



Update on Australian otolith collection and ageing activities in 2025

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Abstract

This report provides an update on the southern bluefin tuna (SBT) otolith collection and ageing activities in Australia in 2025. Otoliths from 140 SBT caught in the Great Australian Bight by the purse seine fishery in 2024 were received and archived in CSIRO's hard-parts collection. A subsample of 100 otoliths was prepared for ageing, however, the reading was postponed until after the SBT ageing workshop held in June 2025 to ensure updated ageing protocols were followed. The 2024 age data will be reported to the ESC next year. An additional 175 otoliths sampled in 2025 have also been collected.

CSIRO continues development of epigenetic ageing methods for tuna, including a new avenue of research in collaboration with Diversity Arrays Technology (DArT). If successful, this would significantly improve the workflows and efficiency of applications of epigenetic ageing for CKMR.

The long-term recapture of strontium-tagged SBT released in the 1990s has enabled direct validation of increment-based ageing methods in adult fish, with confirmed age estimates now extending to 30 years.

Introduction

Reliable age data are critical for understanding population dynamics and informing fisheries management. This report summarises work to provide and improve age estimates for SBT in Australia in 2025 including progress on:

- Otolith collection and ageing of the Australian purse seine catch using otoliths.
- The development of high-throughput approaches for epigenetic ageing of tuna.
- Analysis of strontium-marked otoliths from SBT that have been at liberty for extended periods to validate age estimates and confirm annual deposition of growth rings.

Otolith sampling and reading

Since the 2002 fishing season, Australia has been obliged to provide annual length-at-age estimates for the surface (purse seine) fishery in the Great Australian Bight (GAB) to CCSBT. Under the current protocol, all operators provide a sample of 10 fish that have died either during towing operations or within the first weeks following transfer to stationary farm cages, so that otoliths can be collected for ageing. In the past, there have been between ~250-400 otoliths collected from this sector per season. In recent years, however, the number of fish available for sampling has declined, primarily due to low mortality during towing.

In 2024, a total of 140 sets of otoliths were collected from the Australian surface fishery. Fish were measured to the nearest cm (fork length, FL) and the otoliths were removed and sent to CSIRO. The size range of fish sampled was 69 to 113 cm FL (Figure 1).

For ageing, 100 otoliths were selected using a length-stratified sampling strategy rather than random sampling. This approach ensured all length classes were represented, including those with small sample sizes. One otolith from each fish was sent to Fish Ageing Services Pty Ltd (FAS) in

Victoria for weighing, sectioning, and reading. Transverse sections were prepared following established protocols (Anon., 2002). Reading of these otoliths was deferred until after the SBT ageing workshop to ensure any updated ageing protocols were followed (CCSBT-ESC/2508/10). Age data from the 2024 sampling will be reported to SC31.

An additional 175 otoliths were sampled in 2025, although these are not yet archived or aged.

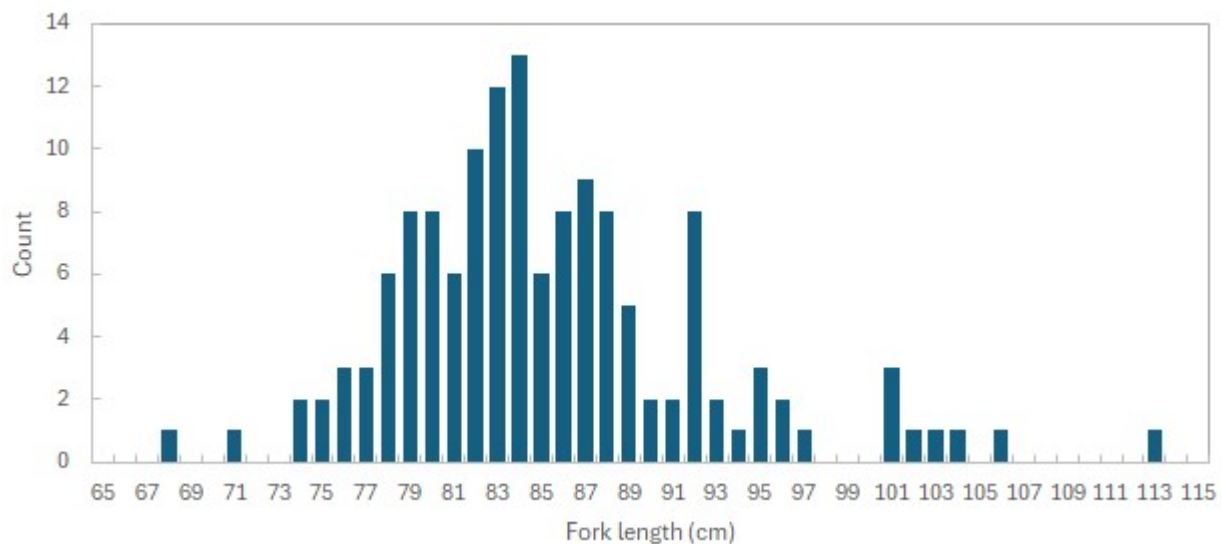


Figure 1. Length frequency of SBT with otoliths sampled from the Australian surface fishery in 2024. One hundred were selected for ageing.

Epigenetic ageing

As noted in CCSBT-ESC/2108/10, epigenetic ageing has the potential to transform the assessment and management of tuna fisheries by being able to estimate age of individual fish directly from tissue samples. This approach would significantly reduce the cost and logistical challenges of collecting direct age data from otoliths. CSIRO and others (e.g., Chevrier et al., 2025) continue to invest in the development of epigenetic ageing methods for tuna. While scaling to high-throughput applications has proved challenging, CSIRO has initiated a new avenue of research in collaboration with DART, which if successful, would improve workflow and efficiency of epigenetic ageing for CKMR. We expect to be able to report on this in more detail to the ESC next year.

Long-term recoveries of tagged SBT

Analysis of strontium-marked otoliths as validation of direct ageing methods in adult SBT

Several SBT tagged and released during the 1990s CSIRO tagging program have been recaptured by recreational fishers in Bass Strait, Australia. Of these, otoliths were recovered from three fish, each having been at liberty for almost 30 years. Two fish carried orange tags, indicating they had been injected with strontium chloride before release (Table 1). Strontium chloride is incorporated into the otoliths for a short period immediately after tagging creating a distinct, bright band visible

under scanning electron microscopy (SEM). This mark serves as a ‘timestamp’ within the otolith structure at the time of tagging.

SEM analysis was carried out on the otoliths from one of the SBT recovered (tag 73198) at the University of Tasmania’s Central Science Facility. The fish had been at liberty for 29.5 years and was estimated to be a 1-year-old at the time of tagging and injection, based on its recorded fish length (52 cm FL; Table 1). Under light microscopy, 30 growth increments were counted in total, with 29 appearing beyond the strontium chloride mark. The alignment between increments observed in otoliths post-tagging and the years at liberty provides further evidence that annual growth deposition continues through to at least 30 years of age (Figure 2). This is consistent with the oldest SBT aged using the “bomb radiocarbon” method at 34 years (Kalish et al., 1996), although increment counts from the largest individuals in the population suggest the species may live beyond 40 years.

Analysis of the otoliths from the remaining two SBT is scheduled for next year.

Table 1. Release and recapture details for three tagged SBT at liberty for almost 30 years.

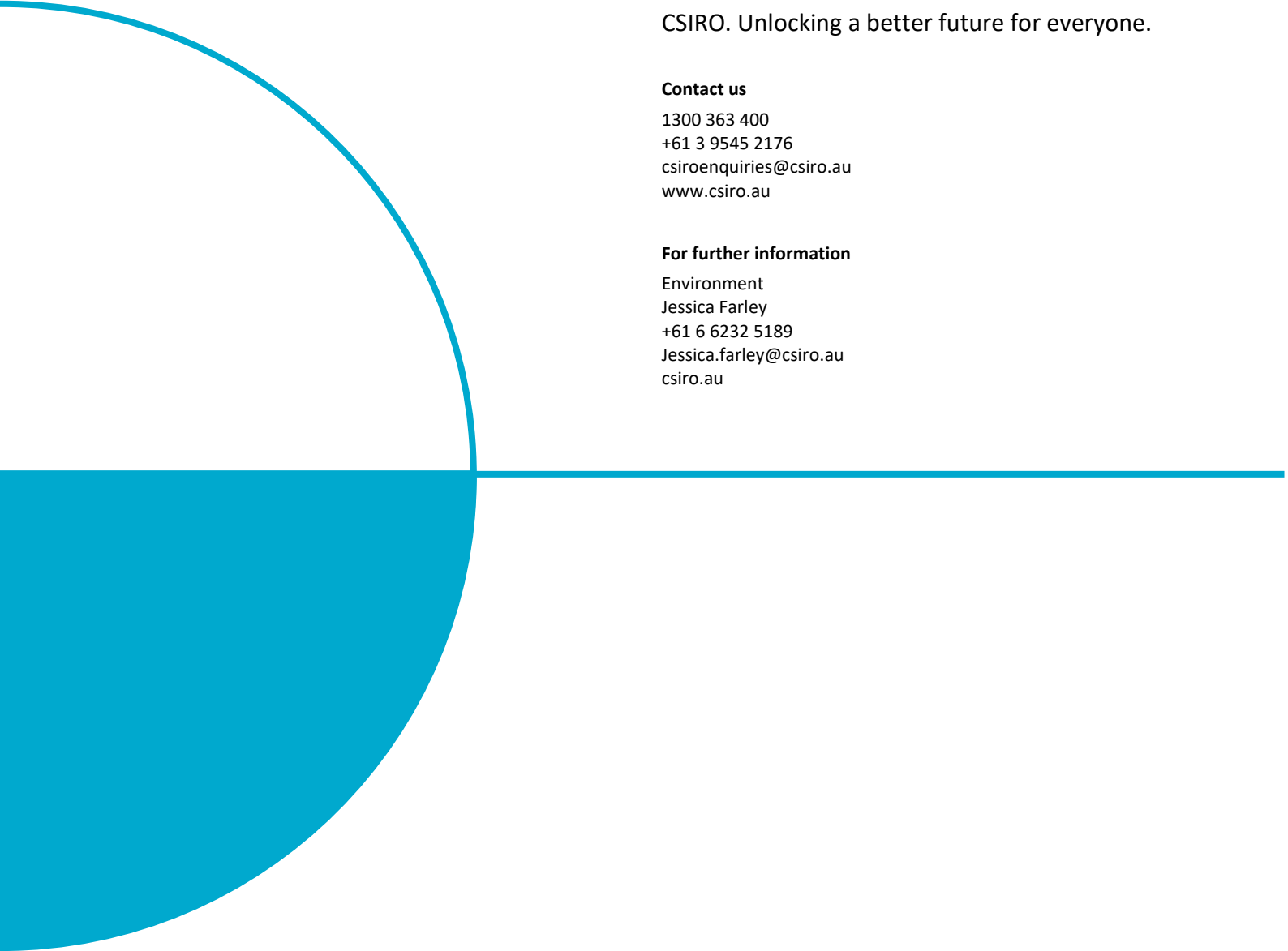
tag	release date	recapture date	time at liberty (years)	release length (cm)	recapture length (cm)	estimated age at-release	age at recapture
73198 orange	24-Feb-1993	03-Sep-2022	29.5	52	195	1	30 - 31
62431/32 orange	03-Feb-1995	15-Sep-2023	28.6	81	191	2	30 - 31
139931 yellow	31-Jan-1995	08-Jun-2024	29.6	93	196	3	32 - 33



Figure 2: Otolith section images under light microscope (left) and SEM (right). The strontium mark appears in the SEM image as a narrow band that is brighter than the surrounding otolith (red arrow).

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