptional Circumstances, then the process is to determine the severity of these and to follow the guidelines for action.
- In 2021, the only Exceptional Circumstance identified was the very high Japanese longline CPUE estimate for 2018, which is used in the MP. This issue was first identified in 2019, with the severity of the impact on the TAC recommendation considered to be low, and a process for action is currently underway through agreement in the ESC to develop a new standardised CPUE series. An alternative interim CPUE series was used in the 2020 stock assessment. There are some small differences in the rate of projected rebuilding, but differences in the population dynamics are not substantial. The OMs have not been updated in 2021, hence there is no new information with which to evaluate the population dynamics.
- The gene-tagging data and close-kin data used in the MP are unchanged. The close-kin dataset has been updated and there is a new gene-tagging abundance estimate for 2019 that will be used in future TAC recommendations. Both these updates are within the expected range of values from the 2019 OMs used in MP testing. Review of other indicators of the stock and fishery has not identified any unusual conditions, and no substantial changes in fishing operations were evident. Total reported catches are below the TAC and there is no update on estimates for potential non-Member catches, which are taken into account within the OMs used to test and tune the CTP.
- In summary, the paper concluded there is no evidence for Exceptional Circumstances other than the issue identified in 2019 with the CPUE series used in the MP, and an agreed process for action is underway to develop a new CPUE series for use in 2022. The paper concluded that no further action is required under the meta-rules and no changes to the 2022 TAC are recommended.

85. Japan presented paper CCSBT-ESC/2108/32. In this paper, the authors examined input index data (longline CPUE, gene-tagging estimate, close-kin mark recapture data) for the CTP by comparing to the 2019 OM predictions. These examinations indicated that all the observations are consistent with the predicted ranges from the 2019 OMs. Regarding the input index/data for the CTP, therefore, there is no evidence to support a declaration of Exceptional Circumstances. Accordingly, regarding a decision on implementation of the recommended TAC (17,647 t , calculated by the CTP in 2020 to be applied to the 2021, 2022, and 2023 fishing seasons) for the 2022 season, the paper concluded

that no modification of the value of this TAC is required because: 1) there is no conclusive evidence to support a declaration of Exceptional Circumstances from the viewpoints of a check against the OM predictions and other potential factors (the extent by which the total reported global catch exceeds the TAC, unaccounted mortality and results of the stock assessment conducted in 2020); and 2) no unexpected change has been detected in the fisheries indicators examined.

86. The ESC recalled that the high 2018 data point in the Base CPUE series used in the CTP had been identified as an Exceptional Circumstance in 2019, and a process for action was agreed at that time (Report of ESC 24). The initial assessment was that the impact on the MP TAC calculation was low and action has been in progress to develop new standardised series for use in applying the CTP in 2022 to recommend the TAC for the 2024-2026 TAC block (CPUE WG report and Item 5 this meeting).

87. Figure 2 (from Figure 2 of CCSBT-ESC/2108/13) compares the estimates of 2-year-old abundance from the gene-tagging program (2016-2019), the corresponding estimates for recent cohorts in the OM and the mean predictions taken from the stock-recruitment estimates in the Reference Set of OMs as reconditioned in 2020. Note the estimate of 2-year-old abundance in 2019 was not available for inclusion in the 2020 OM conditioning. The figure demonstrates that the four gene-tagging estimates are within the range of abundance from the OM.

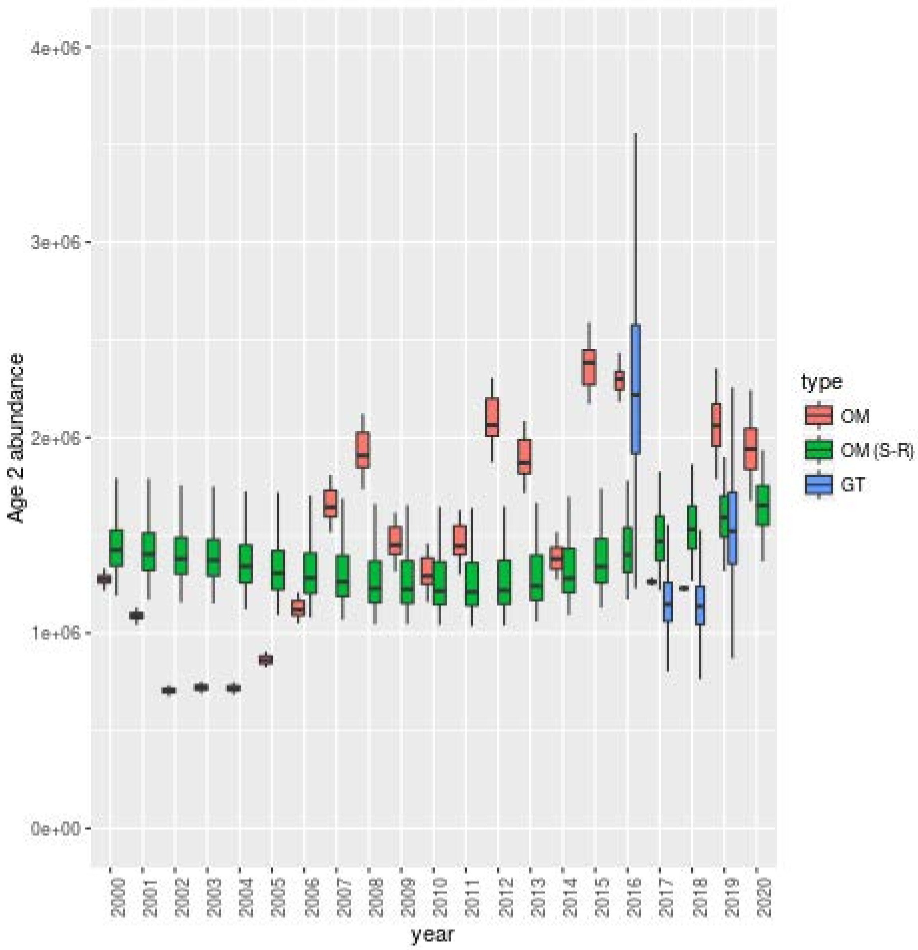

Figure 2: Comparison of 2016-2019 gene-tagging age-2 abundance estimates (blue) with recent age-2 estimates from the 2020 reconditioning of the OM (red) and those predicted from the stock-recruitment function (OM-(S-R)) (green). The 2019 gene-tagging abundance estimate was not included in the OM reconditioning.

88. Figure 3 (from Figure 2 of CCSBT-ESC/2108/32) presents the four gene-tagging estimates and the projected 2-year-old abundance using the 2019 OMs used in MP testing. The ESC noted that the 2016 and 2017 data points were included in the conditioning of the OMs used to tune the MP in 2019 and, therefore, could not be considered in projections for Exceptional Circumstances; only the 2018 and 2019 GT estimates of 2-year-old abundance are relevant to compare with the expected range from the 2019 MP projections for the purposes of evaluating whether Exceptional Circumstances apply.

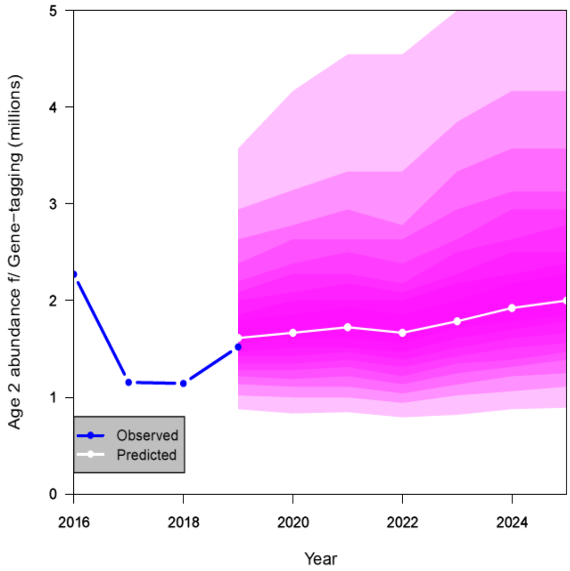

Figure 3: The age-2 SBT abundance estimate for 2019 from this year's (2021) gene-tagging (GT) analysis, and the future estimates of abundance as projected in 2019 from 2019 to 2025 for the Reference set of OMs, where the white lines with points are the medians, and the purple shading represents percentiles from 2.5% to 97.5% in increments of 5%.

89. The ESC concluded that the four estimates of abundance from gene-tagging, including the new 2019 GT data point, were consistent with the range expected from the testing of the CTP.

90. The ESC noted the value of the meta-rule process and the annual review of Exceptional Circumstances in the orderly implementation of the MP. The case of the unusually high 2018 estimate in the CPUE series used in the MP, originally identified in 2019, is a good example. This prompted further investigation, which subsequently identified that this estimate was generated due to a prediction bias in the GLM standardisation method being used, which generated anomalously high estimates for cells with no effort (Report of OMMP 11, paras 11-24 and Report of ESC 25, paras 94-100). The ESC agreed that, even though the 2018 estimate was within the bounds of the range for which the MP had been tested and the immediate implications for the current TAC recommendation were small, this technical bias needed to be addressed through the development of a CPUE standardisation method that more effectively dealt with the spatial-temporal variation in the CPUE data. The meta-rules process provides a structured basis for consideration of Exceptional Circumstance which allows for assessment of the severity of the issue for the TAC recommended by the CTP, and a process for the action required to be agreed and to be implemented in a systematic way.

9.2. Summary of SBT management advice

91. The TAC for 2020 was agreed by the EC in 2016, using the Bali Procedure to set global catches for the 2018-2020 TAC block. Reported catches in 2020 have not exceeded the TAC of 17,647 t.

92. At its 26th annual meeting in 2019, the EC agreed to adopt a new MP, named the CTP, which would be used to recommend the SBT global total allowable catch

(TAC) for 2021 and beyond. The CTP was developed by the ESC following advice from SFMWG5. The adopted CTP was tuned to provide a probability of 0.50 of achieving 30% of the initial TRO by 2035, with a requirement to also exceed a probability of 0.70 of achieving the earlier (2010) interim rebuilding target of 20% of the initial TRO by 2035. The CTP specification includes a minimum and maximum TAC change of 100t and 3000t, respectively. The TAC is to be set for three-year periods.

93. Application of the CTP in 2020 resulted in a recommended annual TAC of 17,647 t for the period 2021-2023, which was adopted by the EC.

94. The 2021 review of Exceptional Circumstances (agenda item 9.1) did not identify any new issues that affect implementation of the MP. The existing Exceptional Circumstance associated with the issue with the CPUE standardisation, identified in 2019, is being addressed through development of a new CPUE series, which will be available for the next TAC recommendation in 2022. There is no new information on unaccounted mortality. An update on the estimates of potential non-Member catches is planned for 2022. The CTP has been designed to be robust to a level of non-reported catch that is higher than the current estimates (Report of ESC 24, para 92).

95. Given the review of Exceptional Circumstances, which did not identify any new issues, and planned actions under the meta-rules process to develop a new CPUE series to be used in the CTP, the ESC recommends that the global TAC in 2022 should remain at 17,647 t.

Agenda Item 10. Operating Model and Management Procedure

10.1. Consideration of missing data in the meta-rules

96. Australia presented CCSBT–ESC/2108/14 which outlines the implications of a range of missing data scenarios for each of the four data inputs to the CTP. For the abundance series - longline CPUE and gene tagging – it was recommended that there should be a minimum of at least two data points in any relevant moving average. For the CPUE index, which uses a 4-year moving average, that suggests that missing any more than 2 data points in a given 4-year time window would make it difficult to run the MP. For the gene tagging data, which uses a 5-year weighted moving average, missing data were automatically accommodated in the weighting scheme (by design) and any more than 3 missing data points in a 5-year time window would make it difficult to run the CTP. For both POPs and HSPs, missing data can easily be handled by the CKMR model embedded within the CTP but, as the severity of the missing data increases, the model gradually ceases to update the more recent population dynamics and reverts to the prior values together with the influence of the historical abundance and mortality information. In all cases of missing data, the meta- rules processes will be used to assess any additional information, or indicators, and the relative severity of events on the likely performance of the MP.

97. It was noted that in other organisations it has been considered desirable to specify an explicit threshold for missing data for an MP that would constitute Exceptional Circumstances and require pre-specified action in relation to the MP recommended TAC. The ESC noted that while this may be appropriate for other

organisations, particularly if the MP was based on one primary input data type only, this is not the case for the CTP, which uses four separate data input types (gene-tagging, CPUE and two sources of CKMR data), which is therefore likely to be more robust to missing data in any particular series. Furthermore, this larger information set better facilitates estimation of the potential impact of missing data.

98. The ESC agreed that:

- The suggestions provided in CCSBT–ESC/2108/14 on the minimal data requirements of each of the input series for the effective operation of the CTP was useful from the perspective of understanding the requirements for the operation of each component (CPUE, gene-tagging and CKMR) of the CTP; and
- The annual review and process for action for Exceptional Circumstances adopted with the CTP (Attachment 8, Report of ESC 25) provides a systematic mechanism for identifying and responding to missing data for the CTP.

10.2. Maintenance and development of OMMP Code

99. The work plan for maintaining the OMMP code included 1) updates to projections code and 2) revising the files structures in the GitHub repository for maintaining version control of the OM code and for facilitating use of the OM outputs in the ‘shiny app’ reporting and graphics system.

100. The Chair of the OMMP working group noted that the projections work would be completed before the OMMP meeting in 2022 as part of updating the OMs to include the new CPUE series.

101. The OMMP consultant noted that some aspects of the GitHub repository had been updated, but there was more work to be done to complete the task.

102. A question was asked on the current state of documentation of algebraic specification of the OMs. The ESC noted that the OM documentation, which is also on the GitHub repository, was regularly updated when new data sources are integrated into the OMs, for example for the inclusion of the CKMR and gene-tagging, or if changes occur. It was noted that there was a need to update the documentation to remove components that are no longer used. The notes on how to run the OM code may also need to be updated to be consistent with recent changes. It was suggested that the OM documentation could be made more readily available via the CCSBT website or provided as an appendix to ESC reports.

103. The future maintenance and development work was discussed as part of development of the SRP (agenda item 11) and the ESC work plan.

Agenda Item 11. Update of the Scientific Research Program (SRP)

104. Australia presented paper CCSBT-ESC/2108/BGD01 which was considered at the 2020 ESC and is provided as background for development of a new SRP. The CCSBT Scientific Research Program has been central to improving the data and methods available for stock assessment and the provision of robust management

advice for rebuilding the SBT stock. The review of the 2014-2018 SRP identifies outstanding activities that should be considered by the ESC for inclusion in the next phase of the SRP. It summarises progress against the 2014-2018 activities that were listed in the plan developed in 2013. The review highlights the substantial progress that has been made in the areas of i) characterisation of the catch, ii) indices of abundance, iii) estimation of biological parameters, iv) MP implementation, and v) stock assessment and OM development. Initial considerations for future activities outlined in the paper included i) quantifying different sources UAM, in particular methods for determining the plausibility of non-Member UAM, ii) a shift to using catch-at-age rather than cohort slicing, iii) completing work on size/age at maturity, iv) a design study for an e-tagging project to examine the potential effects of environmental change and spatial dynamics of the stock, and v) a strategic review and refinement of operation of the OM code.

105. Australia presented paper CCSBT-ESC/2108/15 on developing priorities for potential inclusion in a new SRP. The CCSBT Scientific Research Program has been central to improving the data and methods available for stock assessment and the provision of robust management advice for rebuilding the SBT stock. While the original review was due in 2019, the selection and adoption of a new MP and the scheduled stock assessment took priority, and COVID-19 impacts have made collaborative development of the SRP challenging. In addition, the issues identified with the Base CPUE, used for stock assessment and MP purposes, has resulted in a focus on improving methods for CPUE standardisation in the short term. However, there are a range of other issues to address specific aspects of SBT biology, monitoring systems and spatial dynamics to resolve key uncertainties in the current monitoring and stock assessment. This report summarised short and medium-term priorities for potential inclusion in the SRP, based on discussions at ESC25, and outlines a process for collaborative development of the SRP. If possible, we propose this be done with the addition of extra days to the OMMP and, if necessary, the ESC, to allow for a comprehensive review of past activities and development of proposals under the next phase of the SRP.

106. The ESC noted that the CCSBT Scientific Research Program (SRP) has been central to the collective achievements over the past decade in improving the data and methods available for stock assessment and the provision of robust management advice for rebuilding the SBT stock.

107. The ESC recalled that the 2014-2018 phase of the SRP has been completed and it is timely to prioritise future SRP activities which focus on key uncertainties that are likely to impact on the performance of the CTP and/or the assessments of stock status and that remain relevant and unaddressed from the previous SRP activities.

108. To facilitate the development of the SRP and distinguish between immediate (meaning the priority is high in the short term) and strategic research activities, the ESC identified the importance of separating the two tasks of:

- Outlining an intersessional process with a well-developed framework to help develop a new SRP, which can be discussed and agreed upon at ESC27; and

- Identification of immediate priority research activities to put in the ESC Work Plan for consideration by the Finance and Administration Committee (FAC) in 2022.

109. The ESC considered a wide range of issues when discussing an intersessional process for developing a new SRP, and agreed to the following process:

Process for developing a new SRP

110. The ESC noted that it is often difficult to appraise research projects given that information is often provided in different formats and often with limited detail. The ESC agreed that a standardised set of information was required to help appraise proposed research projects.

111. The template provided in **Attachment 8** was developed during the meeting, and the ESC agreed that this template would be used by Members to propose projects in a consistent manner.

112. The ESC agreed to group research projects into two general categories to reflect whether the proposed research project is aimed at addressing issues related to the OM, the CTP, or both. Within these two broad categories, sub-categories were identified based on categories in the 2014-2018 SRP.

113. The ESC noted that it is important not to restrict the duration of projects in this template to the lifetime of the SRP, as some projects may extend beyond the duration of a particular phase of the SRP. The ESC agreed that maintaining this template as a living document, updated through time, would enable the duration of projects to extend beyond the lifetime of the SRP.

114. The ESC agreed that it was important to include preliminary costing information when ranking the relative priority of projects in the template.

115. The ESC noted that while CCSBT is a valuable source of funding for research, direct contributions from Members have been an important part of previous phases of the SRP. Hence, it will be important to ensure that the process for development of the SRP continues to encourage direct and in-kind contributions from other sources.

116. The ESC noted the importance of developing a higher-level overarching strategic research plan that identifies and prioritises the key research objectives, which would help guide the development of specific project proposals for the SRP. The ESC suggested that an overarching strategic plan should be informed by iterative interactions between the ESC and EC.

117. The ESC noted that the OM was a useful tool to evaluate and provide evidence of the potential impact of proposed projects through MSE testing of scenarios that demonstrate the likely impact on understanding of stock status and/or management advice. Using this approach helps identify and frame research priorities to ensure that the ESC provides robust advice to the EC. However, the ESC also noted that it is important that research projects address issues with the fundamental data that underpins the development and operation of the OM and MP, such as catch monitoring data and biological information, some of which cannot be addressed thought the current OMs. For example, the questions of long-term change in the range of the SBT stock and potential impact on CPUE indices and/or assessment of important of UAM cannot be addressed directly via MSE without the development of a spatial operating model.

118. The ESC agreed that the process for developing the SRP over the next 12 months will include:

- Dr Sean Cox will convene a small drafting group, with representation from all Members, tasked with drafting a background document, based on **Attachment 8** and paper CCSBT-ESC/2108/15. The background paper will articulate the aim and research priorities for the next phase of the SRP and describe the process for developing proposals for research projects using the attached template. In considering the need to keep the meeting to a manageable size, while also acknowledging the need for capacity building, the meeting will be limited to one key participant (plus secondary participants) from each Member. The small drafting group will decide if a subsequent meeting is required to complete the background document.
- The background document will be circulated to all Members with a request for comments and specific research proposals to be submitted using the template provided. Examples will be provided in the template to guide Members with their proposals. Members will also be encouraged to include indicative costs with their proposals.
- Dr Sean Cox will then convene a second intersessional meeting, prior to ESC27, again with representation from all Members. This meeting will be relatively short (e.g., one day) with the aim of prioritising the projects, providing a relative ranking of the proposed projects, and collating these for presentation to ESC27.

119. The ESC agreed that it was important to consider the timing of stock assessments and the review of the MP when determining the period of the next phase of the SRP, but agreed that a decision should be deferred to ESC27, at which time the analysis for a new CPUE series will have been completed and the ESC will know more about the implications of the CPUE refinements on stock projections and performance of the CTP evaluated using a reconditioned OM.

Priority research activities for the 2022 ESC workplan

120. The ESC noted that it was important to distinguish between ongoing essential research required for operation of the stock assessment and MP and any new research projects that are proposed. The latter projects will be those that require prioritisation and ranking before adding to the SRP and ESC workplan.

121. The following provides a summary of the ESC discussion on a range of research activities and priorities identified in paper CCSBT-ESC/2108/15 for inclusion in the 2022 ESC workplan and to assist with the development of the next phase of the CCSBT SRP.

Development of GAM CPUE standardisation for CTP

122. The ESC agreed that work on development of the GAM CPUE standardisation for the CTP remains a high priority, and will have high impact, given the issues identified with the Base CPUE standardisation based on GLM and the need for a new series for the stock assessment and CTP. Identifying a new series to be used in the CTP for the next TAC recommendation (2022) and the next scheduled stock assessment (2023) is the immediate priority.

Electronic tagging design study

123. Australia presented paper CCSBT-ESC/2108/16 which was a proposal for a design study to evaluate electronic tagging programs to understand implications of potential changes in migration of SBT. Recent changes in the distribution of fishing effort in the surface and longline fisheries indicate that there may be spatial or temporal changes in the migration patterns of southern bluefin tuna (SBT). Future electronic tagging would increase our understanding of these potential changes and answer research questions related to (i) CPUE interpretation given contraction of high seas fleets, (ii) mixing of fish in the Indian Ocean and Tasman Sea feeding grounds, and (iii) migration and residency in the Great Australian Bight. In this paper, a design study is proposed to evaluate the feasibility and cost-benefit of a variety of alternative electronic tagging programs for assessing changes in SBT spatial dynamics, and the resulting implications for SBT monitoring and management (e.g., interpretation of monitoring indices) and the fishing industry. Relevant background is considered and the scope of a short (12-month) design study with a budget of $80-100K is outlined. The proposed design study has four stages: (1) Identify and refine the range of questions regarding SBT spatial dynamics; (2) Examine the ability of different electronic tagging designs to answer each question, including the feasibility of releasing tags in the required locations and in the required numbers to obtain data with sufficient statistical certainty; (3) Rank the alternatives based on the priority of questions, feasibility and associated costs; and (4) Provide recommendations for implementation and outline a workplan within the forthcoming SRP timeframe.

124. The ESC noted that the overall objective of the project is to provide the ESC and EC with specific designs and costings to address specific questions on the spatial dynamics of the SBT stock.

125. The ESC supported the proposed electronic tagging design study, and noted that the project will have high impact through designing projects that address the following key uncertainties:

- It remains unknown whether observed changes in the distribution of fishing effort, particularly in the longline fleets, reflect spatial and temporal changes in the migration, mixing and residency of SBT. A well-designed tagging study can provide a contemporary understanding of the spatial distribution of fish relative to the fishery and will directly inform interpretation of the CPUE as an index of abundance for the entire stock.
- A comparison of contemporary information on the spatial distribution of SBT with information derived from the large volume of historical tagging data provides the opportunity to evaluate the impacts from climate change, ENSO cycles and population rebuilding on the distribution of SBT.
- Contemporary information on the distribution of SBT is important for understanding UAM, as habitat maps can be used to assess the likelihood that non-Member effort occurs in areas where SBT are present. In the absence of contemporary information, there is no basis to inform the current understanding of UAM, which relates to an important assumption on non-Member UAM made when the CTP was tested.

126. The ESC noted the value of completing a design study prior to implementing large scale tagging programs to ensure it has confidence that the tagging program

will provide useful information that is directly relevant to the stock assessment and CTP, and that the program can be delivered cost effectively.

127. The ESC noted that there are opportunities for a collaboration among Members in the design study and also in developing proposals for specific tagging programs, based on the outcomes from the design study, to put forward to the ESC in 2022 for potential funding.

128. The ESC noted that the request for research mortality allowance (RMA) in this paper for the potential release of some available pop-up satellite tags was separate to the broader proposal for an electronic tagging design study, and that no funding is requested for the purchase or release of these pop-up satellite tags.

Independent estimate of size/age at maturity

129. The ESC recalled that the existing project to update the estimate of size and age at maturity has involved a multi-Member effort to collect samples across the species range during the non-spawning season. The project is still ongoing with the remaining work required being an analysis of the collected data to generate a final updated age and size at maturity ogive. The ESC noted that the project was budgeted for in the previous SRP, so does not require any further funding beyond was already allocated in 2020.

Epigenetic ageing

130. The ESC noted that successful development and calibration of epigenetic ageing for SBT would provide the technical basis for catch-at-age data across fleets for stock assessment purposes, instead of the current length-based cohort slicing method. It would also potentially reduce the costs associated with otolith ageing for CKMR and catch at age data from the spawning ground monitoring.

131. The ESC noted that funding for the development and calibration of epigenetic ageing for SBT is provided by CSIRO, and no funds are requested from CCSBT. Therefore, this project is not included in the table of projects for funding in 2022.

Review OM code

132. The ESC noted that the routine OM code maintenance and development is an ongoing essential activity that will be captured in the ESC workplan.

133. The ESC also noted the need to review, modernise, and rewrite some of the OM code to facilitate incorporation of within-cell uncertainty, among other things. Discussion for rewriting the code will occur intersessionally and during the 2022 OMMP meeting with a plan presented to the 2022 ESC.

134. The development of a spatial model is a longer-term project and is not currently captured in the workplan or SRP.

Non-Member unaccounted mortality (UAM)

135. The ESC recalled the importance of understanding the level of non-Member UAM as it is a key input to the next assessment of stock status and is part of the regular evaluation of Exceptional Circumstances for the implementation and review of the CTP.

136. The ESC also recalled that it had previously agreed that further work needs to be conducted to examine the sources of potential bias in the current methods used to estimate non-Member UAM for MP testing and stock assessment purposes.

137. It was noted that one potential improvement to the modelling approaches to estimate non-Member UAM might include obtaining effort data from Global Fishing Watch (GFW) in addition to the effort data usually obtained from the RFMOs. The ESC noted that these data are derived from Automatic Identification Systems (AIS) and it is not immediately clear how to interpret these data in the context of the current analysis of non-Member effort. It was agreed that inclusion of GFW data in the analysis of non-Member UAM could be proposed for a future separate project.

138. Another potential improvement suggested was to update the CPUE analysis used to estimate the non-Member effort to the new GAM CPUE model. However, it was noted that this will likely have a relatively minor effect on the relative levels of estimated non-Member UAM compared to the difference between estimates derived from the two catchability assumptions (i.e., target or bycatch catchability). That is, the GAM approach will likely change the estimates from each catchability assumption by a similar amount, but will not address the large difference between the two catchability assumptions.

139. The ESC agreed that any new estimates of non-Member UAM that were meaningfully different to the previous estimates would need to be evaluated through sensitivity analyses to test the robustness of the CTP to the new estimate of non-Member UAM.

140. The ESC noted that while the current methods provide the best information available to the ESC and the CTP is robust to the previous scenarios of non-Member UAM, the ESC does not have current information to demonstrate that the estimated catches are actually being taken. Therefore, the ESC reiterated that priority should be given to examining the potential sources of bias in the current methods and the potential value of recommencing market surveys to improve estimates of non-Member UAM.

141. The ESC noted that a 'best estimate' of non-Member UAM is required for the stock assessment, while the review of Exceptional Circumstances for the MP only requires an evaluation of whether the non-Member UAM is likely to be larger than that evaluated in the robustness tests.

142. The ESC further noted that an evaluation of changes in the level of non-Member effort since the last estimate would provide a good indication of the relative magnitude of changes in non-Member UAM, and that the level of non-Member UAM would need to be substantially larger than the previous estimate to trigger Exceptional Circumstances.

143. The ESC agreed that the priority work for UAM in 2022 should include an analysis of changes in non-Member effort to support the evaluation of Exceptional Circumstances in 2022. The ESC also agreed that the relative priority for this piece of work was slightly higher than for the proposed electronic tagging project and that the work could be completed in approximately 10 days.

144. The ESC agreed that a more detailed update to the estimates of non-Member UAM using the new GAM model would be scheduled for completion in early 2023 in time to support the stock assessment, and that this project would be evaluated more fully through the SRP process.

CPUE (Incorporation of Korean & Taiwanese longline CPUE)

145. The ESC agreed that incorporation of the Korean and Taiwanese longline CPUE into the dataset for the new CPUE would not be included in the workplan for 2022, but could be put forward as part of the intersessional activity to develop the SRP. It was also noted that these two CPUE indices have potentials for fisheries indicators for recruitment, and thus it is worth examining them in this regard.

Review and development of new standard operating procedures (SOP) for monitoring of spawning ground catches

146. Indonesia presented information paper CCSBT-ESC/2108/Info 03 which provides a progress summary of the Indonesian scientific observer program on the tuna fishing vessels operating in the Indian Ocean. The observer data is the most detailed information associated with catch, effort, fishing practices, gear configuration, and environmental conditions. Fleet coverages in this dataset were low. This should be expanded to get robust abundance indices from the fishery.

147. Indonesia also presented information paper CCSBT-ESC/2108/Info 04 which provides an update on the information about the SBT monitoring program in Benoa port, Bali Indonesia 2020, that was presented in the CCSBT-ESC 2021 (CCSBT-ESC/1909/Info 03). The sampling coverage has fluctuated monthly; however, a decreasing trend was observed annually from 44.63% in 2019 to 36.74% in 2020. The number of observed SBT also declined in 2020, with only 1,187 individuals compared to 2019 (1,662 individuals). The length measurement of SBT ranged between 91 and 203 cm FL indicating a smaller size range was caught compared to the previous year (which ranged from 108 to 200 cm FL).

148. The ESC noted the important issues identified in paper CCSBT-ESC/2108/Info 04 in relation to monitoring catches in Areas 1 and 2, which are a result of changes in the longline fleet operations and CDS monitoring in Indonesia. These issues have implications for the collection of length and age data which are used to produce raised estimates of catch-at-age and catch-at-length and for the collection of otolith and tissue samples for CKMR, which is central to the stock assessment.

149. The ESC supported the development of a project to address these issues by developing standard operating procedures (SOPs) for the monitoring of SBT catches from the spawning grounds. The project would focus on i) consolidating and reviewing the length and age data from the Indonesian monitoring program, and ii) providing an overall review and development of comprehensive SOPs for the data collection program.

150. The ESC noted that the proposed project would be collaborative between Australia and Indonesia and encouraged other Members who are interested in participating to engage through the intersessional process for developing the next phase of the SRP. No indicative cost for this project has been identified.

Agenda Item 12. Improving communication between the ESC and Extended Commission

151. Australia presented paper CCSBT-ESC/2108/17. Regular consultation and effective communication are key elements of the Management Strategy

Evaluation process and the implementation phase of an MP. Suggestions for potential improvements in future ESC-EC and stakeholder communication include adding a non-technical summary of the MP and meta-rules to a new page on the CCSBT website; development of factsheets, with similar information to the webpage, that could be used in a variety of forums; and use of the SFMWG for the first review of the MP scheduled for 2025.

152. Japan presented paper CCSBT-ESC/2108/33. In this paper, the authors attempt to explain the mechanics and specifications of the CTP graphically with an explanation to the EC in mind, and to provide a basis for further discussion on the communication issues between scientists and managers. Based on graphic understanding of how the CTP calculates TAC, the mechanics and specifications of the CTP are summarised in simple form, and then the authors attempt to identify a key point that can resolve the miscommunication that occurred between scientists and manages.

153. The ESC considered 3 main questions:

- What can the ESC do to assist all Members to communicate with their Commissioners?
- What can the ESC do to assist communication between the ESC and EC, and possibly more widely?
- What results should be presented to improve clarity of communication on the range of future TACs.

154. The ESC agreed broadly with the suggestions outlined in paper CCSBT-ESC/2108/17 for improved communication in the future and agreed to suggest a range of other ideas discussed in this meeting to the EC. These included development of factsheets on the MP and meta-rules, a CCSBT website page for non-technical information on the MP, and Commissioner and Scientist dialogue via forums like the SFMWG. In addition, the ESC discussed: (i) providing a regular non-technical summary of key agenda items at each ESC, (ii) holding in-country seminars supported by experts or members of the Advisory Panel or other scientists, (iii) having annual dialogue meetings with the EC, (iv) allowing time for discussion sessions between Member's scientists and the Advisory Panel during the ESC, and (v) producing an ESC Chair's summary for the EC. The usefulness of having multiple communication approaches to suit different audiences and stakeholders was highlighted. The format, resources and logistics of providing improved new and non-technical information and dialogue meetings were discussed. Some of the non-technical summary work is underway for other purposes outside the CCSBT and could be made specific to describe CCSBT activities.

155. The concerns regarding the expected and resultant TAC advice were discussed and new figures that may aid communication by promoting understanding of potential future TAC changes were developed. Paper CCSBT-ESC/2108/33 suggested that histograms of future TAC predictions from the CTP could assist with understanding the performance of the MP. The ESC acknowledged that this may be more informative than a figure with median and confidence intervals, especially when the distribution is not monomodal. It was pointed out that a table can take the same role. The ESC agreed to continue to improve communication of likely future TAC. The figures and table in the attachment will be further

discussed and developed for this purpose, following consultation with EC and Members (**Attachment 9**). These, or alternative figures and tables, could be provided when OMs are reconditioned and projections are updated. The workplan for OM reconditioning is shown in Table 2.

Table 2: Workplan and provision of stock status advice, MP TAC advice, and advice on the range and likely next TAC.

Year	Stock status advice	MP TAC advice	Advice on range and likely next TAC
2022		Run the MP. TAC 2024-2026. Reconditioning with new CPUE.	Could provide advice on range and likely TAC in 2027
2023	Reconditioning OM for stock status advice		Could provide advice on range and likely TAC in 2027
2024			
2025		Run MP for TAC 2027-2029	
2026	Reconditioning OM for stock status advice		Could provide advice on likely next TAC 2030
2027		MP review? – or wait until 2030?	
2028		Run MP for TAC 2030-2032	

156. The ESC appreciated the forensic-level of explanation of the process of TAC calculation that was presented in paper CCSBT-ESC/2108/33. The ESC noted the difference in how CKMR is used in the MP and OM. It was clarified that the simplified CKMR model used in the CTP was simulation tested early in the development of candidate MPs to examine its behaviour and performance relative to the full CKMR model used in the OM. This simulation testing demonstrated that the simpler model would adequately track trends in TRO, and that the estimates from the MP were expected to be precautionary (negatively biased) and not the same as those from the OM. This difference in TRO estimation between the MP version and the full model used in the OMs is accounted for in the tuning of the CTP to meet the rebuilding objective.

157. The ESC acknowledged that the unusual circumstances that occurred in 2020 may have made communication more difficult: the ESC and EC meetings were virtual, due to the pandemic, and two complex pieces of work that are usually kept separate were both considered at the ESC, i.e., the MP TAC advice using the CTP for the first time, and the full stock assessment.

158. In summary, in response to the questions on improving communication and considering the discussion described above, the ESC suggested the following communication plan and would seek feedback from the EC on these suggestions.

- General information for all delegations:
  - The ESC could develop factsheets on the MP and meta-rules, based on the plain language summary already included in the Meta-rules for the CTP (Attachment 8, Report of ESC 25);
  - The Secretariat could add pages to the CCSBT website to specifically include non-technical summaries of the MP (based on fact sheets);
  - The Advisory Panel could informally meet with each delegation during the ESC to address particular technical questions/issues; and

    - The ESC could improve the accessibility of the ESC report for non-technical readers by using plain language to summarise key sections of the ESC report.
- Dialogue with the EC:
    - The ESC Chair could provide a written summary of the ESC outcomes to the EC in addition to a presentation, with input from the Advisory Panel;
    - Members could organise in-country seminars with the Chair or Advisory Panel members; and
    - The ESC-EC could consider holding regular informal science briefing sessions for Commissioners in the period between the ESC and EC meetings, or prior to the ESC.
- Improving presentation of information on range and likely future TAC:
    - In stock assessment years (from 2023 and beyond) when stock projections are run to check on performance of the MP, a set of figures and tables on the likelihood of different TAC levels for the next scheduled TAC block (e.g. 2027-2029) could be presented; and
    - In TAC decision years (e.g. 2022), a single TAC value is calculated using the MP for the next TAC block (e.g. 2024-2026), so a range cannot be provided but could be produced for 2027-2029.

Agenda Item 13. Requirements for Data Exchange in 2022

159. Discussion for this agenda item commenced by correspondence in advance of the ESC.

160. The Secretariat submitted paper CCSBT-ESC/2108/05 which proposed the data exchange requirements for 2022. These requirements are based on the 2021 data exchange requirements with all items rolled over and the dates incremented. One change was made to clarify an existing obligation relating to the reporting of discarded southern bluefin tuna.

161. These proposed data exchange requirements were endorsed by the ESC and are provided in **Attachment 10**.

Agenda Item 14. Research Mortality Allowance

162. Discussion for this agenda item commenced by correspondence in advance of the ESC.

163. CSIRO summarised the Research Mortality Allowance (RMA) related part of paper CCSBT-ESC/2108/08 which reported on the 2020-2021 RMA usage and the requested RMA for 2022. None of the 2020 RMA was used during the shortened field work. In 2021 310 kg of RMA was used. There were 34 mortalities. The request for RMA for the 2022 field trip is 2 t. This is expected to be an over-estimate of the requirements, that allows for unusual and unforeseen circumstances.

164. Australia summarised the RMA-related part of paper CCSBT-ESC/2108/16. Separate to the e-tagging design study, an RMA of 0.75 t is requested in the event that a small number of popup satellite tags are released in 2021-22 to examine localised GAB movement and behaviour over the summer.

165. Australia submitted paper CCSBT-ESC/2108/18 which describes Australia's requested RMA for 2021/2022. At CCSBT 27 in 2020, Australia committed to another trial of emerging stereo-video (SV) technology to test whether any current system meets its pre-conditions. Australia has continued to monitor emerging SV technologies in Australia, New Zealand and Japan and there is anecdotal evidence that there may now be systems available that meet, or are close to meeting, Australia's preconditions. However, this cannot be confirmed without testing these in an operational environment. Australia requests a 3 t RMA for a project to trial the use of SV technology to determine the weight of catch taken in Australia's Southern Bluefin Tuna farming sector. The trial will operate between December 2021 and March 2022.

166. Japan submitted paper CCSBT-ESC/2108/34. Japan reported 0.1264 t of RMA usage for 2020/2021 from the RMA approval of 1.0 t. Japan requested 1.0 t of RMA for the 2021/2022 research, including for an age-0 distribution survey and an age-1 trolling survey in Western Australia.

167. The Secretariat advised that a total of 6.75 t of RMA has been requested for projects during 2021/2022 and that this exceeds the total amount of RMA that the EC has agreed to allocate for RMA each year from with the TAC.

168. It was agreed that the RMA request for the gene tagging project could be reduced by 0.25 t and Japan volunteered to lower its request for RMA by 0.5 t. It was considered that these reductions in RMA would not adversely impact these projects.

169. The ESC endorsed the following amounts of RMA for 2021/2022:

- 1.75 t for the CCSBT Gene Tagging Project;
- 0.5 t by Japan for trolling surveys of age-0 SBT in North West Australia and age-1 SBT in South West Australia;
- 3.0 t by Australia for a project to trial the use of stereo video technology to determine the weight of catch taken in Australia's Southern Bluefin Tuna farming sector; and
- 0.75 t by Australia in the event that a small number of popup satellite tags are released in 2021-22 to examine localised GAB movement and behaviour over the summer.

Agenda Item 15. Workplan, Timetable and Research Budget for 2022 (and beyond)

15.1. Overview, time schedule and budgetary implications of proposed 2022 research activities and implications of Scientific Research Program for the work plan and budget

170. The ESC's three-year workplan and resource requirements for 2022 to 2024 are provided at **Attachment 11**.

171. The workplan and resource requirements for 2023 and 2024 are only indicative as project proposals for 2023-2024 will be subject to the new SRP project review process that will occur intersessionally during 2022.

172. The detailed stock assessment and OMMP workplan for 2022-2023 is provided in Table 3.

Table 3: Workplan for stock assessment and MP implementation.

2022		
October (2021) - March	CPUE work-sessions	Progress CPUE workplan.
April-May	CPUE webinar	Agree on CPUE method to use as input to the MP and to condition the OM. Prepare input files and check lags in projection code. Reorganise Github repositories.
June (end)	OMMP11	Recondition the OM to check CTP performance in projections using the new CPUE series as input. Discuss Metarule outcomes to be presented at ESC. Discuss OM code rewriting/reformulation.
September	ESC	Metarule process and TAC calculation for 2024-2026. SRP discussion. Recommend terms of reference and timing for the MP review.
October	EC	Decide on TAC for 2024-2026
2023		
May		Data exchange advanced to try to complete it by mid May Re-evaluation of UAM completed for use as input to stock assessment.
June (end)	OMMP12	Preliminary reconditioning and projections for full stock assessment.
September	ESC	Full Stock Assessment

173. For the OMMP work in 2022, it was noted that:

- The replacement of the old CPUE series by one calculated with a new methodology (as discussed in item 5) will trigger implementation of the meta-rule process (in response to Exceptional Circumstance) to evaluate the effect of the change on future stock projections;
- Stock projections will be conducted using a reconditioned operating model and applying the CTP with the new CPUE series as input; and
- The outcome of the metarule process will determine if the TAC calculation for 2024-2026 can proceed using the adopted CTP or some additional consideration is needed.

15.2. Timing, length and structure of next meeting

174. The EC has agreed tentative dates for the CCSBT's main meetings in 2022. The agreed tentative date for the next ESC meeting is from 29 August 2022 to 3 September 2022 inclusive in New Zealand (the city has yet to be determined).

175. It was noted that there is no certainty that current travel restrictions associated with the COVID-19 pandemic will have eased sufficiently to allow a physical meeting to proceed by the date of the next ESC meeting. If a physical meeting cannot proceed, a virtual meeting will be conducted instead. The virtual meeting duration would be two days longer than the physical meeting (the additional days being 5-6 September 2022) to help make up for the shortened daily sessions of a virtual meeting.

176. In addition, a five-day intersessional OMMP meeting is planned to be held in Seattle, USA during late June 2022. The specific dates for this meeting will be organised by the Executive Secretary in consultation with Member scientists and the Panel after the October 2021 annual meeting as per standard practice. If a virtual OMMP meeting is required due to the COVID-19 pandemic, it is anticipated that the meeting duration will be extended by two days.

Agenda Item 16. Other Matters

177. Australia submitted paper CCSBT-ESC/2108/Info01 on point of recruitment impairment. The paper notes that the Marine Stewardship Council (MSC) defines its Principle 1 sustainability criterion in terms of the concept of a Point of Recruitment Impairment (PRI). In the MSC guidelines a decision tree applies to the definition of a default PRI when an analytical estimate is not available - in the CCSBT case that default PRI is at 20% of the unfished adult population abundance. The CCSBT Management Procedure is defined in terms of meeting future relative adult abundance targets, not current ones. This paper outlines the calculation of a candidate analytic PRI for SBT using the steepness and relative adult abundance level. The paper also calculated the probability being above the MSC-defined risk criteria for historical population abundance estimates from the most recent stock assessment.

178. There were no comments on this paper.

Agenda Item 17. Adoption of Meeting Report

179. The report was adopted.

Agenda Item 18. Close of meeting

180. The meeting closed at 10:38 am on 31 August 2021 (Canberra time).

List of Attachments

Attachments

Attachment 1

List of Participants
Extended Scientific Committee Meeting
of the Twenty Sixth Meeting of the Scientific Committee

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Attachment 2

Agenda
Extended Scientific Committee for the Twenty Sixth Meeting of the Scientific Committee

23 – 31 August 2021

1. **Opening**
   1.1. Introduction of Participants
   1.2. Administrative Arrangements

2. **Appointment of Rapporteurs**

3. **Adoption of Agenda and Document List**

4. **Review of SBT Fisheries**
   4.1. Presentation of National Reports
   4.2. Secretariat Review of Catches

5. **Progression of CPUE analyses**

6. **Review of results of the Scientific Research Program and other inter-sessional scientific activities**
   6.1. Results of scientific activities.
   6.2. Updated analysis of SBT catch by non-Members
   6.3. Verification of all Members' catch by product distribution in markets
   6.4. Update on progress made to address the recommendations from the independent review of the Japanese market analysis presented and discussed at the ESC in Cape Town in 2019
   6.5. Update on progress made to address the recommendations from the independent review of the Australian farm analysis presented and discussed at the ESC in Cape Town in 2019

7. **Evaluation of Fisheries Indicators**

8. **SBT stock status**

9. **SBT Management Advice**
   9.1. Evaluation of meta-rules and exceptional circumstances
   9.2. Summary of SBT management advice

10. **Operating Model and Management Procedure**
    10.1. Consideration of missing data in the meta-rules
    10.2. Maintenance and development of OMMP Code

11. Update of the Scientific Research Program (SRP)

12. Improving communication between the ESC and Extended Commission

13. Requirements for Data Exchange in 2022

14. Research Mortality Allowance

15. Workplan, Timetable and Research Budget for 2022 (and beyond)

15.1. Overview, time schedule and budgetary implications of proposed 2022 research activities and implications of Scientific Research Program for the work plan and budget

15.2. Timing, length and structure of next meeting

16. Other Matters

17. Adoption of Meeting Report

18. Close of Meeting

Attachment 3

List of Documents
Extended Scientific Committee
for the Twenty Sixth Meeting of the Scientific Committee

(CCSBT-ESC/2108/)

1. Provisional Agenda
2. List of Participants
3. List of Documents
4. (Secretariat) Secretariat review of catches (ESC agenda item 4.2)
5. (Secretariat) Data Exchange (ESC agenda item 13)
6. (CCSBT) Update on the SBT close-kin tissue sampling, processing and kin-finding (ESC Agenda item 6.1)
7. (CCSBT) Review of data to estimate the length and age distribution of SBT in the Indonesian longline catch (ESC Agenda item 6.1)
8. (CCSBT) Report of the SBT gene-tagging program 2021 (ESC Agenda item 6.1 and 14)
9. (Australia) Preparation of Australia's southern bluefin tuna catch and effort data submission for 2020 (Rev.1) (ESC Agenda item 4.1)
10. (Australia) Rapid epigenetic age estimation for southern bluefin tuna (ESC Agenda item 6.1)
11. (Australia) An update on Australian otolith collection activities and direct ageing activities for the Australian surface fishery (ESC Agenda item 6.1)
12. (Australia) Fishery indicators for the southern bluefin tuna stock 2020–21 (Rev.1) (ESC Agenda item 7)
13. (Australia) Meta-rules: consideration of exceptional circumstances in 2021 (ESC Agenda item 9.1)
14. (Australia) How the Cape Town Procedure deals with missing data (Rev.1) (ESC Agenda item 10.1)
15. (Australia) Developing a new SRP – review and priorities (ESC Agenda item 11)
16. (Australia) Proposal for a design study to evaluate potential electronic tagging programs to understand implications of changes in migration of SBT (ESC Agenda item 11 and 14)
17. (Australia) Enhancing ESC – EC communication (ESC Agenda item 12)
18. (Australia) Research mortality allowance: Proposed allowance for 2021 and 2022 (ESC Agenda item 14)
19. (Taiwan) Preparation of Taiwan's Southern bluefin tuna catch and effort data submission for 2020 (ESC Agenda item 4.1)

20. (Taiwan) Updated information and analysis for gonad samples of southern bluefin tuna collected by Taiwanese scientific observer program (ESC Agenda item 6.1)
21. (Taiwan) Updated report of direct ageing of the SBT caught by Taiwanese longliners in recent 5 years (ESC Agenda item 6.1)
22. (Taiwan) CPUE standardization for southern bluefin tuna caught by Taiwanese longline fishery for 2002-2020 (ESC Agenda item 7)
23. (Korea) Korean SBT otolith collection activities in 2020 (ESC Agenda item 6.1)
24. (Korea) Data exploration and CPUE standardization for the Korean southern bluefin tuna longline fishery (1996-2020) (ESC Agenda item 7)
25. ~~(Japan) Review of Japanese southern bluefin tuna fisheries in 2020 (ESC Agenda item 4.1)~~
26. (Japan) Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2020 (ESC Agenda item 4.1)
27. (Japan) Update work of the core vessel data and CPUE for southern bluefin tuna in 2021 (ESC Agenda item 4, 5, 6 and 7)
28. (Japan) Change in operation pattern of Japanese southern bluefin tuna longliners in the 2020 fishing season (ESC Agenda item 4, 5, 6 and 7)
29. (Japan) Report of the piston-line trolling monitoring survey for the age-1 southern bluefin tuna recruitment index in 2020/2021 (ESC Agenda item 6.1)
30. (Japan) Trolling indices for age-1 southern bluefin tuna: update of the grid type trolling index in 2021 (ESC Agenda item 6.1)
31. (Japan) Summary of fisheries indicators of southern bluefin tuna stock in 2021 (ESC Agenda item 7)
32. (Japan) A check of operating model predictions from the viewpoint of implementation of the management procedure in 2021 (ESC Agenda item 9.1)
33. (Japan) Graphic understanding of how the Cape Town Procedure calculate TAC (ESC Agenda item 12)
34. (Japan) Report of the 2020/2021 RMA utilization and application for the 2021/2022 RMA (ESC Agenda item 14)
35. (CCSBT) Potential CPUE model improvements for the primary index of Southern Bluefin Tuna abundance (ESC Agenda item 5)

(CCSBT- ESC/2108/BGD)

1. (Australia) CCSBT Scientific Research Program: A brief review (2014-2018) (*Previously* CCSBT-ESC/2008/15) (ESC Agenda item 11)

(CCSBT-ESC/2108/SBT Fisheries -)

Australia	Australia's 2019–20 southern bluefin tuna fishing season (Rev.1)
European Union	Annual Review of National SBT Fisheries for the Extended Scientific Committee
Indonesia	Indonesia Southern Bluefin Tuna Fisheries: A National Report Year 2020
Japan	Review of Japanese Southern Bluefin Tuna Fisheries in 2020 (Rev.1)
Korea	2021 Annual National Report of Korean SBT Fishery (Rev.1)
New Zealand	New Zealand Annual Report to the Extended Scientific Committee (Rev.2)
South Africa	South African National Report to the Extended Scientific Committee of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), 2021
Taiwan	Review of Taiwan SBT Fishery of 2019/2020

(CCSBT-ESC/2008/Info)

1. (Australia) Developing a Point of Recruitment Impairment (PRI) for Southern Bluefin tuna (ESC Agenda item 16)
2. (Indonesia) Reproductive activity of Southern Bluefin Tuna (*Thunnus maccoyii*) caught in Indonesian tuna fisheries (ESC Agenda item 4.1)
3. (Indonesia) Indonesia scientific observer program activities in the Indian Ocean from 2015-2020 (ESC Agenda item 4.1)
4. (Indonesia) The updated on daily SBT catch monitoring program in Benoa port, Bali, Indonesia 2020 (ESC Agenda item 4.1)

(CCSBT-ESC/2108/Rep)

1. Report of the Twenty Seventh Annual Meeting of the Commission (October 2020)
2. Report of the Twenty Fifth Meeting of the Scientific Committee (August - September 2020)
3. Report of the Eleventh Operating Model and Management Procedure Technical Meeting (June 2020)
4. Report of the Twenty Sixth Annual Meeting of the Commission (October 2019)
5. Report of the Twenty Fourth Meeting of the Scientific Committee (September 2019)

6. Report of the Tenth Operating Model and Management Procedure Technical Meeting (June 2019)
7. Report of the Twenty Third Meeting of the Scientific Committee (September 2018)
8. Report of the Ninth Operating Model and Management Procedure Technical Meeting (June 2018)

Attachment 4

Global Reported Catch By Flag

Reviews of southern bluefin tuna data presented to a special meeting of the Commission in 2006 suggested that the catches may have been substanstially under-reported over the previous 10 to 20 years. The data presented here do not include estimates for this unreported catch.
All shaded figures are subject to change as they are either preliminary figures or they have yet to be finalised.
Blank cells are unknown catch (many would be zero).

	Australia			New Zealand									
Calendar Year	Commercial	Amateur	Japan	Commercial	Amateur	Korea	Taiwan	Philippines	Indonesia	South Africa	European Union	Miscellaneous	Research & Other
1952	264		565	0		0	0	0	0	0	0	0	
1953	509		3,890	0		0	0	0	0	0	0	0	
1954	424		2,447	0		0	0	0	0	0	0	0	
1955	322		1,964	0		0	0	0	0	0	0	0	
1956	964		9,603	0		0	0	0	0	0	0	0	
1957	1,264		22,908	0		0	0	0	0	0	0	0	
1958	2,322		12,462	0		0	0	0	0	0	0	0	
1959	2,486		61,892	0		0	0	0	0	0	0	0	
1960	3,545		75,826	0		0	0	0	0	0	0	0	
1961	3,678		77,927	0		0	0	0	0	145	0	0	
1962	4,636		40,397	0		0	0	0	0	724	0	0	
1963	6,199		59,724	0		0	0	0	0	398	0	0	
1964	6,832		42,838	0		0	0	0	0	197	0	0	
1965	6,876		40,689	0		0	0	0	0	2	0	0	
1966	8,008		39,644	0		0	0	0	0	4	0	0	
1967	6,357		59,281	0		0	0	0	0	5	0	0	
1968	8,737		49,657	0		0	0	0	0	0	0	0	
1969	8,679		49,769	0		0	80	0	0	0	0	0	
1970	7,097		40,929	0		0	130	0	0	0	0	0	
1971	6,969		38,149	0		0	30	0	0	0	0	0	
1972	12,397		39,458	0		0	70	0	0	0	0	0	
1973	9,890		31,225	0		0	90	0	0	0	0	0	
1974	12,672		34,005	0		0	100	0	0	0	0	0	
1975	8,833		24,134	0		0	15	0	0	0	0	0	
1976	8,383		34,099	0		0	15	0	12	0	0	0	
1977	12,569		29,600	0		0	5	0	4	0	0	0	
1978	12,190		23,632	0		0	80	0	6	0	0	0	
1979	10,783		27,828	0		0	53	0	5	0	0	4	
1980	11,195		33,653	130		0	64	0	5	0	0	7	
1981	16,843		27,981	173		0	92	0	1	0	0	14	
1982	21,501		20,789	305		0	182	0	2	0	0	9	
1983	17,695		24,881	132		0	161	0	5	0	0	7	
1984	13,411		23,328	93		0	244	0	11	0	0	3	
1985	12,589		20,396	94		0	241	0	3	0	0	2	
1986	12,531		15,182	82		0	514	0	7	0	0	3	
1987	10,821		13,964	59		0	710	0	14	0	0	7	
1988	10,591		11,422	94		0	856	0	180	0	0	2	
1989	6,118		9,222	437		0	1,395	0	568	0	0	103	
1990	4,586		7,056	529		0	1,177	0	517	0	0	4	
1991	4,489		6,477	164		246	1,460	0	759	0	0	97	
1992	5,248		6,121	279		41	1,222	0	1,232	0	0	73	
1993	5,373		6,318	217		92	958	0	1,370	0	0	15	
1994	4,700		6,063	277		137	1,020	0	904	0	0	54	
1995	4,508		5,867	436		365	1,431	0	829	0	0	201	296
1996	5,128		6,392	139		1,320	1,467	0	1,614	0	0	295	290
1997	5,316		5,588	334		1,424	872	0	2,210	0	0	333	
1998	4,897		7,500	337		1,796	1,446	5	1,324	1	0	471	
1999	5,552		7,554	461		1,462	1,513	80	2,504	1	0	403	
2000	5,257		6,000	380		1,135	1,448	17	1,203	4	0	31	
2001	4,853		6,674	358		845	1,580	43	1,632	1	0	41	4
2002	4,711		6,192	450		746	1,137	82	1,701	18	0	203	17
2003	5,827		5,770	390		254	1,128	68	565	15	3	40	17
2004	5,062		5,846	393		131	1,298	80	633	19	23	2	17
2005	5,244		7,855	264		38	941	53	1,726	29	0	0	5
2006	5,635		4,207	238		150	846	50	598	15	3	0	5

	Australia		Japan	New Zealand									
Calendar Year	Commercial	Amateur		Commercial	Amateur	Korea	Taiwan	Philippines	Indonesia	South Africa	European Union	Miscellaneous	Research & Other
2007	4,813		2,840	379	4	521	841	46	1,077	58	18	0	3
2008	5,033		2,952	319	0	1,134	913	45	926	44	14	4	10
2009	5,108		2,659	419	0	1,117	921	47	641	40	2	0	0
2010	4,200		2,223	501	0	867	1,208	43	636	54	11	0	0
2011	4,200		2,518	547	0	705	533	45	842	64	3	0	1
2012	4,503		2,528	776	0	922	494	46	910	110	4	0	0
2013	4,902		2,694	756	1	918	1,004	46	1,383	67	0	0	0
2014	4,559		3,371	826	0	1,044	944	45	1,063	56	0	0	1
2015	5,824		4,745	922	1	1,051	1,162	0	593	63	0	0	0
2016	5,962		4,721	951	1	1,121	1,023	0	601	64	0	0	2
2017	5,221		4,567	913	21	1,080	1,171	0	835	136	0	0	2
2018	6,401		5,945	1,008	12	1,268	1,218	0	1,087	207	0	0	2
2019	6,185	270	5,851	959	2	1,238	1,229	0	1,206	160	0	0	0
2020	4,757	270	5,929	853	50	1,226	1,116	0	1,298	161	0	0	0

European Union: From 2006, estimates are from EU reports to the CCSBT. Earlier catches were reported by Spain and the IOTC.
Miscellaneous: Before 2004, these were from Japanese import statistics (JIS). From 2004, the higher value of JIS and CCSBT TIS was used combined with available information from flags in this category.
Research and other: Mortality of SBT from CCSBT research and other sources such as discarding practices in 1995/96.

Attachment 5

CPUE Workplan

The small group noted that there are two main areas of CPUE work underway. The first, and highest priority, is in the selection of a refined CPUE series/model to be used for the Cape Town procedure (CTP) and for OM reconditioning in 2022. The second is for further research and sensitivity evaluation for assessment and indicator work, and future OM conditioning. The following work plan is focused on the index for the CTP.

The goal for the work is to have the selection and finalisation of the CPUE index for the CTP completed by May 2022. Given discussions from the small group meeting, to meet this goal a number of web meetings will be required. An initial proposal is to hold two "work-sessions", and two more formal working group meetings where the results of the work would be more formally reviewed. To help with collaboration it is proposed that the format of the work-sessions would be hands on, reviewing and running R code, with analysts assisting each other with configurations and related issues.

Activities identified

Tasks prior to first work-session (by Japanese scientists):

- Refine dataset considerations; the ESC recommended selecting the Japanese vessels, area 4-9, months 4-9 and SBT age 4+. For bycatch covariates, the cluster analysis should consider four species (BET, YFT, ALB, and SWO) but including bycatch species is a lower priority. For the year range, the preference is to start in 1969 for the final model, but for initial runs, it may be preferable to use 1986 as the starting year as this covers the most important period.
- Test parallel processing to speed up 1x1 degree square and shot-by-shot data computations.
- Fit the GAM15s model to shot-by-shot data by the model with 5x5 month resolution. Attempt similar work for the 1x1 aggregated data but this is a lower priority.
- Ensure VS/CS analogues of GAM calculations are computed as the sum of cell (1x1 or 5x5) predictions weighted by cell area (there is no need to aggregate at the Statistical Area level used for GLM).

Tasks for the consultant:

- Collaborate in configuring software for implementing the shot-by-shot data analyses to be carried out by Japan.
- Prepare maps of the estimated errors for GAM predictions (SE or CVs by month) to evaluate possible threshold approaches for selecting the cells to drop each year for a VS diagnostic/sensitivity test (blocking approach).
- Simulate data to use these as a test platform for developing efficient R code to analyze shot-by-shot data.
- Consider comparable data from other members (e.g., Korea and Taiwan) to see if inclusion of area-time strata could usefully supplement the Japanese data.

Attachment 6

Recent trends in all indicators of the SBT stock

Indicator	Period	Min.	Max.	2017	2018	2019	2020	2021	12-month trend	Main Ages	NOTES
Scientific aerial survey	1993–2000 2005–17	0.25 (1999)	4.85 (2016)	1.80	–	–	–	–	–	2-4	Discontinued
Trolling index (piston line)	1996–2003 2005–06 2006–14 2016–20	0.00 (2018, 2019)	5.09 (2011)	1.71	0.00	0.00	1.72	–	–	1	
Trolling index (grid)	1996–2003 2005–14 2016–21	0.26 (2002)	1.77 (2008, 2011)	0.79	0.82	0.47	1.01	0.72	↑	1	
Gene tagging	2016–18	1.14 (2018)	2.27 (2016)	1.15	1.14	1.52	–		↑	2	
NZ domestic standardised CPUE	2003–2019	0.355 (2006)	2.99 (2016)	2.46	2.42	1.22	2.05		↑	All	
NZ domestic age/size composition (proportion age 0–5 SBT)*	1980–2019	0.001 (1985)	0.48 (2017)	0.48	0.33	0.27	0.24		↓	2-5	Peripheral Area
Indonesian mean size class**	1993–19	156 (2016)	188 (1994)	155	162	161	–		–	spawners	
Indonesian age composition:** mean age on spawning ground, all SBT	1994–19	11.8 (2016)	21.2 (1995)	12.9	13.4	13.2	–		–	spawners	
Indonesian age composition:** mean age on spawning ground 20+	1994–19	21.3 (2016)	25.3 (2004)	23.1	23.1	22.4	–		–	Older spawners	
Indonesian age composition:** median age on spawning ground	1994–19	11.5 (2017)	21.5 (1994–95; 1996–97; 1998–99)	11.5	12.5	12.5	–		--	spawners	

Indicator		Period	Min.	Max.	2017	2018	2019	2020	12-month trend	Main Ages	Notes
Japanese nominal CPUE, age 4+		1969–2020	1.338 (2006)	22.123 (1965)	5.271	6.012	7.742	6.513	↓	4+	
Japanese standardised CPUE (W0.5, W0.8, Base w0.5, Base w0.8)		1969–2020	2007 (0.259–0.358)	1969 (2.284– 2.697)	0.926–1.307	0.925–2.269	0.888-1.756	1.164-2.646	↑	4+	
Korean nominal CPUE		1991–2020	1.312 (2004)	21.523 (1991)	6.552	7.406	8.702	7.487	↓	4+	Bycatch effects
Korean standardised CPUE (selected data)	Area 8	1996-2020	0.36 (2002)	3.20 (2016)	–	–	–	2.78	–	4+	
	Area 9	1996-2020	0.17 (2005)	2.56 (2019)	1.39	2.12	2.56	1.90	↓		
Korean standardised CPUE (clustered)	Area 8	1996-2020	0.42 (2002)	3.63 (2020)	–	–	–	3.63	–	4+	
	Area 9	1996-2020	0.18 (2005)	2.63 (2020)	1.38	2.05	2.42	2.63	↑		
Taiwanese nominal CPUE, Areas 8+9		1981–2020	<0.001 (1985)	0.956 (1995)	0.156	0.217	0.204	0.283	↑	2+	Bycatch effects
Taiwanese nominal CPUE, Areas 2+14+15		1981–2020	<0.001 (1985)	3.672 (2007)	1.588	1.686	1.638	1.324	↓	2+	Bycatch effects
Taiwanese standardised CPUE	(Area E)	2002-2020	0.120(2002)	0.938 (2012)	0.719	0.809	0.727	0.804	↑	2+	In development
	(Area W)	2002-2020	0.193(2016)	2.406 (2002)	0.198	0.217	0.179	0.343	↑		Bycatch effects
Japanese age comp, age 0–2*		1969–2020	0.004 (1966)	0.192 (1998)	0.002	0.006	0.009	0.004	↓	2	Affected by release/discard
Japanese age comp, age 3*		1969–2020	0.011 (2015)	0.228 (2007)	0.044	0.047	0.082	0.080	↓	3	Affected by release/discards
Japanese age comp, age 4*		1969–2020	0.091 (1967)	0.300 (2010)	0.142	0.145	0.160	0.087	↓	4	
Japanese age comp, age 5*		1969–2020	0.072 (1986)	0.300 (2010)	0.126	0.123	0.196	0.089	↓	5	
Taiwanese age/size comp, age 0–2*		1981–2020	<0.001 (1982)	0.251 (2001)	0.002	0.009	0.015	0.002	↓	Mostly 2	
Taiwanese age/size comp, age 3*		1981–2020	0.024 (1996)	0.349 (2001)	0.063	0.063	0.108	0.059	↓	3	
Taiwanese age/size comp, age 4*		1981–2020	0.027 (1996)	0.502 (1999)	0.218	0.234	0.168	0.169	↑	4	
Taiwanese age/size comp, age 5*		1981–2020	0.075 (1997)	0.428 (2018)	0.381	0.428	0.338	0.325	↓	5	
Australia surface fishery median age composition		1964–2020	age 1 (1979–80)	age 3 (multiple years)	age 3	age 3	age 2	age 2	–	1-4	

Indicator		Period	Min.	Max.	2017	2018	2019	2020	12-month trend	Ages	Notes
Jpn LL standardised CPUE (age 3)	w0.5	1969–2020	0.23 (2003)	3.35 (1972)	0.43	0.57	0.72	1.17	↑	3	Affected by release/discard
	w0.8		0.26 (2003)	3.09 (1972)	0.57	0.77	0.89	1.54			
Jpn LL standardised CPUE (age 4)	w0.5	1969–2020	0.27 (2006)	2.96 (1974)	0.94	1.14	1.07	0.86	↓	4	
	w0.8		0.29 (2006)	2.62 (1974)	1.27	1.54	1.31	1.07			
Jpn LL standardised CPUE (age 5)	w0.5	1969–2020	0.23 (2006)	2.70 (1972)	0.88	0.89	1.31	0.87	↓	5	
	w0.8		0.25 (2006)	2.42 (1972)	1.15	1.17	1.63	1.06			
Jpn LL standardised CPUE (age 6&7)	w0.5	1969–2020	0.18 (2007)	2.48 (1976)	1.36	1.05	0.97	1.36	↑	6-7	
	w0.8		0.20 (2007)	2.20 (1976)	1.72	1.34	1.22	1.74			
Jpn LL standardised CPUE (age8-11)	w0.5	1969–2020	0.27 (2007)	3.81 (1969)	0.67	0.88	0.84	1.43	↑	8-11	
	w0.8		0.28 (1992)	3.33 (1969)	0.88	1.14	1.08	1.85			
Jpn LL standardised CPUE (age 12+)	w0.5	1969–2020	0.45 (2017)	3.42 (1970)	0.45	0.57	0.47	1.02	↑	12+	
	w0.8		0.59 (1997)	2.92 (1970)	0.59	0.75	0.61	1.30			

*derived from size data; ** Indonesian catch not restricted to just the spawning grounds since 2012–13; na = not available

^ All the Jpn LL standardised CPUE indicators are based on the standardisation model by Nishida and Tsuji (CCSBT/SC/9807/13) using all vessel data. w0.5 and w0.8 refer to the weighting in the formula of the indicator calculation, w*VS + (1-w)*CS (VS and CS represent Variable Square and Constant Square hypotheses, respectively).

Note that the close kin mark recapture index is not provided in this table as the years for which the index is available do not match the years covered in the table. See the text in agenda item 8 for information on the index.

Attachment 7

Report on Biology, Stock Status and Management of Southern Bluefin Tuna: 2021

The CCSBT Extended Scientific Committee (ESC) updated the stock assessment and conducted a review of fisheries indicators in 2020 to provide updated information on the status of the stock. This report updates the description of fisheries and the state of stock as advised in 2021 by the ESC.

1. Biology

Southern bluefin tuna (*Thunnus maccoyii*) are found in the southern hemisphere, mainly in waters between 30° and 50° S, but only rarely in the eastern Pacific. The only known spawning area is in the Indian Ocean, south-east of Java, Indonesia. Spawning takes place from September to April in warm waters south of Java and juvenile SBT migrate south down the west coast of Australia. During the summer months (December-April), they tend to congregate near the surface in the coastal waters off the southern coast of Australia and spend their winters in deeper, temperate oceanic waters. Results from recaptured conventional and archival tags show that young SBT migrate seasonally between the south coast of Australia and the central Indian Ocean. After age 5 SBT are seldom found in nearshore surface waters, and their distribution extends over the southern circumpolar area throughout the Pacific, Indian and Atlantic Oceans.

SBT can attain a length of over 2 m and a weight of over 200 kg. Direct ageing using otoliths indicates that a significant number of fish larger than 160 cm are older than 25 years, and the maximum age obtained from otolith readings has been 42 years. Analysis of tag returns and otoliths indicate that, in comparison with the 1960s, growth rate has increased since about 1980 during the period when the stock was declining. There is some uncertainty about the size and age when SBT mature, but available data indicate that SBT do not mature younger than 8 years (155 cm fork length), and perhaps as old as 15 years. SBT exhibit age-specific natural mortality, with M being higher for young fish and lower for old fish, increasing again prior to senescence.

Given that SBT have only one known spawning ground, and that no morphological differences have been found between fish from different areas, SBT are considered to constitute a single stock for management purposes.

2. Description of Fisheries

Reported catches of SBT up to the end of 2020 are shown in Figures 1 - 3. Note that a 2006 review of SBT data indicated that there may have been substantial under-reporting of SBT catches and surface fishery bias in the previous 10 - 20 year period, and there is currently substantial uncertainty regarding the true levels of total SBT catch over this period. The SBT stock has been exploited for more than 50 years, with total catches peaking at 81,750 t in 1961 (Figures 1 - 3). Over the period 1952 - 2020, 77% of the reported catch was taken by longline and 23% using surface gears, primarily purse-seine and pole and line (Figure 1). The proportion of reported catch made by the surface fishery peaked at 50% in 1982, dropped to 11-12 % in 1992 and 1993 and increased again to average 34% since 1996 (Figure 1). The Japanese longline fishery (taking a wide age range of fish) recorded its peak catch of 77,927 t in 1961 and the Australian surface fishery catches of young fish peaked at 21,501 t in 1982 (Figure 3). New Zealand, the Fishing Entity of Taiwan and Indonesia have also exploited southern bluefin tuna since the 1970s - 1980s, and Korea started a fishery in 1991.

On average, 78.4% of the SBT catch has been made in the Indian Ocean, 16.8% in the Pacific Ocean and 4.8% in the Atlantic Ocean (Figure 2). The reported Atlantic Ocean catch has varied widely between about 18t and 8,200t since 1968 (Figure 2), averaging 1,291 t over the past two decades. This variation in catch reflects shifts in longline effort between the Atlantic and Indian Oceans. Fishing in the Atlantic occurs primarily off the southern tip of South Africa (Figure 4). Since 1968, the reported Indian Ocean catch has declined from about 45,000 t to less than 11,000 t, averaging 18,122 t, and the reported Pacific Ocean catch has ranged from about 800 t to 19,000 t, averaging 4,992 t over the same period[1].

3. Summary of Stock Status

Since 2017, CCSBT has measured reproductive capacity as Total Reproductive Output (TRO) rather than SSB. The 2020 stock assessment indicated that the SBT TRO is at 20% of its initial biomass as well as below the level that could produce maximum sustainable yield. The 2020 assessment indicated the stock has increased from a low of 10% of initial TRO in 2009.

A review of indicators in 2021 suggested that age 1 recruitment may have decreased somewhat in recent years but that recruitment levels still remain above historical averages. There are some consistent positive trends in the age-based longline CPUE estimates across a number of fleets. The detection rate of parent-offspring pairs from the most recent close-kin mark-recapture data is consistent with an increase in adult abundance.

4. Current Management Measures

Total Allowable Catch (TAC)

The primary conservation measure for management of the southern bluefin tuna stock is the TAC.

At its eighteenth annual meeting in 2011, the CCSBT agreed that a Management Procedure (MP) would be used to guide the setting of the SBT global total allowable catch (TAC) to ensure that the SBT spawning stock biomass achieves the interim rebuilding target of 20% of the initial spawning stock biomass. The CCSBT set TACs until 2020 based on the outcome of that MP. At its twenty sixth annual meeting in 2019, the CCSBT agreed a new MP tuned to achieve a 0.5 probability of achieving 30% of initial TRO by 2035. In 2020 the ESC advised on a TAC for 2021-2023 based

[1] Note: a 2006 review of SBT data indicated that catches over the preceding 10 to 20 years may have been substantially under-reported.

on the new MP. The CCSBT set TAC for 2021-2023 in line with advice from the ESC.

In adopting the first MP in 2011, the CCSBT emphasised the need to take a precautionary approach to increase the likelihood of the spawning stock rebuilding in the short term and to provide industry with more stability in the TAC (i.e. to reduce the probability of future TAC decreases). Under the adopted MP, the TACs were set in three-year periods. The TACs for 2015 to 2017 were 14,647 tonnes and the TACs for 2018 to 2020 were 17,647 tonnes. In 2020, based on the new MP adopted in 2019, the TAC for 2021-2023 remained unchanged at 17,647 tonnes.

The allocations of the TAC to Members and Cooperating Non-Members of the CCSBT from 2016 to 2021 is summarised below. In addition, some flexibility is provided to Members for limited carry-forward of unfished allocations between quota years.

Current Allocations to Members (tonnes)

	2016-2017	2018-2020	2021
Japan	4,737	6,117[1]	6,197.4[3]
Australia	5,665	6,165	6,238.4[3]
Republic of Korea	1,140	1,240.5	1,256.8
Fishing Entity of Taiwan	1,140	1,240.5	1,256.8
New Zealand	1,000	1,088	1,102.5
Indonesia	750	1,023[1]	1,122.8[3]
European Union	10	11	11
South Africa	150	450[2]	455.3[3]

Current Allocations to Cooperating Non-Members (tonnes)

	2016-2017[4]	2018-2021
Philippines	45	0

Monitoring, Control and Surveillance

The CCSBT has adopted a Compliance Plan that supports its Strategic Plan and provides a framework for the CCSBT, Members and Cooperating Non-Members to improve compliance, and over time, achieve full compliance with CCSBT's

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[2] These figures reflect the voluntary transfers of 21 t that Japan provided to Indonesia and 27 t that Japan provided to South Africa for the 2018 to 2020 quota block.

[3] These figures reflect: (1) voluntary transfers of 21 t that Japan is providing to Indonesia and 27 t that Japan is providing to South Africa for the 2021 to 2023 quota block; (2) a voluntary transfer of 7 t that Australia is providing to Indonesia for the 2021 to 2023 quota block; and (3) a special temporary allowance of 80 t to Indonesia for 2021.

[4] Ceased 12 October 2017.

conservation and management measures. The Compliance Plan also includes a three-year action plan to address priority compliance risks. The action plan will be reviewed and confirmed or updated every year. The action plan is therefore a ‘rolling’ document and over time its emphasis will change.

The CCSBT has also adopted three Compliance Policy Guidelines, these being:

- Minimum performance requirements to meet CCSBT Obligations;
- Corrective actions policy; and
- MCS information collection and sharing

In addition, the CCSBT has implemented a Quality Assurance Review (QAR) program to provide independent reviews to help Members identify how well their management systems function with respect to their CCSBT obligations and to provide recommendations on areas where improvement is needed. It is further intended that QARs will:

- Benefit the reviewed Member by giving them confidence in the integrity and robustness of their own monitoring and reporting systems;
- Promote confidence among all Members as to the quality of individual Members’ performance reporting; and
- Further demonstrate the credibility and international reputation of the CCSBT as a responsible Regional Fisheries Management Organisation.

Individual MCS measures that have been established by the CCSBT include:

Catch Documentation Scheme

The CCSBT Catch Documentation Scheme (CDS) came into effect on 1 January 2010 and replaced the Statistical Document Programme (Trade Information Scheme) which had operated since 1 June 2000. The CDS provides for tracking and validation of legitimate SBT product flow from catch to the point of first sale on domestic or export markets. As part of the CDS, all transhipments, landings of domestic product, exports, imports and re-exports of SBT must be accompanied by the appropriate CCSBT CDS Document(s), which will include a Catch Monitoring Form and possibly a Re-Export/Export After Landing of Domestic Product Form. Similarly, transfers of SBT into and between farms must be documented on either a Farm Stocking Form or a Farm Transfer Form as appropriate. In addition, each whole SBT that is transhipped, landed as domestic product, exported, imported or re-exported must have a uniquely numbered tag attached to it and the tag numbers of all SBT (together with other details) will be recorded on a Catch Tagging Form. Copies of all documents issued and received will be provided to the CCSBT Secretariat on a quarterly basis for compiling to an electronic database, analysis, identification of discrepancies, reconciliation and reporting.

Monitoring of SBT Transhipments

The CCSBT program for monitoring transhipments at sea came into effect on 1 April 2009. The program was revised to include requirements for monitoring transhipments in port from 1 January 2015.

Transhipments at sea from tuna longline fishing vessels with freezing capacity (referred to as “LSTLVs”) require, amongst other things, carrier vessels that receive SBT transhipments at sea from LSTLVs to be authorised to receive such transhipments and for a CCSBT observer to be on board the carrier vessel during the transhipment. The CCSBT transhipment program is harmonised and operated in conjunction with those of ICCAT and IOTC to avoid duplication of the same measures. ICCAT or IOTC observers on a transhipment vessel that is authorised to receive SBT are deemed to be CCSBT observers provided that the CCSBT standards are met.

Transhipments in port must be to an authorised carrier vessel (container vessels are exempted) at designated foreign ports and, amongst other things, require prior notification to Port State authorities, notification to Flag States, and transmission of the CCSBT transhipment declaration to the Port State, the Flag State and the CCSBT Secretariat.

Port State Measures

The CCSBT adopted a Resolution for a CCSBT Scheme for Minimum Standards for Inspections in Port in October 2015. The Resolution entered into force on 1 January 2017. The scheme applies to foreign fishing vessels, including carrier vessels other than container vessels. Under this scheme, Members wishing to grant access to its ports to foreign fishing vessels shall, amongst other things:

- Designate a point of contact for the purposes of receiving notifications;
- Designate its ports to which foreign fishing vessels may request entry;
- Ensure that it has sufficient capacity to conduct inspections in every designated port;
- Require foreign fishing vessels seeking to use its ports for the purpose of landing and / or transhipment to provide certain required minimum information with at least 72 hours prior notification; and
- Inspect at least 5% of foreign fishing vessel landings in their designated ports each year.

List of Approved Vessels and Farms

The CCSBT has established records for:

- Authorised SBT vessels;
- Authorised SBT carrier vessels; and
- Authorised SBT farms.

Members and Cooperating Non-Members of the CCSBT will not allow the landing or trade etc. of SBT caught by fishing vessels and farms, or transhipped to carrier vessels that are not on these lists.

List of Vessels Presumed to have carried out IUU Fishing Activities for SBT

The CCSBT has adopted a Resolution on Establishing a List of Vessels Presumed to have Carried Out Illegal, Unreported and Unregulated Fishing Activities For Southern Bluefin Tuna.

At each annual meeting, the CCSBT will identify those vessels which have engaged in fishing activities for SBT in a manner which has undermined the effectiveness of the Convention and the CCSBT measures in force.

Vessel Monitoring System

The CCSBT Vessel Monitoring System (VMS) came into effect immediately after the Fifteenth Annual Meeting of the Commission, on 17 October 2008. It requires CCSBT Members and Cooperating Non-Members to adopt and implement satellite-linked VMS for vessels fishing for SBT that complies with the IOTC, WCPFC, CCAMLR, or ICCAT VMS requirements according to the respective convention area in which the SBT fishing is being conducted. For fishing outside of these areas, the IOTC VMS requirements must be followed.

5. Scientific Advice

Based on the new MP adopted in 2019 and implemented in 2020, and the outcome of reviews of exceptional circumstances at its 2020 and 2021 meetings, the ESC recommended that there is no need to revise the 2021-2023 TAC. The ESC-recommended annual TAC for 2021-2023 is 17,647 t.

6. Biological State and Trends

The 2020 stock assessment indicated that the SBT TRO is at 20% of its initial level and remains below the target and the level that could produce maximum sustainable yield. However, as estimated by the 2020 stock assessment, it has trended upwards since its low point of 10% initial TRO in 2009.

Exploitation rate: Moderate (Below F_{MSY})

Exploitation state: Overexploited

Abundance level: Low abundance

SOUTHERN BLUEFIN TUNA SUMMARY FROM ESC in 2020 (global stock)	
Maximum Sustainable Yield	33,207 t (31,471-34,564 t)
Reported (2020) Catch	16,441 t
Current (2020) biomass (B10+)	204,596 t (184,272-231,681)
Current condition relative to initial	
TRO	0.20 (0.16–0.24)
B10+	0.17 (0.14–0.21)
TRO (2020) Relative to TRO_{msy}	0.69 (0.49–1.03)
Fishing Mortality (2019) Relative to F_{msy}	0.52 (0.37–0.73)
Current Management Measures	Effective Catch Limit for Members and Cooperating Non-Members: 17,647 t per year for the years 2021-2023

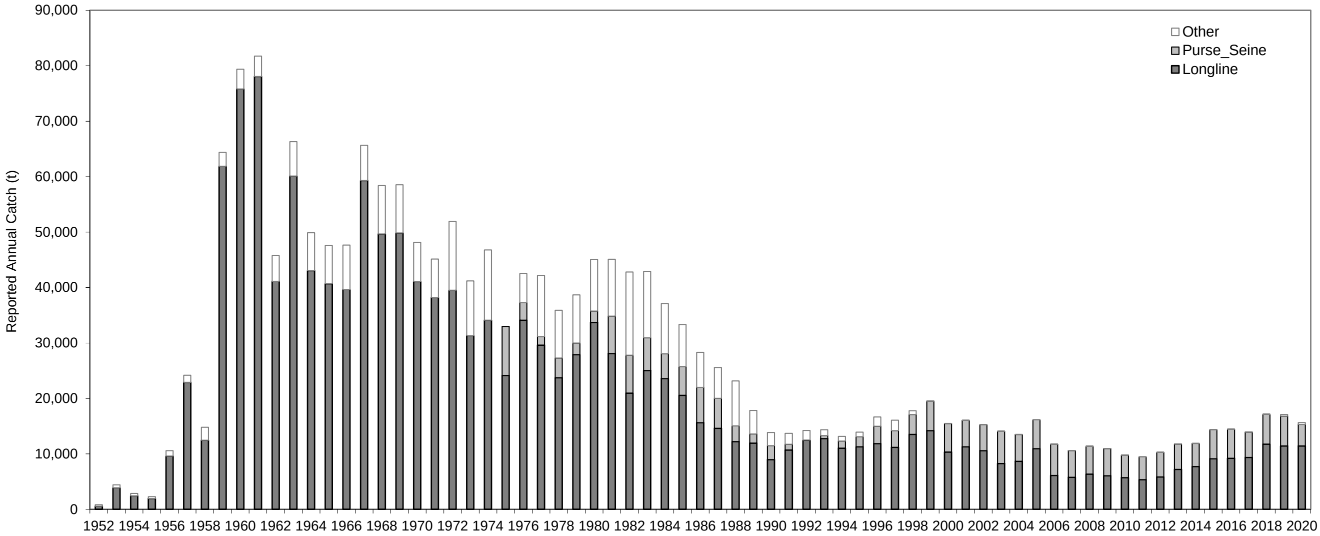

Figure 1: Reported southern bluefin tuna catches by fishing gear, 1952 to 2020. Note: a 2006 review of SBT data indicated that catches over the preceding 10 to 20 years may have been substantially under-reported.

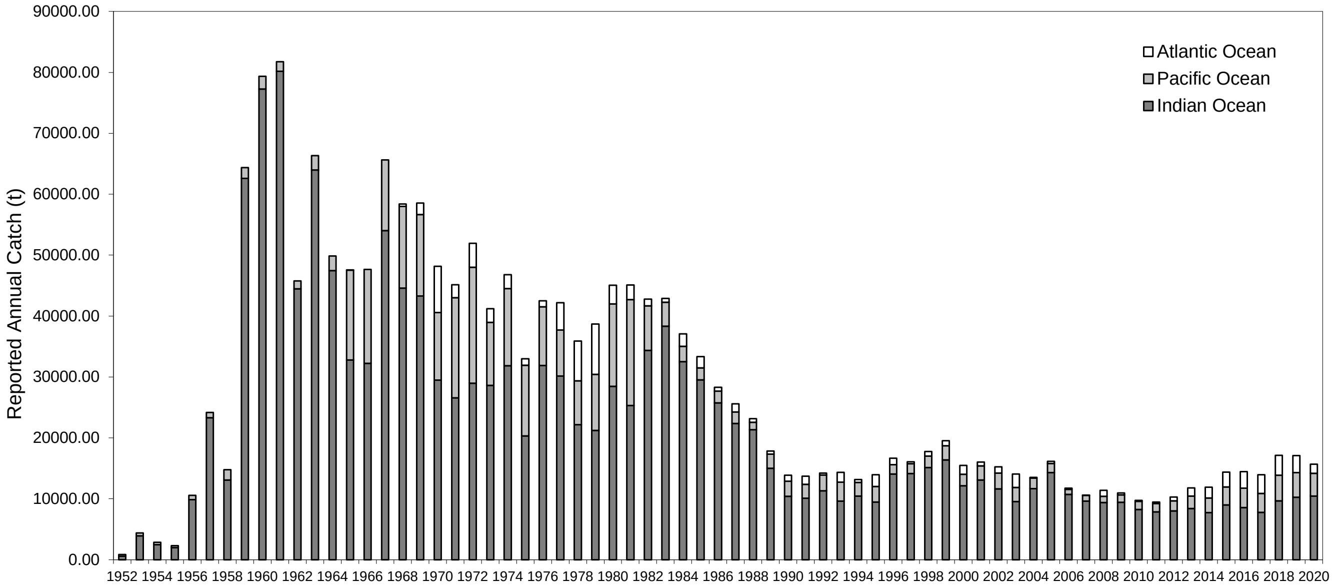

Figure 2: Reported southern bluefin tuna catches by ocean, 1952 to 2020. Note: a 2006 review of SBT data indicated that catches over the preceding 10 to 20 years may have been substantially under-reported.

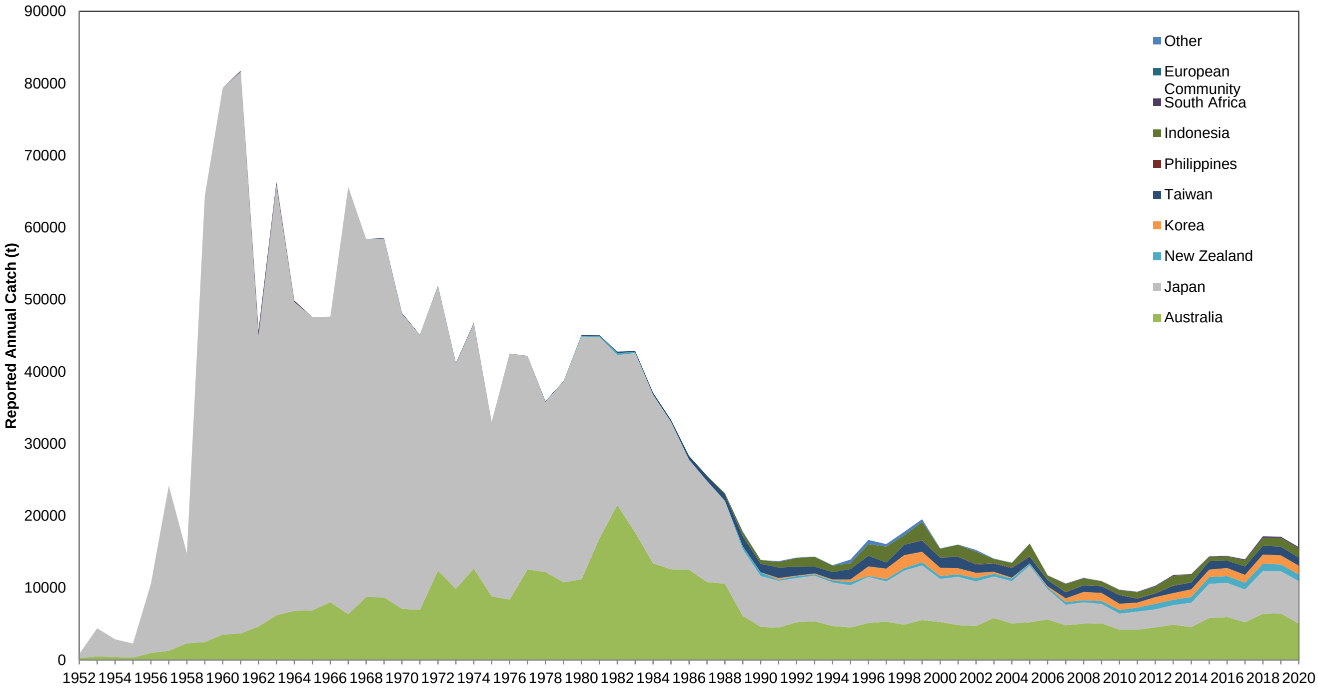

Figure 3: Reported southern bluefin tuna catches by flag, 1952 to 2020. Note: a 2006 review of SBT data indicated that catches over the preceding 10 to 20 years may have been substantially under-reported.

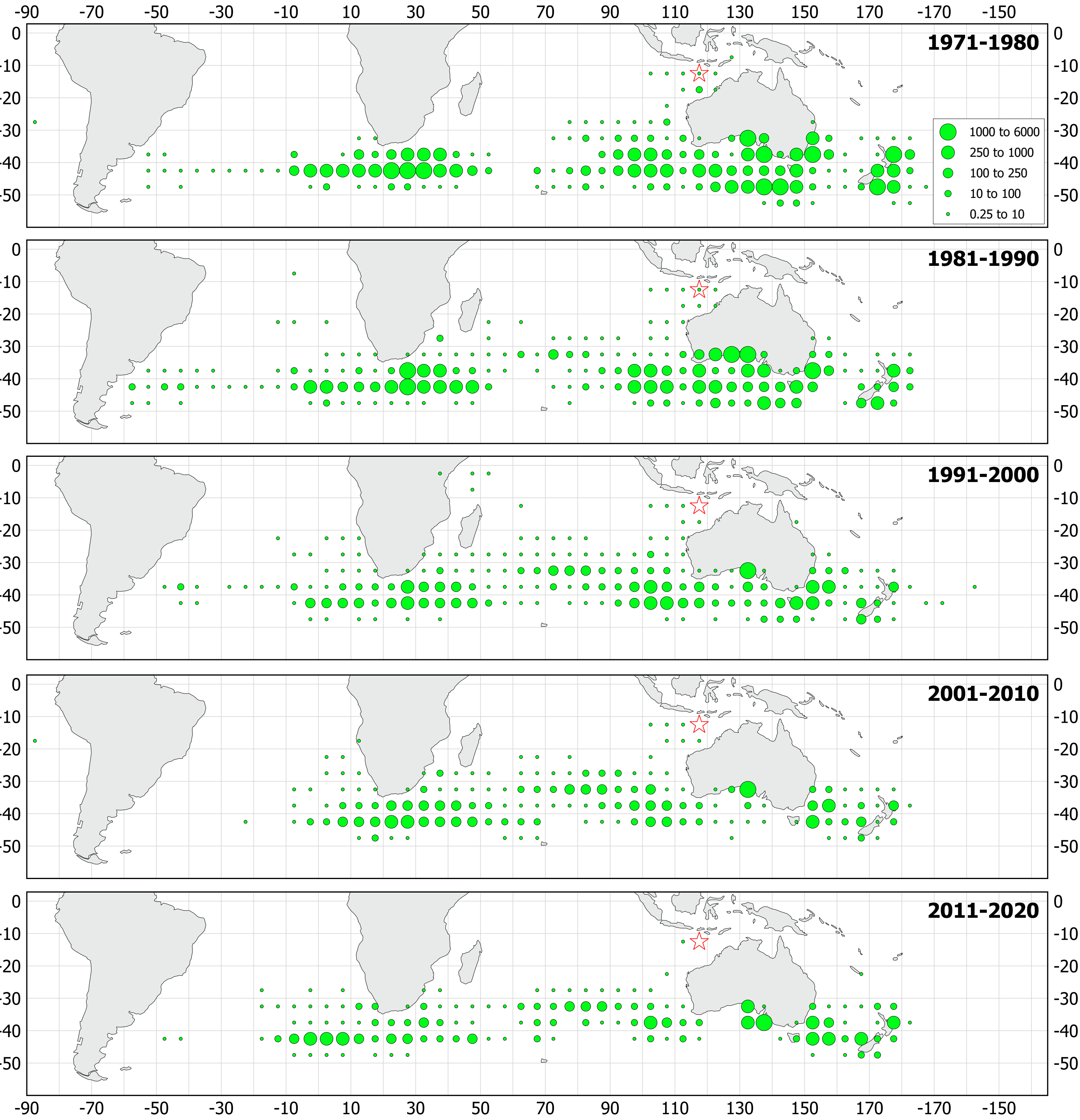

Figure 4: Geographical distribution of average annual reported southern bluefin tuna catches (t) by CCSBT Members and cooperating non-Members over the periods 1971-1980, 1981-1990, 1991-2000, 2001-2010 and 2011-2020 per 5° block. The area marked with a star is an area of significant catch in the breeding ground. Block catches averaging less than 0.25 tons per year are not shown. Note: This figure may be affected by past anomalies in catch.

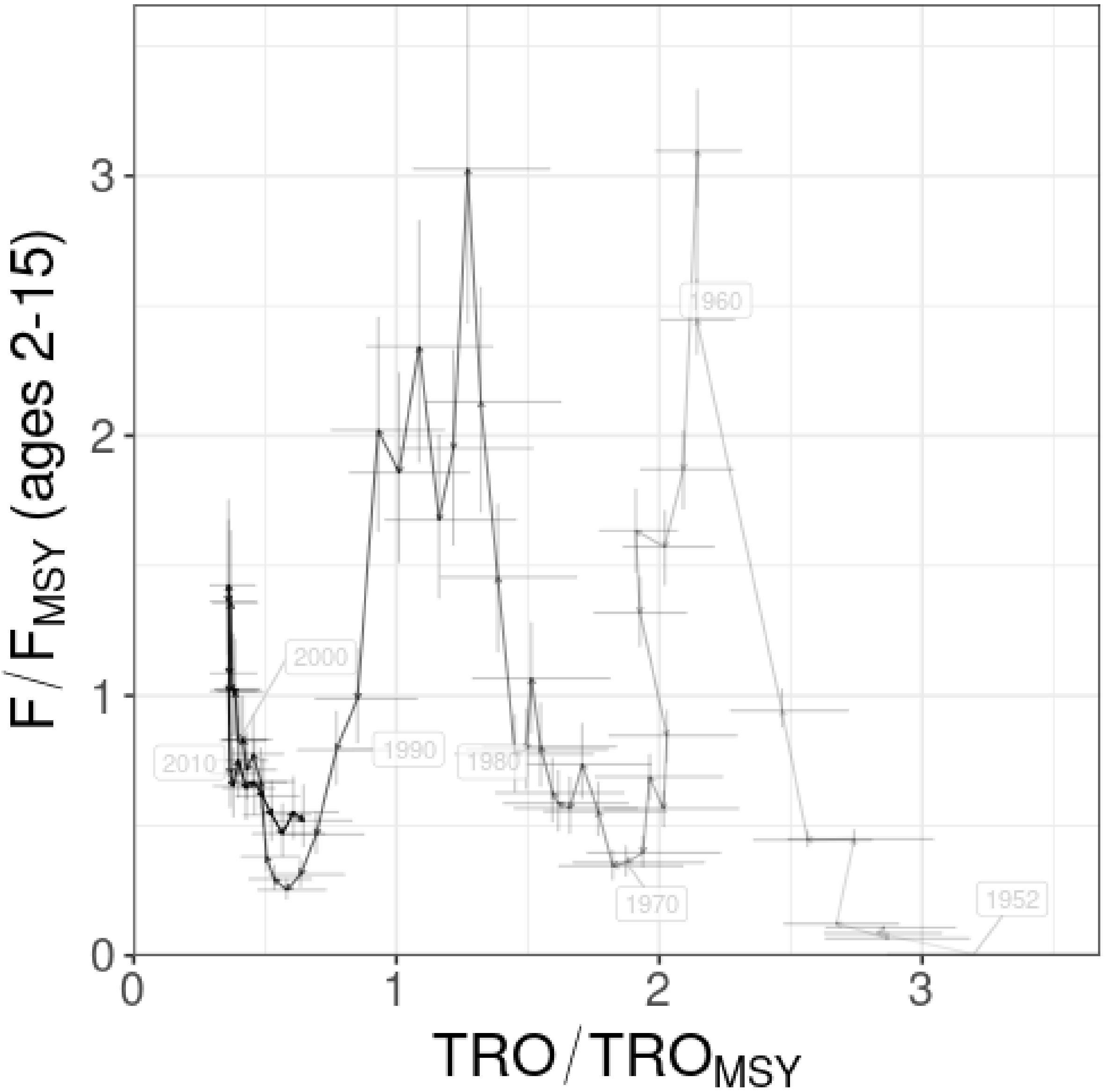

Figure 5. Time trajectory from 1952 to 2019 of median fishing mortality over the F_{MSY} (for ages 2-15) versus Total Reproductive Output (TRO) over TRO_{MSY}. The fishing mortality rates are based on biomass-weighted values and the relative fishery catch composition and mean SBT body weights in each year. Vertical and horizontal lines represent 25th-75th percentiles from the operating model grid.

Attachment 8

Proposed template for submitting and prioritising CCSBT Scientific Research Program proposals

A consistent format for submitting CCSBT SRP proposals would help to streamline the evaluation process. This paper provides a draft template that is meant to provide an informative summary of research proposals that can be easily sorted, searched, evaluated, and prioritised.

Description of template fields

A. Start year – the year in which the project is expected to begin and for which funding is needed. Ongoing projects should use "Ongoing" instead of a numerical year, e.g., 2022

B. Duration – the number of years, restricted to the duration of the current SRP

C. General category – currently operating model (OM), Cape Town Procedure (CTP), or Both

D. Sub-category – these are roughly the original categories from the 2014-2018 SRP: Catch, Indices, Biology, Assess, Review

E. Project title – a concise, informative title for the project

F. Problem – a brief description of the specific problem being addressed

G. Objectives – a list of concise project objectives, which should include the main research objectives as well as an objective for how the results will be incorporated/implemented in the General Category (e.g., how results will be incorporated into the OM or CTP or Both)

H. Rationale – a brief statement justifying the project based on importance and impact

I. Impact-Scale – High, Med, Low impact on the General Category

J. Impact-Timing – expected timeframe in which the Impact-Scale will occur. These are labeled Short1 (within 1 year), Med2-4 (2-4 years), and Long6+ (more than 6 years)

K. Priority – to be completed at ESC meetings

L. Rank – to be completed at ESC meetings

Template for projects under the CCSBT Scientific Research Plan. Two examples are provided for demonstration purposes only.

A	B	C	D	E	F	G	H	I	J
Start Year	Duration	General category	Sub-category	Project title	Problem	Objectives	Rationale	Impact-Scale	Impact-Timing
2022	3	Both	Indices	Development of GAM CPUE standardisation for CTP	Current Base GLM is highly sensitive and biased when spatial effort distribution changes over time	1. Develop alternative CPUE standardisation methods to reduce biases caused by effort redistribution. 2. Test new methods on existing datasets. 3. Recommend new BaseCPUE model for OMMP 2022 and CTP 2022	The CPUE GLM is a core component of the CTP and biases could lead to deviations from expected TAC and rebuilding performance	High	Short1
Ongoing	1	OM	Biology	Develop and evaluate independent estimates of size/age at maturity		1. Complete ongoing study	Independent estimates are needed to inform assessment and CKMR estimates	High	Short1

Attachment 9

Histograms and probabilities of TAC in 2021

The operating model projections with the Cape Town Procedure (CTP) tested in 2019 result in variable TAC outcomes. Figure 1 shows the relative probabilities of 2021 TACs projections, similar to that shown in paper CCSBT-ESC/2108/33 (with the same bin width of 50 t and a probability density line overlaid). Figure 2 shows the same information presented as a cumulative density plot. Table 1 presents the probability of occurrence of TAC in 200 t increments.

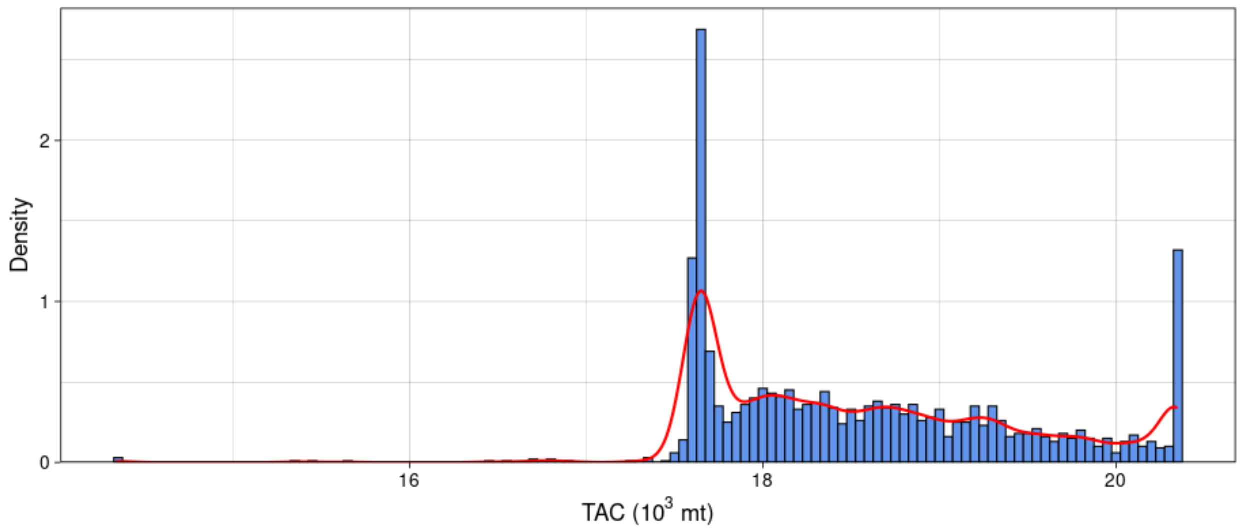

Figure 1: Histogram (bin width of 50 t) and density (red line) of total allowable catch (TAC) during 2021 predicted in the projections when the Cape Town Procedure (CTP) was tested in 2019.

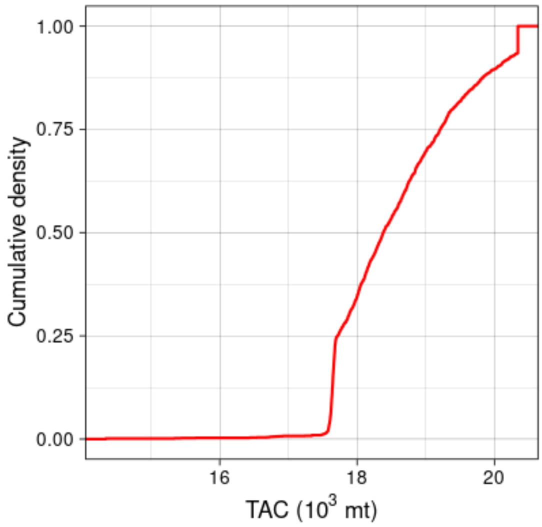

Figure 2: Cumulative density (probability) of total allowable catch (TAC) projected for 2021 from the applied Cape Town Procedure (CTP) as tested in 2019. The TAC's with high probability are indicated by steep (almost vertical) parts of the curve. The vertical axis represents the probability that the TAC will be less than the corresponding value on the horizontal axis.

Table 1: The probability of realising the total allowable catch (TAC, in 200 t increments). The notation (a, b] implies that a < TAC ≤ b (i.e., a is included but b is excluded from the interval). The highest three probabilities are indicated in red, orange and yellow in descending order.

TAC (10^3 mt)	Probability		TAC (10^3 mt)	Probability
(14.0, 14.2]	0.000		(17.6, 17.8]	0.235
(14.2, 14.4]	0.002		(17.8, 18.0]	0.070
(14.4, 14.6]	0.000		(18.0, 18.2]	0.089
(14.6,14.8]	0.000		(18.2, 18.4]	0.073
(14.8, 15.0]	0.000		(18.4, 18.6]	0.060
(15.0, 15.2]	0.000		(18.6, 18.8]	0.072
(15.2, 15.4]	0.001		(18.8, 19.0]	0.059
(15.4, 15.6]	0.001		(19.0, 19.2]	0.051
(15.6, 15.8]	0.001		(19.2, 19.4]	0.053
(15.8, 16.0]	0.000		(19.4, 19.6]	0.037
(16.0, 16.2]	0.000		(19.6, 19.8]	0.034
(16.2, 16.4]	0.000		(19.8, 20.0]	0.025
(16.4, 16.6]	0.001		(20.0, 20.2]	0.024
(16.6, 16.8]	0.002		(20.2, 20.4]	0.081
(16.8, 17.0]	0.002		(20.4, 20.6]	0.000
(17.0, 17.2]	0.000		(20.6, 20.8]	0.000
(17.2, 17.4]	0.002		(20.8, 21.0]	0.000
(17.4, 17.6]	0.031			

Attachment 10

Data Exchange Requirements for 2022

Introduction

The data exchange requirements for 2022, including the data that are to be provided and the dates and responsibilities for the data provision, are provided in **Annex A**.

Catch effort and size data should be provided in the identical format as were provided in 2021. If the format of the data provided by a Member is changed, then the new format and some test data in that format should be provided to the Secretariat by 31 January 2022 to allow development of the necessary data loading routines.

Data listed in Attachment A should be provided for the complete 2021 calendar year plus any other year for which the data have changed. If changes to historical data are more than a routine update of the 2020 data or very minor corrections to older data, then the changed data will not be used until discussed at the next ESC meeting (unless there was specific agreement to the contrary). Changes to past data (apart from a routine update of 2020 data) must be accompanied by a detailed description of the changes.

Annex A

Type of Data to provide[1]	**Data Provider(s)**	**Due Date**	**Description of data to provide**
CCSBT Data CD	Secretariat	31 Jan 22	An update of the data (catch effort, catch at size, raised catch and tag-recapture) on the data CD to incorporate data provided in the 2021 data exchange and any additional data received since that time, including: • Tag/recapture data (*The Secretariat will provide additional updates of the tag-recapture data during 2022 on request from individual members*); • Update the unreported catch estimates using the revised scenario (S1L1) produced at SAG9,
Total catch by Fleet	all Members and Cooperating Non-Members	30 Apr 22	Raised total catch (weight and number) and number of boats fishing by fleet and gear. These data need to be provided for both the calendar year and the quota year.
Recreational catch	all Members and Cooperating Non-Members that have recreational catches	30 Apr 22	Raised total catch (weight and number) of any recreationally caught SBT if data are available. A complete historical time series of recreation catch estimates should be provided (unless this has previously been provided). Where there is uncertainty in the recreational catch estimates, a description or estimate of the uncertainty should be provided.
SBT import statistics	Japan	30 Apr 22	Weight of SBT imported into Japan by country, fresh/frozen and month. These import statistics are used in estimating the catches of non-member countries.
Mortality allowance (RMA and SRP) usage	all Members (& Secretariat)	30 Apr 22	The mortality allowance (kilograms) that was used in the 2021 calendar year. Data is to be separated by RMA and SRP mortality allowance. If possible, data should also be separated by month and location.

[1] The text "**For MP/OM**" means that this data is used for both the Management Procedure and the Operating Model. If only one of these items appears (e.g. **For OM**), then the data is only required for the specified item.

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
Catch and Effort	all Members (& Secretariat)	23 Apr 22 (New Zealand)[2] 30 Apr 22 (other members & Secretariat) 31 July 22 (Indonesia)	Catch (in numbers and weight) and effort data is to be provided as either shot by shot or as aggregated data (New Zealand provides fine scale shot by shot data which is aggregated and distributed by the Secretariat). The maximum level of aggregation is by year, month, fleet, gear, and 5x5 degree (longline fishery) or 1x1 degree for surface fishery. Indonesia will provide estimates based on either shot by shot or as aggregated data from the trial Scientific Observer Program.
Non-retained catches	All Members	30 Apr 22 (all Members except Indonesia) 31 July 22 (Indonesia)	The following data concerning non retained catches will be provided by year, month, and 5*5 degree for each fishery for all sets where SBT is either caught or targeted: • Number of SBT reported (or observed) as being non-retained; • Raised number of non-retained SBT taking into consideration vessels and periods in which there was no reporting of non-retained SBT; • Estimated size frequency of non-retained SBT after raising; • Details of the fate and/or life status of non-retained fish. Indonesia will provide estimates based on either shot by shot or as aggregated data from the trial Scientific Observer Program.
RTMP catch and effort data	Japan	30 Apr 22	The catch and effort data from the real time monitoring program should be provided in the same format as the standard logbook data is provided.
Raised catch data for AU, NZ catches	Australia, Secretariat	30 Apr 22	Aggregated raised catch data should be provided at a similar resolution as the catch and effort data. Japan, Korea and Taiwan do not need to provide anything here because they provide raised catch and effort data. New Zealand does not need to provide anything here because the Secretariat produces New Zealand's raised catch data from the fine scale data provided by New Zealand.
Raised number of hooks data for NZ catches	Secretariat	30 Apr 22	Raised New Zealand number of hooks data, to be provided to NZ only, generated from NZ fine scale data by the Secretariat.

[2] The earlier date specified for New Zealand is so that the Secretariat will be able to process the fine scale New Zealand data in time to provide aggregated and raised data to members by 30 April.

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
Observer length frequency data	New Zealand	30 Apr 22	Raw observer length frequency data as provided in previous years.
Raised Length Data	Australia, Taiwan, Japan, New Zealand, Korea	30 Apr 22 (Australia, Taiwan, Japan, Korea) 7 May 22 (New Zealand)[3]	Raised length composition data should be provided[4] at an aggregation of year, month, fleet, gear, and 5x5 degree for longline and 1x1 degree for other fisheries. Data should be provided in the finest possible size classes (1 cm). A template showing the required information is provided in Attachment C of CCSBT-ESC/0609/08.
Raw Length Frequencies	South Africa	30 Apr 22	Raw Length Frequency data from the South African Observer Program.
RTMP Length data	Japan	30 Apr 22	The length data from the real time monitoring program should be provided in the same format as the standard length data.
Indonesian LL SBT age and size composition	Australia Indonesia	30 Apr 22	Estimates of both the age and size composition (in percent) is to be generated for the spawning season July 2020 to June 2021. Length frequency for the 2020 calendar year and age frequency for the 2020 calendar year is also to be provided. Indonesia will provide size composition in length and weight based on the Port-based Tuna Monitoring Program. Australia will provide age composition data according to current data exchange protocols.

[3] The additional week provided for New Zealand is because New Zealand requires the raised catch data that the Secretariat is scheduled to provide on 30 April.
[4] The data should be prepared using the agreed CCSBT substitution principles where practicable. It is important that the complete method used for preparing the raised length data be fully documented.

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
Direct ageing data	All Members except the EU	30 Apr 22	Updated direct age estimates (and in some cases revised series due to a need to re-interpret the otoliths) from otolith collections. Data must be provided for at least the 2019 calendar year (see paragraph 95 of the 2003 ESC report). Members will provide more recent data if these are available. The format for each otolith is: Flag, Year, Month, Gear Code, Lat, Long, Location Resolution Code[5], Stat Area, Length, Otolith ID, Age estimate, Age Readability Code[6], Sex Code, Comments. It is planned that the Secretariat will provide the direct age estimates for Indonesia through a contract with CSIRO.
Trolling survey index	Japan	30 Apr 22	Estimates of the different trolling indices (piston-line index and grid-type trolling index (GTI)) for the 2021/22 season (ending 2022), including any estimates of uncertainty (e.g. CV).
Tag return summary data	Secretariat	30 Apr 22	Updated summary of the number tagged and recaptured per month and season.
Gene tagging data	Secretariat	30 Apr 22	An estimate of juvenile abundance and mark-recapture data from the pilot gene-tagging study through a contract with CSIRO. The mark-recapture data will include the tagging release data (e.g. date of tagging, length of fish), tag recapture data (e.g. recapture sample date, length) and whether or not a genetic match with a release tissue was found.
Close Kin Data	Secretariat	30 Apr 22	Updated dataset of identified SBT parent-offspring pairs and half-sibling using SNPs. This is a deliverable of the SBT annual close-kin tissue sampling, processing, kin identification and Indonesian ageing project conducted by CSIRO under contract to the CCSBT.
Catch at age data	Australia, Taiwan, Japan, Secretariat	14 May 22	Catch at age (from catch at size) data by fleet, 5*5 degree, and month to be provided by each member for their longline fisheries. The Secretariat will produce the catch at age for New Zealand and Korea using the same routines it uses for the CPUE input data and the catch at age for the MP.
Global SBT catch by flag and by gear	Secretariat	22 May 22	Global SBT catch by flag and gear as provided in recent reports of the Scientific Committee.

[5] M1=1 minute, D1=1 degree, D5=5 degree.
[6] Scales (0-5) of readability and confidence for otolith sections as defined in the CCSBT age determination manual.

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
Raised catch-at-age for the Australia surface fishery. **For OM**	Australia	24 May 22[7]	These data will be provided for July 2020 to June 2021 in the same format as previously provided.
Raised catch-at-age for Indonesia spawning ground fisheries. **For OM**	Secretariat	24 May 22	These data will be provided for July 2020 to June 2021 in the same format as on the CCSBT Data CD.
Total catch per fishery and sub-fishery each year from 1952 to 2021. **For OM**	Secretariat	31 May 22	The Secretariat will use the various data sets provided above together with previously agreed calculation methods to produce the necessary total catch by fishery and total catch by sub-fishery data required by the Operating Model.
Catch-at-length (2 cm bins) and catch-at-age proportions. **For OM**	Secretariat	31 May 22	The Secretariat will use the various catch at length and catch at age data sets provided above to produce the necessary length and age proportion data required by the operating model (for LL1, LL2, LL3, LL4 – separated by Japan and Indonesia, and the surface fishery). The Secretariat will also provide these catch at length data subdivided by sub fishery (e.g. the fisheries within LL1).
Global catch at age	Secretariat	31 May 22	Calculate the total catch-at-age in 2021 according to Attachment 7 of the MPWS4 report except that catch-at-age for Japan in areas 1 & 2 (LL4 and LL3) is to be prepared by fishing season instead of calendar year to better match the inputs to the operating model.
CPUE input data	Secretariat	31 May 22	Catch (number of SBT and number of SBT in each age class from 0-20+ using proportional aging) and effort (sets and hooks) data[8] by year, month, and 5*5 lat/long for use in CPUE analysis.

[7] The date is set 1 week before 1 June to provide sufficient time for the Secretariat to incorporate these data in the data set it provides for the OM on 1 June.

[8] Data restricted to months April to September, SBT statistical areas 4-9, and the Japanese, Australian joint venture and New Zealand joint venture fleets.

Type of Data to provide[1]	Data Provider(s)	Due Date	Description of data to provide
CPUE monitoring and quality assurance series.	Australia, Japan, Taiwan, Korea	15 Jun 22 (earlier if possible)[9]	8 CPUE series are to be provided for ages 4+, as specified below: • Nominal (Australia) • B-Ratio proxy (W0.5)[10] (Japan) • Geostat proxy (W0.8)[10] (Japan) • GAM (Australia) • Shot x shot Base Model (Japan) • Reduced Base Model (Japan) • Taiwan Standardised CPUE (Taiwan) • Korean Standardised CPUE (Korea)
Core vessel CPUE series **for MP**	Japan	15 Jun 22 (earlier if possible)	Provide both the w0.5 and w0.8 Core Vessel CPUE Series, which are calculated from the GLM Base model
Core vessel CPUE series **for OM**	Japan	15 Jun 22 (earlier if possible)	Provide CS, VS w0.6 and w0.9 of Core Vessel CPUE Series, which are calculated from GAM.

[9] When there are no complications, it is possible to calculate the CPUE series less than two weeks after the CPUE input data is provided. Therefore, if there are no complications, Members should attempt to provide the CPUE series earlier than 15 June.

[10] This series is based on the standardisation model by Nishida and Tsuji (1998) using all vessel data. Due to loss of data from Japanese-flagged charter vessels in the New Zealand fishery from 2016 onward, these indices are calculated combining areas 4 and 5, areas 6 and 7, respectively.

Attachment 11

ESC's three-year workplan, including resource requirements

(abbreviations: Sec=Secretariat Staff, Interp=Interpretation, Ch=Independent ESC Chair, P=Independent Advisory Panel, C=Consultant, Cat=Catering only, FM=full meeting costs – venue & equipment hire etc., Contracted=CCSBT contract with CSIRO)

The number of days specified for meetings below assume that these will be physical meetings. However, due to the COVID-19 pandemic, it may be necessary to hold virtual meetings. In the event of virtual meetings, the number of days for each meeting will likely increase by two days.

	2022	2023 (Indicative only)	2024 (Indicative only)
Meetings			
ESC Meeting	6 days FM: 1Ch, 3P, 1C, 3 Interp, 3 Sec	6 days FM: 1Ch, 3P, 1C, 3 Interp, 3 Sec	6 days FM: 1Ch, 3P, 1C, 3 Interp, 3 Sec
ESC Meeting Chair's report	1Ch, 1P days	1Ch, 1P days	1Ch, 1P days
June/July OMMP Meeting in Seattle *(no Sec, no Interp)*	5 days Cat: 3P, 2C, 1Ch + 3C Prep Days	5 days Cat: 3P, 1C, 1Ch + 3C Prep Days	No
CPUE Webinars	4 Webinars[1] 4 * (2.5P days, 1C day)	2 Webinars 4 * (2.5P days, 1C day)	2 Webinars 4 * (2.5P days, 1C day)
SRP Workshop	1-2 minor virtual meetings, 1 Webinar 3 P Days	No	No
Informal technical workshop (immediately prior to ESC, *no Interp*)	No	No	No
SRP Projects requiring CCSBT resources			
Gene Tagging	Contracted ($720,000)	Contracted ($720,000)	Contracted ($720,000)
Continued close-kin sample collection & Processing	Contracted ($50,867)	Contracted ($55,783)	Contracted ($57,351)
Close-kin identification & exchange	Contracted ($113,804)	Contracted ($123,653)	Contracted ($126,578)
Continued aging of Indonesian otoliths	Contracted ($54,732)	Contracted ($56,938)	Contracted ($58,477)
Routine OMMP Code Maintenance / Development	13 P days[2] + 6 months Shiny App	5 P days + 6 months Shiny App	5 P days + 6 months Shiny App
Maturity study	$55,000[3]	No	No
CPUE *(Development of GAM standardisation for CTP)*	28 C days[4] 2 P days	No	No
UAM *(simple update to inform consideration of Exceptional Circumstances for the MP)*	10 C days	No	No

[1] One webinar in late 2021 and 3 in 2022.
[2] Nine days moved from 2021 to 2022 for work on the Shiny App etc. plus 4 days for regular code maintenance/file preparation and for improvement of OM technical documentation.
[3] CCSBT provided funding for a statistician for the maturity study in 2019. However, the work has been deferred while waiting for ovary histology from Members. It is now planned to conduct this work in 2022.
[4] This is to cover work to be conducted from the end of ESC 26 until the completion of the planned work in 2022.

	2022	2023 (Indicative only)	2024 (Indicative only)
E-tagging design study	$80,000	No	No
UAM *(update to incorporate revised CPUE and changes in effort by early May to inform stock assessment)*	No	28 C days	No
Review/rewrite of OM Code and move code to a new platform	-[5]	To be advised	To be advised
CPUE *(Incorporation of KR & TW CPUE)*	No	To be advised[6]	To be advised[6]
Review and development of new SOP[7] for monitoring of spawning ground catches	No	To be advised[6]	To be advised[6]

[5] Discussion for rewriting stock-assessment/OM code is to occur during 2022 OMMP with a plan presented to the 2022 ESC.
[6] This priority of this project will be reviewed, with other potential projects, as part of the new SRP project review process that will occur intersessionally during 2022. That review will recommend which projects proceed from 2023 and onwards.
[7] Standard Operating Procedure.