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Report of the piston-line trolling monitoring survey for the age-1 southern bluefin tuna recruitment index in 2025

ミナミマグロ 1 歳魚の加入指標のための
ピストンライン曳縄モニタリング調査 2025 の結果報告

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要約

ミナミマグロ 1 歳魚の加入指数を求める科学曳縄調査を、2025 年 2 月に実施した。Esperance から Bremer Bay を含んで Albany までの海域を調査し、ピストンラインは 10 回、調査した。航海を通じて漁獲したミナミマグロは 316 個体であった。87 個体にアーカイバルタグを装着して放流し、ミナミマグロを含む 71 個体の胃内容物を分析し、12 点で CTD による海洋観測を実施した。2024 年には 0.3 歳魚が初めて主体となったが、2025 年には 1 歳魚が主体に戻った。

Summary

In February 2025, the scientific trolling survey that provides the data for recruitment index of age-1 southern bluefin tuna (SBT) was carried out. The surveyed area extended from Esperance to Albany, including Bremer Bay with 10 times on the piston line. A total of 316 SBT were caught during the survey. 87 SBT individuals were released with archival tags implemented, and the stomach contents of 71 fish including SBT were analyzed. Oceanographic observations were also conducted at 12 locations using CTD. In 2024, age-0.3 was the dominant for the first time, however, age-1 returned to being the dominant group in 2025.

1. Introduction

Recruitment level is crucial information on stock management of fish, including southern bluefin tuna (*Thunnus maccoyii*, SBT). Several research activities have been attempted for the recruitment monitoring of SBT. Since 1989, Japan has conducted a series of recruitment monitoring survey within a cooperative research framework with Australian scientists. Japan carried out a trolling and pole-and-line catch monitoring survey from 1989 to 1993, and then carried out an acoustic monitoring survey using sonar and echo sounder from 1995 to 2006, for age-1 SBT distributed off the southern coast of Western Australia (Itoh 2006). The recruitment index derived from the acoustic monitoring survey predicted the low recruitment levels of the 1999-2001 year classes of SBT which was confirmed several years later by the model-based assessment so that it was likely to be a reliable index. However, the acoustic survey was ceased after the final survey in 2006 due to the budget restriction. Alternatively, we have carried out a trolling survey since 2006. Australia had carried out a scientific aerial survey in the Great Australian Bight in South Australia since 1993 and provided the recruitment indices, as the aerial survey index, to CCSBT (Eveson et al. 2006). The aerial survey was discontinued after 2017 because of budgetary reason and logistical problems. Since 2016, pilot Gene Tagging (GT) project has been started instead of the aerial survey. GT estimates the absolute amount of stock of age-2 SBT and utilized in the current Management Procedure (MP) (Preece and Bradford 2023).

The trolling survey is a reasonable way to know the recruitment status of age-1 SBT. The recruitment index of age-1 SBT derived from this survey have provided to CCSBT as a fishery independent indicator and utilized in robustness test for MP. This survey finds SBT schools by trolling off the southern coast of Western Australia. Additionally, we set the single straight transect line in the survey area and are investigating intensively each year on this line (Itoh and Kurota 2006). This survey is a long-term survey covering 18 years from 2006 to 2024 except 2015 (Itoh 2021, 2022, 2023, 2024, Itoh and Kurota 2006, Itoh and Sakai 2007, 2008, 2009a, 2010, Itoh et al. 2011, 2012a, 2013, Itoh and Tokuda 2014, Itoh and Tsuda 2016, 2020, Tsuda and Itoh 2017a, 2018, 2019). The long time series data can be expected to detect not only the interannual fluctuation of recruitment of age-1 SBT but also a medium-term trend of it. Additionally, the recruitment index from this survey become available immediately in the same year of the survey carried out. Therefore, in order to find recruitment failure, if it occurred, as quick as possible and understand the recruitment trend, it is necessary to continue the trolling survey for the age-1 SBT.

In 2021, due to the global pandemic of COVID-19, the trolling survey was conducted in a limited area in a short period of time. In 2022, the trolling survey was carried out in full range scale including piston-line, though the research items were limited due to still under

the influence of COVID-19. Since 2023, the trolling survey has been able to be carried out in the same specification as before 2020. The trolling index calculated from this survey data is described in another paper (Itoh 2025a: CCSBT-ESC/2508/24).

2. Materials and methods

An Australian vessel, *The Southern Conquest* with 17 m in total length, was chartered (Fig. 1). This vessel was consistent to the previous year surveys.

The survey area was off the southern coast of Western Australia between off Esperance (123E) and east of Albany (117E), including off Bremer Bay (Fig. 2). The area covers about 450 km x 60 km. From the coast to offshore the continental shelf of about 70 m in depth extended largely, and then dropped sharply at shelf-edge to deeper than 500 m in depth within 2 km distance. The piston-line laid off Bremer Bay.

The vessels engaged in the survey from 6:00 to 17:00 and returned to a port or a calm bay everyday. GPS position data were recorded every second in GPS logger devices. The vessel operated trolling at speed of 7-8 knots. Eight trolling lines consists of four types of lines at maximum were trolled. Each line has one hook with a plastic lure. Because the trolling index derived from the survey is based on the number of SBT schools, not the total number of SBT individuals caught, we did not try to maximize the number of fish caught. Individual fish caught of any species were measured by its length. Some SBT were killed for biological samples includinng stomach for contents analysis and musscle tissue for stable isotope analysis. Other SBT were released followed by its fork length (FL) measured. SBT in good condition were implemented archival tag (LAT2810L from Lotek Inc.) and released.

Oceanographic observation for vertical profile of temperature and salinity (conductivity) was carried out at 12 points using the Conductivity-Temperature-Depth profiler (JFE Advantech Co. ltd., CTD RINKO-Profiler) to just above sea bottom or 200 m in depth.

3. Results

The trolling survey started on 4th February and finished on 21st February, 2025. After two days survey off Esperance, the vessel moved to Bremer Bay. We surveyed off Bremer Bay area for three days, followed by move west to Albany. After one day of survey off Albany, we back to Bremer Bay. We surveyed two days more off Bremer Bay and move east to Esperance. Four more days were surveyed off Esperance. In total, 15 days were surveyed and three days weren't due to strong winds. The piston line were surveyed 10 times.

During the survey, a total of 400 fish were caught, including 316 SBT, 7 skipjack *Katsuwonus pelamis*, 17 yellowtail kingfish *Seriola lalandi*, 20 oriental bonito *Sarda orientalis*, 16 western australian salmon *Arripis truttaceus* and others. 71 fish including 55 SBT were killed for stomach contents observation where pilchard *Sardinops sagax* was dominant. Muscle tissue for isotope analysis were sampled from 70 fish including 54 SBT. Total weight of SBT killed was 125.7 kg. 87 SBT were implemented archival tags, detailed are reported in another document (Itoh 2025b: CCSBT-ESC/2508/25).

There are four size/age components of SBT in this area at the time of the year: age-0.3 in 30-35 cmFL, age-1.0 having mode at around 48 cmFL, age-1.3 in 57-63 cmFL, and age-2 in 65-80 cmFL (Itoh et al. 2012b). There are two sub-cohorts in age-1 presumably due to different spawning peaks exists in October and January/February. SBT caught in 2025 ranged from 31 to 78 cmFL (Fig. 3). Estimated from fork length, age-0.3 fish was dominant, which is an unusual pattern compared to previous years being age-1.0 dominated. Applying a mixed normal distribution to length frequency estimated that age-0.3 was 15.6%, the total of age-1.0 and age-1.3 was 83.8% and age-2 was 8.5%.

In 2024, age-0.3 was the dominant, which was the first time happened since recruitment monitoring surveys began in the late 1980s. In 2025, however, age-1 returned to being the dominant group followed by age-0.3. The paucity of age-2 is consistent with the paucity of age-1 in the 2024 survey, may suggest a low recruitment of the 2023 year class.

4. Discussion

Fishery data are basic information to assess the current stock status of SBT in CCSBT. Especially, CPUE of Japanese longline, which covers wide area, season and SBT age range that based on detailed information reported from fishermen, is a long time series index exceeding 50 years used for SBT stock status. The aerial survey was also valuable research because it covered a wide area in a short duration of time in the Great Australian Bight (GAB) by using airplane and data of school biomass is derived as an estimation of a spotter, though ceased in 2017. Gene Tagging is expected to be a fishery-independent index for age-2 SBT and is also used in the Management Procedure. However, there is no single index that can directly reflects the status of SBT stock in whole ranges in both age and geographical distribution. Therefore, we need to collect a variety of information as many as possible to assess the stock status appropriately. Trolling survey provides important information of age-1 SBT abundance.

The design of the trolling survey corresponds to the temporal and spatial distribution of age-1 SBT, although its survey period and geographic area are limited. A majority of age-1 SBT is thought to be distributed in the coastal area of Western Australia in austral

summer (Itoh and Sakai 2009b). Then the age-1 SBT widely migrates to east and west at the end of the summer, while the majority of the SBT move to the GAB. SBT of age-2 and older are distributed widely in the area between off New Zealand and off Cape, and the fish returns to GAB by the following year is not always. Therefore, the recruitment survey targeting age-1 SBT in the southern coast of Western Australia may provide abundance index that represents whole the stock at age-1 SBT.

To derive accurate year trend in an index of recruitment level, we need to exclude other factors that fluctuate by year. Carrying out the survey in a consistent method for all years is a good way for this. We have not changed the gear specification used, and general research method for 19 years. We changed the survey vessel at the 10th and 12th survey, but the type and size of the vessels were consistent all the survey. The survey area has been consistent for 18 years except 2021 where the main survey area has been limited to off Esperance relevant with COVID issue. Such consistent survey design is expected to facilitate to obtain an index that reflects only for annual SBT recruitment change. Additionally, the trolling is robust survey method against environmental factors, including wind, wave, and swell. There were a few days that suspended the research during the cruise due to rough sea condition in 19 years. We did not find a tendency that SBT were less caught in rough weather condition (see Tsuda and Itoh 2017b).

Combining recruitment monitoring data from over 30 years since the early 1990s with information on past fishermen's experience catching SBT, we now know a lot about the distribution of age-1 SBT along the coast of Western Australia. It was a surprising that the age-0.3 fish was the dominant in 2024 for the first time in over 30 years. Since age-1 become the dominant again in 2025, it may be considered thta 2024 is an unusual year and that the age and migration of SBT may not have necessarily changed. The proportion of age-0.3 fish should be monitored carefully in the future. Furthermore, although there were few age-1.0 fish in the surveys from 2017 to 2025 and the trolling index (TRG) has been low, the CPUE of longline by the corresponding year class remained high (Takahashi and Itoh 2025: CCSBT-ESC/2508/27). This discrepancy between the indices is a concern. If there are changes in the distribution and migration of age-1 SBT that are different from the past, we should understand the situation well and make changes to the trolling survey design if necessary. Also, if there are changes in the distribution and migration of age-1 fish, this may have an impact on GT that use age-2 fish, and MP that use it as input data. Caution should continue to be exercised in comparing the various recruitment indices. This may be something that should be discussed at the ESC, including possible changes in the distribution and migration of age-1 fish, or juvenile fish between age 1 and 4, and their impacts on assessment and management through GT estimates.

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Figure 1 The Southern Conquest, used for the 2025 trolling survey.
Photo was taken in 2018.

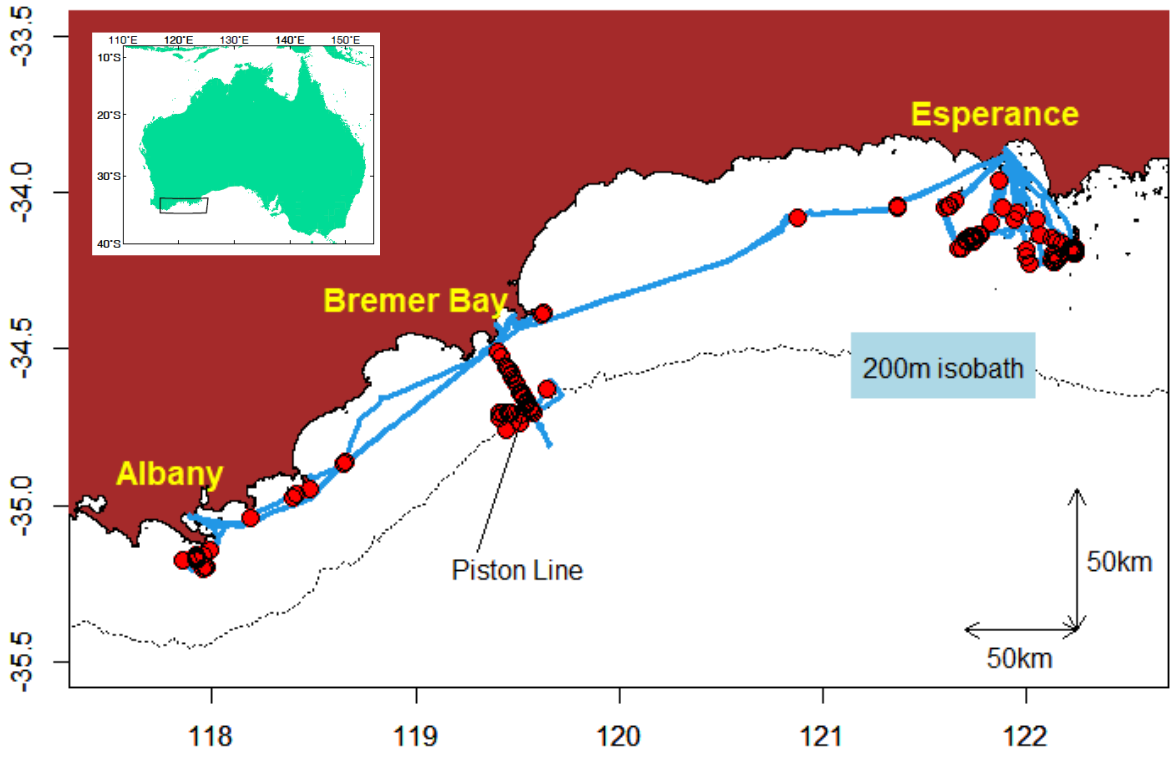

Figure 2 Trajectory of the vessel with location of southern bluefin tuna caught (circle) in the 2025 trolling survey.

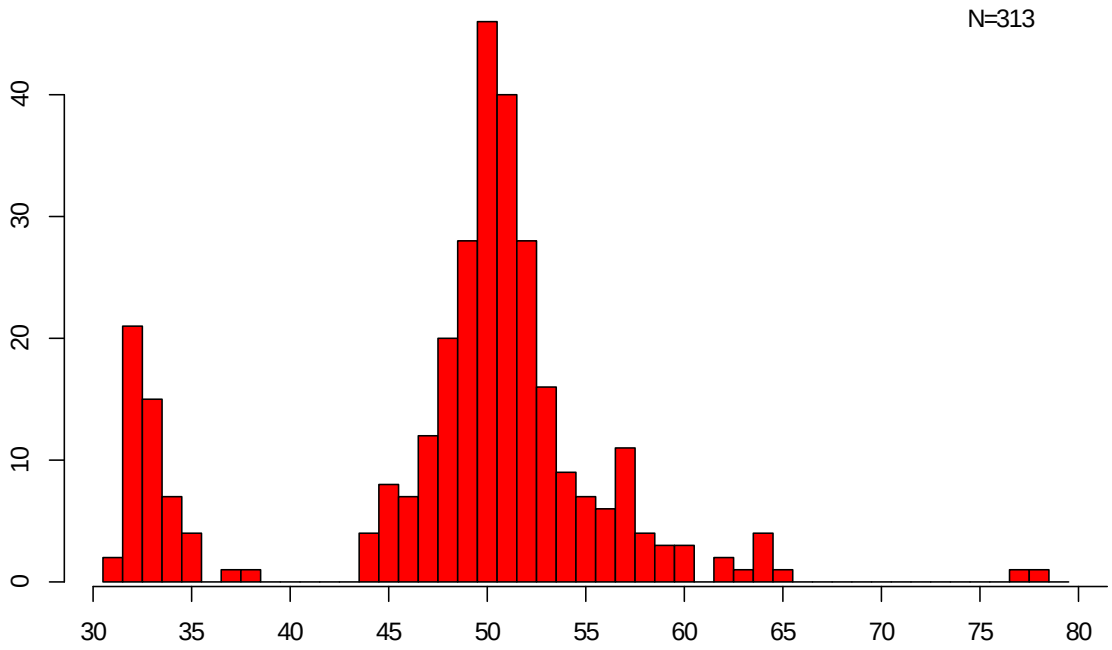

Figure 3 Fork length frequency distribution of southern bluefin tuna caught in the 2025 trolling survey.