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Southern Bluefin Tuna Inter-sessional Science 2020-21

Final Report

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The work presented to the 2020 CCSBT meetings was reviewed by ABARES, the CCSBT Advisory Panel and CCSBT member scientists.

The team of CSIRO scientists involved included: Ann Preece, Campbell Davies, Rich Hillary, Jessica Farley, Paige Eveson, Jason Hartog and Scott Cooper.

Non-technical summary

Through the Southern Bluefin Tuna (SBT) Inter-sessional Science Project, CSIRO provides scientific support and advice to AFMA, the SBT Management Advisory Committee, Australian Government and Industry and participates in Australian delegation contributions to the workings of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) Extended Scientific Committee.

Consultation and advice are provided to AFMA on the CCSBT work plans, the scientific data exchange, evaluation of exceptional circumstances and indicators, discussion of the CCSBT Scientific Research Program and future planning. The technical work program in 2020-21 included a full stock assessment and implementation of the new management procedure to recommend the global catch for 2021-2023.

The full stock assessment indicated that rebuilding the SBT stock has been very successful, with current stock status estimated to be 20% of initial levels. The 2020 stock assessment uses the new juvenile abundance estimates from the gene-tagging program, for the first time.

The Cape Town Procedure was also implemented for the first time in 2020 to recommend the TAC for 2021-2023. The recommended TAC was adopted by the Commission.

Review of metarules indicated that no changes to the TAC were required. Further work is required, however, to examine standardisation methods to address the issues with the Japanese longline CPUE and develop a new series to include in a revised MP before 2022.

The review of the CCSBT Scientific Research Program (2014-2018) noted substantial progress has been made on priority research and monitoring programs. CCSBT now funds these programs (e.g. gene-tagging for an estimate of juvenile abundance and Close-kin mark-recapture for adult abundance and natural mortality), which provide informative data for the stock assessment and management procedure.

Data have been provided to the 2021 scientific data exchange on direct ageing, age-length keys for the Australian surface fishery, catch at age for longline and surface fisheries and nominal CPUE for use in models. Australian surface fishery otoliths have been aged and archived.

Outputs from this inter-sessional science project have been considered in depth by the CCSBT scientific committee and Advisory Panel members and are reflected in recommendations and advice of the ESC to the Commission, and by the Extended Commission in the 2020 funding decisions and approach to the future work program.

This work provides ongoing scientific advice to the Southern Bluefin Tuna MAC and AFMA to support the adequate monitoring, implementation and success of management arrangements in the Southern Bluefin Tuna Fishery.

1 Background

Through this SBT Inter-sessional Science Project, CSIRO provides scientific support and advice to AFMA, Southern Bluefin Tuna MAC (SBTMAC), Australian Government and Industry and participates in the Australian delegation to the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) Extended Scientific Committee (ESC). This is essential work that provides ongoing scientific advice to the SBTMAC and AFMA to support the monitoring, implementation and success of management arrangements in the Southern Bluefin Tuna Fishery. Consultation and advice are provided to AFMA on the CCSBT work plans, the scientific data exchange, evaluation of exceptional circumstances and indicators, review of the CCSBT Scientific Research Program and future planning. The project covers attendance at ESC and Operating Model and Management Procedure (OMMP) technical meetings, and domestic consultation and planning discussions.

The 2020 ESC workplan focus was on the full stock assessment and the first implementation of the new management procedure. The 2020 stock assessment is the first assessment to use the new juvenile abundance estimates from the gene-tagging program. The new management procedure uses close-kin, Japanese longline CPUE and gene-tagging data. A full specification of the new management procedure (the Cape Town Procedure) has been developed by CSIRO in collaboration with CCSBT members. The assessment models and the new management procedure use updated data provided through the 2020 data exchange. The 2020 ESC also addressed further development of the CCSBT's scientific research program, in addition to the regular review of meta-rules consideration of exceptional circumstances and data provided through the CCSBT data exchange. This project also incorporates the archiving and ageing of otoliths collected in the surface fishery and provides age-length keys and other data to the 2021 data exchange.

2 Need

This is essential work that provides ongoing scientific advice to the Southern Bluefin Tuna MAC and AFMA to support the adequate monitoring, implementation and success of management arrangements in the Southern Bluefin Tuna Fishery. Consultation and advice is provided to AFMA on the CCSBT work plans, the scientific data exchange, evaluation of exceptional circumstances and indicators, progress in the CCSBT Scientific Research Program and future planning. The project covers attendance at ESC and technical meetings, and domestic consultation and planning discussions.

The reconditioning of operating models for the 2020 stock assessment will integrate new data available through the 2020 data exchange, which may result in changes to the reference set of operating models. The gene-tagging data will be integrated into the stock assessment models for the first time. The stock assessment will provide information on the effectiveness of management for stock rebuilding since the 2011 implementation of a management procedure.

The SBT inter-sessional science project also includes the work on routine otolith archiving, ageing and developing age-length keys for the Australian SBT surface fishery. Provision of these data, by Australia, is a requirement of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT).

3 Objectives

1. Provide scientific advice and support to AFMA and SBTMAC and participate in the relevant domestic and international meetings. Participate in planning and technical consultation meetings, CCSBT ESC and technical meetings and inter-sessional webinars.
2. Prepare and review a fully updated assessment of stock status.
3. Review exceptional circumstances in relation to implementation of the new management procedure.
4. Participate in discussion and planning of a new CCSBT Scientific Research Program.
5. Provide data to the CCSBT data exchange in 2021.
6. Undertake the routine otolith archiving, ageing and developing age-length keys for the Australian SBT surface fishery and provide data to CCSBT.

4 Results and Discussion

The project has delivered results against each of the objects:

4.1 Objective 1. Scientific advice and support to AFMA and SBTMAC

Provide scientific advice and support to AFMA and SBTMAC and participate in the relevant domestic and international meetings. Participate in planning and technical consultation meetings, CCSBT ESC and technical meetings and inter-sessional webinars.

CSIRO were significant participants in the 2020 CCSBT ESC meeting, June 2020 OMMP meeting and preceding webinars, providing scientific reports, papers and expertise to the meetings. Preece, Davies and Williams rapporteured key sections of the scientific discussions and technical agreements for the meeting reports.

CSIRO has remained in consultation with AFMA, the Department of Agriculture, ABARES and Industry despite the Covid-19 related travel restrictions and disruptions. Productive and informative domestic discussions occurred prior to, and after, each of the main meetings. The CCSBT meetings were also all held as web conferencing meetings but the time available each day was extremely restricted because of the range of time zones that needed to be accommodated for the participants. The agenda was not adjusted to reflect these limitations and instead discussion and the ability to consult with the members to clarify issues off-line was constrained. Despite this, and thanks in large part to good-will and collaboration established between CSIRO and member scientists, the key items of the ESC, the stock assessment and management procedure TAC recommendation, have been achieved. Some details will need to be revisited in 2021 and 2022, as documentation and report adoption were very rushed.

Preece and Davies participated as observers at SBTMAC 2020 and provided summaries of research programs, scientific committee outcomes and future work plans.

Consultation and preparation for the 2021 work program has continued with advice provided on the draft ESC agenda and participation in the March CPUE technical meeting and development of Terms of Reference for that meeting.

Objective 1 has been completed.

4.2 Objective 2. The 2020 full Stock Assessment

Prepare and review a fully updated assessment of stock status.

CSIRO prepared the 2020 full stock assessment in collaboration with Japan's member scientists (Hillary et al., 2020a). At the OMMP technical working group meeting, a preliminary reconditioning of the SBT operating models was presented, and the reference set and sensitivity tests for the assessment of stock status were reviewed. CSIRO worked collaboratively with Japan and the Chair

of the Advisory Panel to complete running of the full set of models and collation of results for the paper presented to ESC.

The stock assessment has not been conducted since 2107 (as specified in the schedule of activities associated with adoption of the management procedure) and is the first assessment to use the gene-tagging abundance estimates of the age-2 cohorts (2016-2018). The stock assessment paper carefully examines fit to the data for each of the data sources.

An important milestone in the history of SBT science and rebuilding of the stock has been reached. The assessment indicates that the stock has rebuilt from very low levels to 20% of initial total reproductive output. Total reproductive output (TRO) is a measure of the reproductive strength of the adult population, similar to spawning stock biomass used in other fisheries' performance statistics. The estimate of current stock status is (TRO current/initial) 0.2 (0.16-0.24, 80% confidence interval). All the key stock status statistics are more optimistic than in 2017 when the last assessment was completed. Sensitivity tests did not indicate any substantial changes in outcomes. Projections indicated that the MP population would continue to rebuild under the adopted MP.

The 2020 ESC reviewed and accepted the results of the assessment. The assessment has confirmed that the MP rebuilding plan is working as intended in the timeframes expected. None of the stock assessment results or outputs are used for TAC recommendation management advice, as that is the separate process of the adopted management procedure.

Objective 2 is complete.

4.3 Objective 3. Annual review of exceptional circumstances

Review exceptional circumstances in relation to implementation of the new management procedure.

CSIRO prepared a review of exceptional circumstances (Preece et al., 2020) to address the CCSBT schedule of activities for implementation of the management procedure which includes an annual review of exceptional circumstances. The review examines the CCSBT Management Procedure (MP) input data series, and stock and fishery indicators, to identify conditions and/or circumstances that may represent a substantial departure from conditions under which the MP was tested, termed "exceptional circumstances", and where appropriate recommend action. This provides a safety net around setting the TAC via the management procedure. In 2020, the ESC used the new Cape Town Procedure to calculate the recommended TAC for the 2021-2023 TAC block. Normally the TAC setting process is off-set from the year in which we complete the stock assessment, but calculating the TAC was delayed by one year to allow an extra year in the workplan for final testing and adoption of the new MP.

The review examined whether: 1) the inputs to the MP are affected, 2) the population dynamics are potentially significantly different from those for which the MP was tested (as defined by the 2019 Reference and Robustness sets of OMs), 3) the fishery or fishing operations have changed substantially, 4) total removals are greater than the MP's recommended TACs, and 5) if there are likely to be impacts on the performance of the SBT rebuilding plan as a result.

Several potential exceptional circumstances were examined in detail, but the key issue of concern was the standardised Japanese longline CPUE series used in the MP. Examination of the data and standardisation in 2020 identified predictions of high CPUE estimates from the standardisation model in areas without observed effort. The CPUE working group and OMMP meeting reviewed this issue, to the extent possible within the time available, and determined that the CPUE standardisation needs further examination and that testing of alternative standardisation methods is required. The severity of this exceptional circumstance on the operation of the MP in 2020 was assessed as low. No action was suggested to change the recommended TAC from the Cape Town Procedure, however, action over the next two years is required, to examine standardisation methods to address the issues with the CPUE, develop a new series to include in the MP, and then revise and re-tune the MP with a new CPUE series, by 2022.

In addition to this review, CSIRO and Japan collaborated to update the meta-rules associated with adoption of the new MP on behalf of members. Two papers were developed (led by Preece); 1) draft meta-rules for the OMMP meeting, which members revised (Anon, 2020a); and a final draft presented to the ESC (Anon, 2020b). The updated meta-rules were included in the full specification of the management procedure (Att 8 for the ESC report: Anon 2020c). The full specification was developed by CSIRO on behalf of the ESC members and includes an introduction, non-technical summary of the MP, a technical description (Anon 2020d), description of the analysis and data for the 3 inputs to the MP (close-kin (Anon 2020e), CPUE and gene-tagging (Anon 2020f)), and the updated meta-rules (Anon 2020b).

Objective 3 is complete.

4.4 Objective 4. The CCSBT Scientific Research Program

Participate in discussion and planning of a new CCSBT Scientific Research Program.

In 2019 CSIRO initiated a technical subgroup of participants to discuss a review of the CCSBT Scientific Research Program (SRP) and enlisted the new Advisory Panel member (Sean Cox) to Chair this group, with the aim of further broadening active engagement by other member scientists in activities funded under the SRP. An initial review of the 2014-2018 SRP was provided to the ESC to progress the development of a new SRP (Davies and Preece, 2020).

The Davies and Preece review acknowledged that substantial progress had been made in addressing key uncertainties since they were identified in 2013-14. 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. Of particular importance has been the development and implementation of gene-tagging as an alternative to the scientific aerial survey for recruitment monitoring, the transition of Close-kin Mark Recapture (CKMR) to SNP markers and associated extension to Half-Sibling Pairs (HSP) and an increased focus on alternative CPUE series and approaches to monitor the change in fleet dynamics of the LL1 fishery. In addition, the OMs have been modified to accommodate the new data series (CKMR and gene-tagging) in conditioning and projections. The addition of CKMR data has also contributed to improved estimates of natural mortality at age 10 in the assessment models.

Priority items to consider for the 2021-2025 SRP include:

- Quantifying different sources of Unaccounted Mortality (UAM), in particular, methods for determining the plausibility of estimates of non-member UAM.
- The potential to move from cohort slicing to catch at age; particularly if epigenetic ageing proves to be possible for SBT.
- Completion of the independent estimate of size/age at maturity.
- A design study to examine the relative costs and benefits of alternative e-tagging in addressing questions associated with environmental change and potential changes in spatial dynamics of different components of the stock.
- Strategic review and refinement of operation of the OM code.

A proposal for a design study to examine alternative electronic-tagging programs was provided (Patterson et al., 2020), and supported by the ESC and recommended to the Commission for funding. The design study will: (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 priority of questions, feasibility and associated costs; (4) Provide recommendations for implementation and outline a workplan within the forthcoming SRP timeframe.

Objective 4 is complete, however further work to develop a new CCSBT SRP will need to be continued at the 2021 ESC.

4.5 Objective 5. CCSBT data exchange 2021

Provide data to the CCSBT data exchange in 2021.

The 2021 CCSBT scientific data exchange has been completed. CSIRO has provided to the CCSBT data exchange the raised catch at age for the Australian surface and longline fisheries and will provide the Japanese longline nominal CPUE series by 15 June. Direct ageing data for the Australian Surface Fishery are up to date (discussed in 4.6 below).

Additional data were provided to the data exchange in relation to projects funded by the Commission. These included new close-kin data and a preliminary gene-tagging abundance estimate from year 4 of the program. The gene-tagging data are being checked and a final estimate will be available for the 2021 ESC. There is no new age data from Indonesia because they were unable to send the otoliths to us due to covid-19 restrictions at the airport in Bali.

Objective 5 is complete.

4.6 Objective 6. Otolith archiving and ageing

Undertake the routine otolith archiving, ageing and developing age-length keys for the Australian SBT surface fishery and provide data to CCSBT.

Over 200 otoliths were received from the Australian surface fishery in 2020. Of the otoliths received, 100 were selected and read by Fish Ageing Services. A small age bias was detected in

ageing of these readings by FAS and CSIRO in 2019. Work to investigate this was delayed because of covid-19 travel restrictions but has recently been completed. FAS and CSIRO have examined the bias and interpretation of otolith edge formation. The direct ageing data exchanged to the CCSBT are up to date.

Objective 6 is complete.

5 Benefits / management outcomes

Stakeholders in the Southern Bluefin Tuna Fishery benefit from the implementation of a scientifically designed and tested management procedure since 2011 (Hillary et al, 2016 and Hillary et al, 2019). The CCSBT MP is used to recommend the global TAC and encompasses meta-rules that provide a regular schedule and agreed process for review of data, methods, and MP performance. The Bali Procedure (MP) adopted in 2011 has provided stability, increased certainty and increases in the Australian TAC, over 9 years. The new MP, The Cape Town Procedure, adopted in 2019, is designed to rebuild the stock beyond the initial target level. The benefits of the adopted MPs have been attested to by Industry, fisheries managers and E-NGOs. An additional benefit has been the time and strategic focus this orderly science and management process has provided to concentrate on planning, prioritising and securing the necessary funding for future inter-sessional science work plans as well as addressing strategic science needs.

The 2020 stock assessment has provided an update on stock status and progress in rebuilding of the stock. A significant milestone in the history of SBT science and stock status has been reached. The assessment indicates that the stock has rebuilt from very low levels to 20% of initial total reproductive output. Total reproductive output (TRO) is a measure of the reproductive strength of the adult population, similar to spawning stock biomass used in other fisheries' performance statistics. Successful rebuilding to this level provides confidence, for managers and stakeholders, that the rebuilding strategy for SBT has been working.

Through this project, CSIRO has provided substantial input to the 2020 OMMP and ESC meetings; presenting 10 papers to the meetings (Appendix A) and leading discussions that informed decisions made at the ESC and Extended Commission, providing technical input to meetings, summarising technical model changes and runs, and rapporteured meeting reports.

The CCSBT Scientific Research Program has made substantial investment and progress in projects providing monitoring data for recruitment (gene-tagging) and adult abundance (close-kin mark recapture). CSIRO's development of cost-effective methods for monitoring the stock have been incorporated into the CCSBT Scientific Research Program and included in the Commission's budget in 2021. These research programs often have flow on effects for other Australian and International fisheries, potentially leading to improved monitoring, assessment and management of other global stocks.

The direct benefits of this project include: government, industry and community confidence that the SBT rebuilding strategy and MP implementation program is based on the best scientific advice; that previous TAC reductions and current TAC settings have been effective in reducing fishing mortality on the stock and are providing for rebuilding consistent with the Commission's rebuilding plan; and over the period 2011-2020 there have been increases in the TAC, with associated economic returns to the Australian Industry and wider community.

Extension of results has been achieved through:

- 1) Submission of working papers and attendance at the CCSBT Extended Scientific committee (online, September 2020) and the June 2020 OMMP meeting.

- 2) Communication with industry, stakeholders and government in meeting throughout the project.
- 3) Briefing papers and advice have been provided to AFMA, ABARES and the Department of Agriculture, and CSIRO has participated as observers at SBTMAC.

6 Conclusions

This SBT Inter-sessional Science 2020-21 project has covered the identified priority items of SBTMAC for the 2020 CCSBT work program, and the work up to June 2021. All the objectives of the project have been met.

CSIRO has delivered thorough, rigorous scientific advice on the key agenda items at the 2020 OMMP technical meeting and ESC meeting, and provided briefings, consultation and advice to AFMA, ABARES, Industry and SBTMAC. The CSIRO components of the CCSBT 2021 data exchange are complete, and preparation for the 2021 meetings is underway. COVID-19 travel restrictions and the difficult international time zones that mean that the web meeting can only be conducted 1.5-2 hours each day which hampers thorough communication with our international colleagues.

The 2020 full stock assessment indicates that the stock has rebuilt from very low levels to 20% of initial total reproductive output, the CCSBT's interim rebuilding target. The 2020 stock assessment incorporated the juvenile abundance estimates from the gene-tagging program for the first time.

The new MP, developed by CSIRO, has been implemented in 2020 to recommend the TAC for the 2021-2023 TAC block. TAC advice is usually offset from the years when stock status advice from the stock assessment is updated, but both occurred in 2020.

The 2020 review of meta-rules identified several potential exceptional circumstances. No action was suggested to change the recommended TAC from the Cape Town Procedure, however, action over the next two years is required to examine standardisation methods to address the issues with the CPUE, develop a new series to include in the MP, and then revise the MP, by 2022.

A review of the CCSBT Scientific Research Program (2014-2018) noted that substantial progress has been made to improve the data and methods available for stock assessment and the provision of robust management advice for rebuilding the SBT stock. These have included implementation of gene-tagging for recruitment monitoring, the transition of Close-kin Mark Recapture (CKMR) to SNP markers and associated extension to Half-Sibling Pairs (HSP) and an increased focus on alternative CPUE series and approaches to monitor the change in fleet dynamics of the Japanese longline (LL1) fishery, and incorporation of the new data series (CKMR and gene-tagging) in conditioning and projections. Priorities for the 2021-2025 Scientific Research Program have been developed for further discussion in 2021.

The 2021 data exchange has been completed, including the surface fishery direct ageing component that was delayed last year because of Covid-19. A small age bias was detected in ageing of the otolith readings by FAS and CSIRO, in 2019, related to interpretation of otolith edge formation. This has been resolved and the data exchanged to the CCSBT are up to date.

Outputs from this inter-sessional science project have been reviewed by the OMMP and ESC scientists and are reflected in recommendations and advice of the ESC to the Commission, and by the Extended Commission in the 2020 funding decisions and approach to the future work program.

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Appendix A

Ten papers* to the CCSBT ESC and OMMP meetings have resulted from this project.

These are available from the CCSBT website: <https://www.ccsbt.org/en/past-meeting-documents/564> and <https://www.ccsbt.org/en/past-meeting-documents/563>

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