CCSBT Scientific Research Program 2023-2027

This document outlines the CCSBT Scientific Research Program for the period 2023-2027.

Historical context for CCSBT's Scientific Research Program

The CCSBT Scientific Research Program (SRP) was initiated in 2000 to address priority scientific monitoring and research requirements for the assessment of southern bluefin tuna (SBT) and management of the fishery (CCSBT 2000). The External Scientific Advisory Panel was engaged by the Commission to design the SRP in consultation with national scientists. In designing the SRP, the focus was on where potential improvements could be made in stock assessment inputs, basic fishery data (e.g. size and age distribution), biological parameters (e.g. natural mortality, age of maturity, growth rates etc), and absolute and/or relative measures of abundance (e.g. CPUE, fishery independent surveys, tagging experiments) (CCSBT 2000).

The original SRP identified the following four research areas where direct CCSBT initiatives could reduce uncertainty in the stock assessment over the short term (CCSBT-SC 2001, Attachment D):

1. Characterisation of the catch
2. CPUE interpretation and analyses
3. Development of a Scientific Observer Program
4. Development of a SBT Tagging Program.

The SRP has since involved a combination of tactical and strategic research activities identified to meet relevant research priorities over 5 year windows. Following a review at ESC12 in 2007 (Anon. 2007, Davies et al 2007, Itoh et al 2007), the 2008-2013 SRP shifted focus to redevelopment of the operating models, including the incorporation of the scientific aerial survey, and the design and testing of candidate management procedures, which culminated in the Bali Procedure (Anon 2011; Hillary et al 2016).

The structure and priorities for the 2014-2018 SRP developed over time as part of ESC17 (Anon 2012, Attachment 8, Davies et al 2012), the CCSBT strategic plan (CCSBT, 2011), and CCSBT's first independent performance review (Garcia and Koehler, 2014) (Anon 2013, Attachment 12). The new structure adopted by the ESC distinguished between the ongoing monitoring and work program associated with the stock assessment and MP from explicit research activities to be defined in the SRP.

Initial review of the 2014-18 SRP (Anon. 2021, paras 170-194; Davies and Preece 2021, Table 1) at ESC 25 noted how the SRP had been central to progress in the following areas:

1. **Characterisation of catch:** Encapsulating a greater proportion of total removals by defining attributable catch by the Extended Commission, developing approaches to estimating non-member UAM, and including UAM in operating model (OM) conditioning have all improved stock assessment performance and management advice.

2. **Abundance indices:** Development and implementation of gene-tagging as an alternative to the scientific aerial survey for recruitment monitoring, updating Close-kin Mark Recapture (CKMR) genetic methods for direct monitoring of spawning SBT, and increased attention to alternative CPUE series have collectively reduced uncertainty in SBT abundance and stock assessment estimates.
3. **Biological parameters:** Fishery-independent estimates of size and age at maturity from autumn/winter feeding grounds along with standardised histological and reproductive staging methods reduced uncertainty about key biological traits of SBT.
4. **MP Implementation:** Methods developed to include gene-tagging and CKMR in candidate management procedures and the development, testing, and selection of the Cape Town Procedure reduce uncertainty in future SBT abundance and catch.
5. **Stock Assessment (OM development):** Modifying OM specifications and code to incorporate the new CKMR and gene-tagging data in conditioning and projections. Among other things, the new CKMR data improved estimates of natural mortality for the age-10+ SBT age-class (M10).

Strategic Research Priorities for the 2023-2027 SRP

The five SRP research priorities given above aim to improve stock assessment and management advice by reducing key uncertainties, as well as to pursue, where practical, basic research that improves our understanding of SBT biology. Table 1 lists priority research topics within each of these five main categories based on discussions at the most recent ESC, as well as within the 2022 SRP Working Group.

Table 1. Research priorities organised into the 5 SRP areas. Priorities are arranged in approximate rank order of importance.

1. **Characterisation of Catch**
    - Quantify sources of UAM and, in particular, develop methods for determining plausibility of indirect estimates of non-member UAM to include in future stock assessments and regular evaluation of exceptional circumstances for the MP
    - Reduce uncertainty in length and age composition of Indonesian catches and assignment to statistical areas for use in the stock assessment
    - Address current uncertainty in the magnitude and fate of discards by fishery for estimating total removals.
    - Review the potential value (via OM simulation) and feasibility of collecting tissue samples for epigenetic ageing of SBT as an alternative/complementary source of age data.

2. **Abundance indices**

- Develop CPUE series to reflect alternative hypotheses for stock and fishery distributions in OM conditioning and MP exceptional circumstances
- Explore and, where possible, refine CPUE monitoring series incorporating longline data from other fishing fleets
- Continue development of alternative recruitment indices (e.g., piston-line survey, Taiwanese CPUE)

3. Biological Parameters

- Complete unbiased estimation (e.g., histology, gonad samples) of size/age at maturity Complete age validation review workshop as agreed at ESC18 (high priority)
- Review observer protocols and standard operating procedures for collection of additional biological samples (e.g. tissue samples for determining sex and age via DNA)
- Investigate processes (e.g., selectivity, migration behaviour, skip spawning, within season spawning frequency) leading to higher realised reproductive potential of larger SBT. Differential reproductive output at length is relevant to CKMR (φ parameter) estimates of spawning stock size.
- Investigate spatial and temporal changes in biological processes, parameters, and dynamics of SBT stock, including:
    - Rates of growth and variation in size-at-age over period of stock rebuilding.
    - Timing and rate of migration 2-3 year old fish within the GAB and implications for recruitment monitoring (i.e. gene-tagging).
    - Short to medium-term changes in the spatial and temporal distribution across the current and historical range of the stock in response to changing environmental conditions and the distribution of fishing effort, as it relates to interpretation of CPUE as an index of stock abundance.
    - Medium to longer-term changes in the distribution of the stock as it rebuilds and the extent to which different life-history stages expand into areas they previously occupied (e.g., juveniles in SE Australia).

4. MP implementation

- Develop criteria and schedule for CTP performance review

5. Stock Assessment and OM development

- Develop new SBT assessment and OM platform for potential application by 2026 (high priority)
- Determine direct ageing needs to enable the potential to move from fitting size distributions to estimated age frequency distributions
- Develop a spatially explicit simulation model to explore ways of incorporating SRP tagging data into stock assessment and OM, as well as to investigate potential impacts of climate change on SBT stock and fisheries