

14th MEETING OF THE SCIENTIFIC COMMITTEE

7 to 12 September 2026, Tórshavn, Faroe Islands

SC14 - DW 11

**Exploratory Patagonian Toothfish Fishery: George V Fracture Zone -
2024-26 Fishing Campaign Stock Assessment**

European Union



Georgia Seafoods Ltd

Exploratory Patagonian toothfish
demersal longline fishery:
George V Fracture Zone,
SPRFMO Convention Area

2024-26 Fishing Campaign:
Stock Assessment



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1. Review table

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Version 3	P Brickle	5 March 2026

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Citation

SAERI (Falklands) Ltd (2026) Exploratory Patagonian toothfish demersal longline fishery: George V Fracture Zone, SPRFMO Convention Area. 2024-26 Fishing Campaign: Stock Assessment. Prepared by SAERI (Falklands) Ltd for Georgia Seafoods Ltd.

Data Access

All data is stored in the SAERI Environmental Data Centre (<https://www.south-atlantic-research.org/>) and can be accessed by request and subject to permission from the data owner.

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1. Introduction

An exploratory fishery for Patagonian toothfish (*Dissostichus* sp) has been underway since 2021 (CMM14e-2021) in an area known as the George V Fracture Zone Research Block (GVFZ) adjacent to the CCAMLR Convention Sub-area 58.4.1 (Figure 1).

The objectives of this exploratory fishery are;

- a) to further explore the presence and distribution of toothfish in the SPRFMO Convention Area;
- b) to collect and provide information and data contributing towards the sustainable management of potential toothfish stocks in specific, data-poor zones of the Convention Area;
- c) to assess the potential for a future sustainable toothfish fishery in specific zones of the Convention Area;
- d) to provide occurrence information on marine mammals, seabirds, sharks, skates and rays and other species of concern;
- e) to better understand patterns of seabirds and marine mammals and their potential for interactions with fishing vessels;
- f) to evaluate the potential impacts of longlines on non-target associated or dependent species, and vulnerable marine ecosystems; and
- g) to undertake tagging activities on toothfish to enable future studies on the migration of toothfish as well as a preliminary stock assessment.

In this report we conduct a stock assessment (Objective g) of Patagonian toothfish based on the first fishing campaigns (2021-2023), and the first two years (2024-25) of the second campaign, summarising biological data, assessment of biomass, and provide guidance for future fishing campaigns in the area. These data will directly inform integration of this region into current Patagonian toothfish stock hypotheses and connectivity analyses with other regions where appropriate.

2. Methods

2.1 Fishing area

The fishing area straddles the Southeast Indian Ridge at approximately 139°E / 53°S, at a position roughly surrounding the George V Fracture Zone (Sempéré et al. 1996). The area is characterised by short chains of seamounts and spreading ridges (Harris et al., 2014) generally rising to approximately 1000m depth (500m depth for the highest seamount) and surrounded in abyssal hills of approximately 2500m – 3500m depth.

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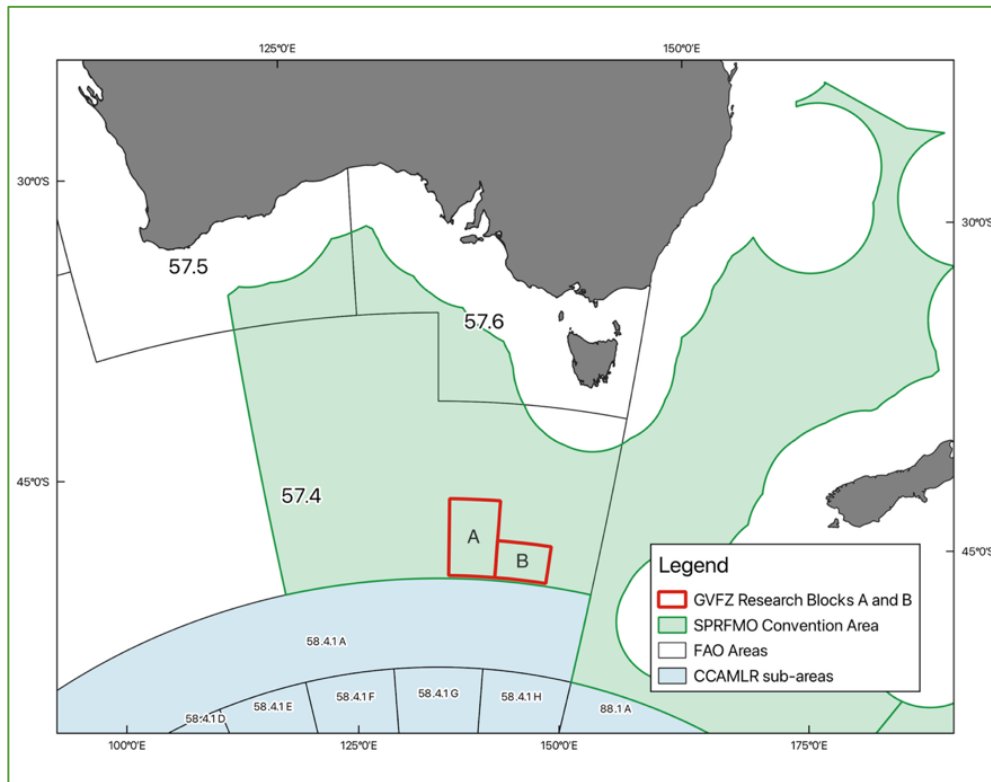


Figure 1. George V Fracture Zone research blocks A and B within SPRFMO Convention Area. Also shown are FAO Area and CCAMLR Convention Area.

2.2 Data collection

All fishing was conducted on the *FV Tronio* using 'Spanish' demersal longline fishing gear (CCAMLR Gear Catalogue, specifically WG-FSA-11/53). Total length, weight, and sex and maturity for the target species were collected according to the CCAMLR Scheme of International Scientific Observation Scientific Observer's Manual Finfish Fisheries (2020). Data was collected and tagging was conducted by Scientific Observers. Further details are found in the proposed fishing plan (COMM9-Prop16 and SC8-DW05_Rev2). Fishing depths are limited to 600-2500m.

2.3 Tag-recapture analysis

Toothfish were tagged at a rate of 5 per tonne. Details can be found in recent cruise reports and Scientific Observer reports.

Analysis of tagging data was done using the Chapman method as detailed in CCAMLR SC-XXXV Annex 5. Biomass is calculated as;

$$B_j = \frac{c(n_{j-1} + 1)}{mx_j + 1}$$

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where n_{j-1} is the number of tagged fish available for recapture at the end of the season prior to season j , c_j is the catch in season j (including those that were tagged and release) and m_j is the number of tagged fish recaptured in season j (excluding within-season recaptures).

The number of tags available is calculated as;

$$n_j \begin{cases} j = 1, & r_j(1 - t)e^{-(f+M)} - m_j \\ j > 1, & n_{j-1}e^{-(f+M)} + r_j(1 - t)e^{-(f+M)} - m_j \end{cases}$$

Where r_j is the total number of fish released in CCAMLR fishing season j , m_j is the total number of tagged fish recaptured in CCAMLR fishing season j , and n_{j-1} is the number of tagged fish available for recapture at the end of the season prior to season j . t is the post-tagging mortality rate of 0.1 (Agnew et al., 2006). f is the annual tag loss rate which is 0.0084 (WG-SAM-11/18). M is natural mortality: 0.155 for Patagonian toothfish (*D. eleginoides*) (Candy et al., 2011). A length-weight relationship (Figure 2) was calculated for fish captured in 2021-2025 as:

$$W = 5.690e-06 L^{3.138}, R^2 = 0.926$$

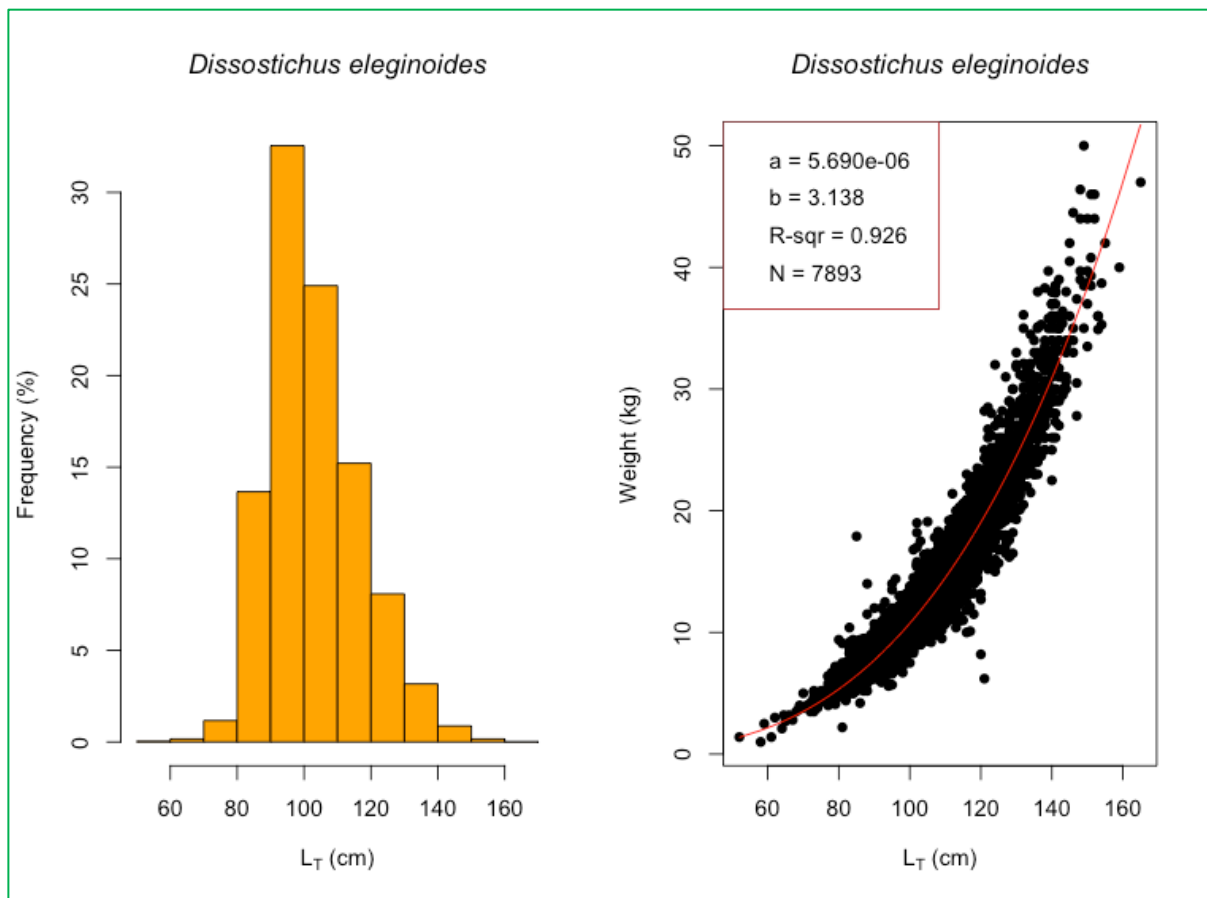


Figure 2. Length-frequency and length-weight relationship for Patagonian toothfish in the GVZF Research Blocks A and B, 2021-25.

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Calculations for biomass using Chapman tag-recapture methods were implemented in R (4.3.0) using modified scripts provided by CCAMLR (https://github.com/CCAMLR-Science/Trend_Analysis). Only the last three years of tag releases are used as per SC-CAMLR-XXXV, Annex 5 para 2.34.

3. Results

3.1 Catch and effort

Fishing effort is well distributed over Research Block A and revisited over the period 2021-25 (Figure 3), whilst effort in Research Block B is still limited with only a few repeated sites. Over-all mean CPUE between 2021 and 2025 was 273 kg/km line, with wide variability in CPUE between lines set (Figure 4). There is wide variation in CPUE within years. Inter-annual changes in CPUE are not significant (ANOVA, $f_{4,204}=0.685$, $p = 0.603$).

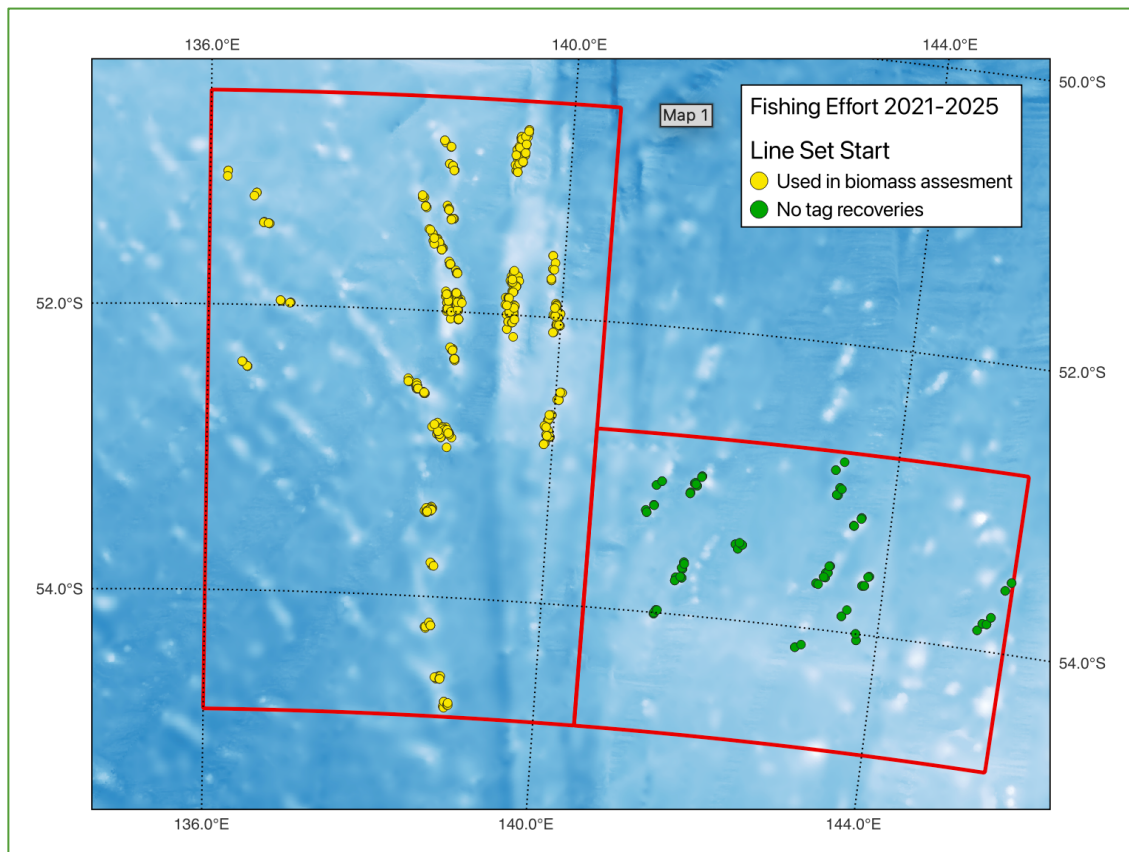


Figure 3. Location of lines set (set start) between 2021-2025 for RB-A, and 2024-2025 for RB-B. Indicated are those lines where tags have been released; these site are used in tag-recapture biomass estimation. Fishing depths range between 600m – 2500m depth.

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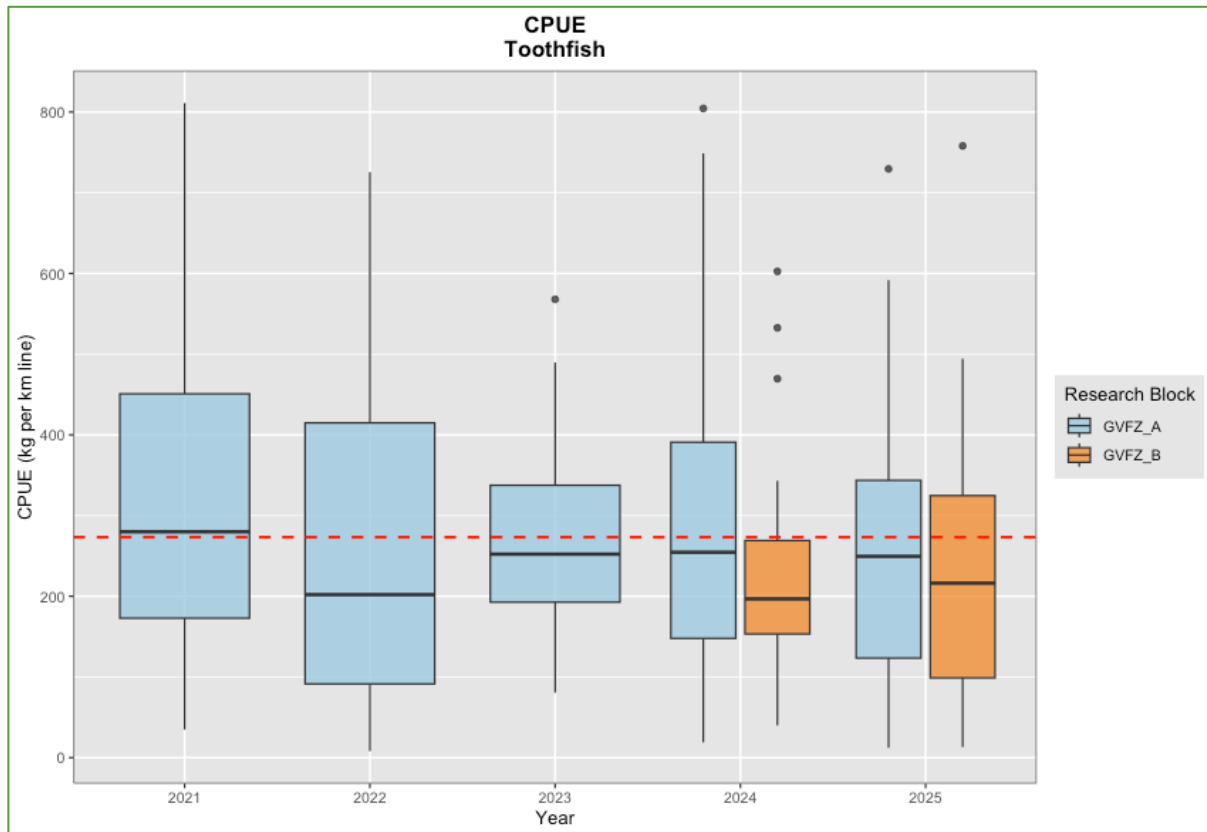


Figure 4. Box and whisker plot of CPUE (kg per km of line set) of all lines between 2021 and 2025, representing medians, upper and lower quartiles and statistical max and min values. CPUE are split between Research Blocks A and B in 2024 and 2025. Mean CPUE for all years is also shown.

3.2 Length – Frequency

The length-frequency of TOP from all areas in 2021-2025 is shown in (Figure 5). Modal fish lengths (5 cm bins) declined in 2021 and 2023, but then increased again in 2025. The overall distributions are significantly different (Kruskal-Wallis chi-squared = 369.8, df = 4, p-value < 2.2e-16).

3.3 Sex ratio

Ratio of males to females from all years and areas varied all years each year (Table 1). Males were found in larger numbers than females. The ratio shifted dramatically from approximately 1:1 in 2021 to predominantly males in 2023, then lowering again in 2025.

Table 1. Numbers and ratio of males and females sampled in each year from all areas.

Year	N Males	N Females	M:F	%Male	%Female
2021	679	631	1.08	51.83	48.17
2022	721	286	2.52	71.60	28.40
2023	702	135	5.20	83.87	16.13
2024	2007	864	2.32	69.91	30.09
2025	2012	1321	1.52	60.37	39.63

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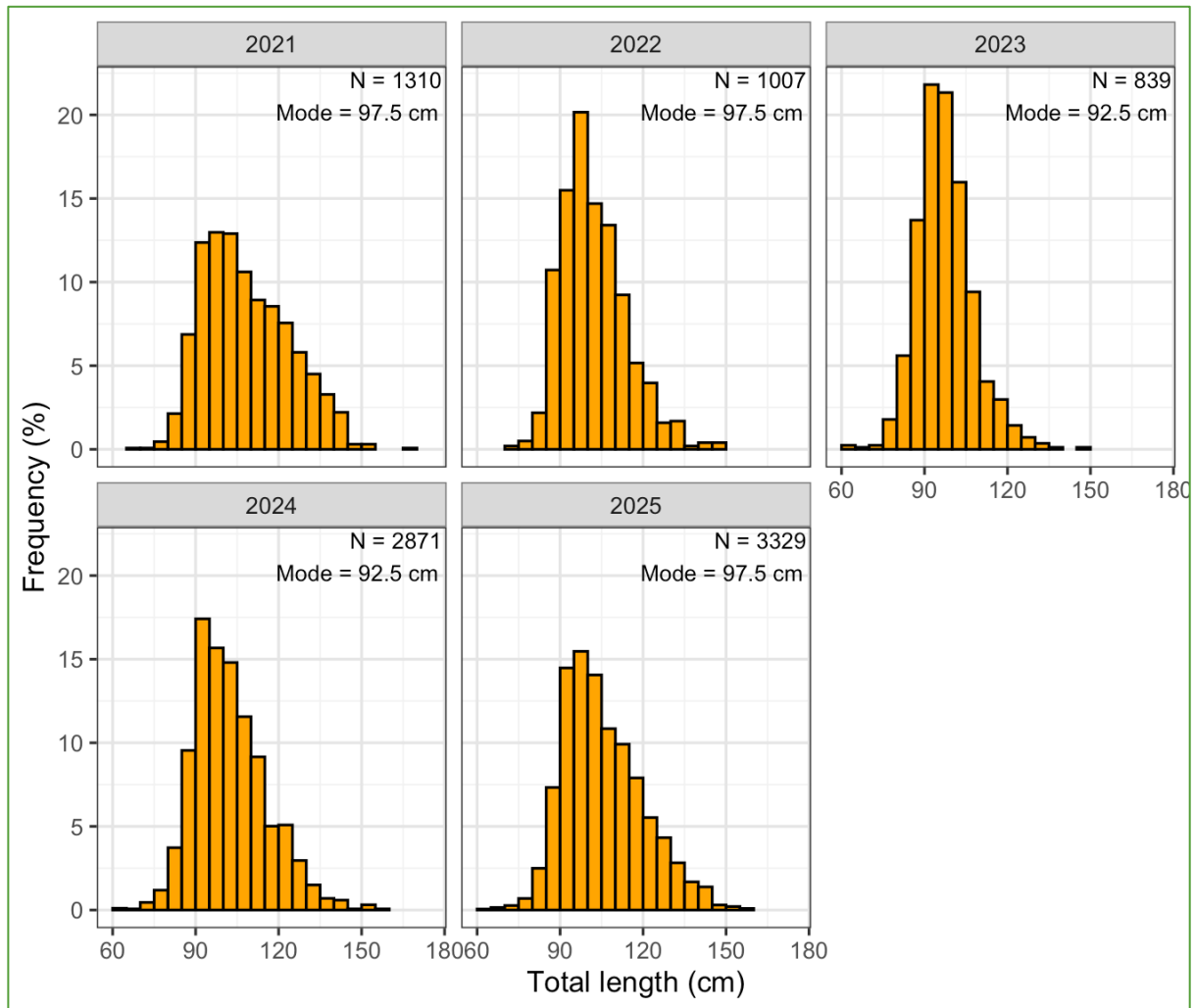


Figure 5. Length-frequency of all TOP in Research Block A and B for all years.

3.4 Tagging and Stock Identity

A total of 2225 tagged fish have been released in Research Block A between 2021 and 2025 and 331 released in Research Block B between 2024 and 2025 (Table 2). There have been no tag fish recaptures in Research Block B, and so releases in this block have not been included in tag-recapture based biomass analysis.

Table 2. Tagged and recaptured TOP in the GVFZ between 2021 and 2025.

Year	Release			Recaptures				Total
	Block A	Block B	Total	2022 Block A	2023 Block A	2024 Block A	2025 Block A	
2021	378	0	378	3	2	0	1	6
2022	380	0	380	0	1	0	3	4
2023	222	0	222	0	0	1	1	2
2024	596	160	756	0	0	0	5	5
2025	649	171	820	0	0	0	0	0
Totals	2225	331	2556	3	3	1	10	17

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Since 2021, there have been 11 tag recoveries in the GFVZ of fish originally liberated in the Macquarie Island Fishery, and all from Macquarie Ridge (Figure 6). Whilst some of these fish were tagged as early as 2004, two fish were liberated as recently as 2022. Additionally, one tagged fish was recovered that was liberated outside the GFVZ but not from the Macquarie Ridge region (CCAMLR to provide release data). These records suggest that there may be relatively frequent immigration into the GFVZ area, and raises the question of emigration rates out of the GFVZ, although as per February 2026, no tag-recaptures from this exploratory fishery had been reported in any of the established and relatively nearby toothfish fisheries, such as HIMI, Kerguelen and Macquarie. Better understanding of immigration/emigration rates (i.e. stock identity) will be important future research for interpretation of tag – recapture analyses.

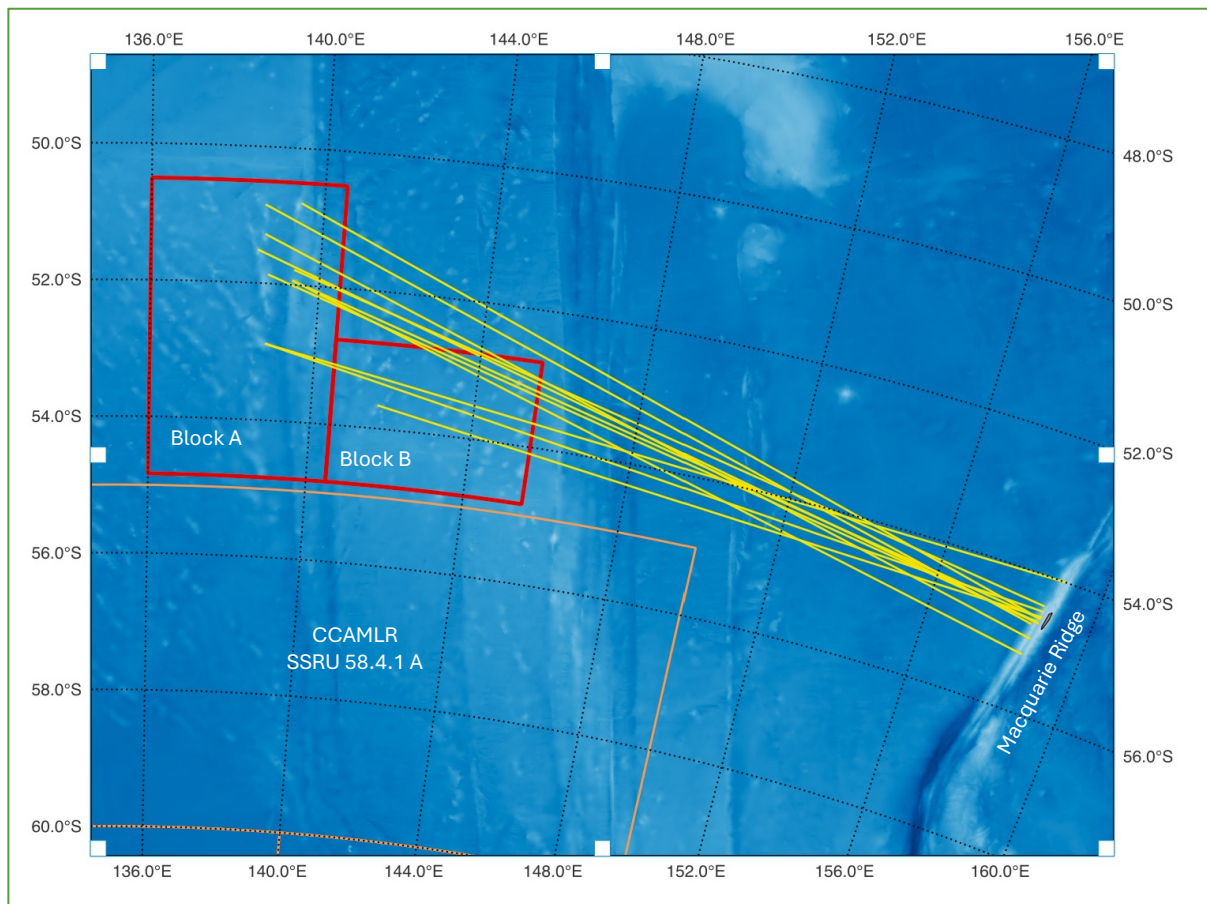


Figure 6. Movement of recaptured TOP into the GFVZ between 2021-25, originally tagged in the Macquarie Ridge area.

3.5 Biomass estimate

The estimated stock biomass estimate for Research Block A is 12,149 tonnes (CI_{lower} - 7,270; CI_{upper} - 28,069) (Table 3), with the analysis restricted to the last 3 years of release. Research Block B was excluded as there have not been any recaptures in this area. The Chapman estimate is impacted largely by the high rate of recaptures in 2025.

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Table 3. Biomass (t) estimates for research block GVFZ A, based on the Chapman method and limited to releases in 2023, 2024, 2025

Research Block	Species	Season (recapture)	Biomass Est (t)	CI_lower	CI_upper	N_Recaptures	N_Hauls	Method
GVFZ_A	TOP	2022	5,955	2,992	13,478	3	32	Chapman
GVFZ_A	TOP	2023	6,302	3,513	13,226	3	17	Chapman
GVFZ_A	TOP	2024	27,227	11,528	32,170	1	45	Chapman
GVFZ_A	TOP	2025	12,149	7,270	28,069	10	56	Chapman

4. Overall assessment

A TAC of 129t and 33t was set for Research Block A and B respectively under CMM14e-2024 and this was reached in the 2025 fishing campaign. This is approximately 1% of the estimated biomass. However, there is still a great deal of variability around the biomass estimate. Moreover, there appears to be a strong influence of varying tag recoveries.

In terms of the spatial discrimination of the stock in the GVFZ, it is unclear how stocks in Research Block A and B are connected; future fishing in both areas may find fish mixing between areas indicated by mixing of tag recoveries. For example, whilst the majority of tags recovered in Block A have been in the same location as the fish was released, one tag was recovered in 2025 that indicated this fish moved between seamounts within Block A. In addition, connectivity to the wider region may be greater than previously thought, as indicated by two recaptures in the GVFZ that were originally released on the Macquarie Ridge in as recently as 2022. There have been no reported tag recoveries outside the GVFZ. Better understanding immigration/emigrate rates will allow for better interpretation of estimated biomass.

Examination of other stock characteristics between 2021-2025 also indicate that some caution should be given to setting the TAC in the future. CPUE varies widely between years indicating that fished seamounts may vary in the level at which they can sustain repeated fishing effort. Additionally, size-frequency analysis showed variation in the shape of the length-frequency curve as well as variation in modal size classes fished. This may be due to natural variability between years, or indicate some spatial structuring at this time of year. Further research in the area would be required to elucidate on interannual patterns of CPUE and stock structure.

5. Preliminary TAC advice for the 2027-2029 proposal

With reference to data limited exploratory fisheries, CCAMLR constructed a decision tree indicating rules for setting TAC based on trend analysis of CPUE-by-seabed area analogy and tag-recapture estimates of biomass (WG- FSA-17 para 4.33). Based on those decision rules, an appropriate annual TAC would be based on the biomass estimate x 0.04 (4%) exploitation rate. However, recognising in the GVFZ that 1) there has been a limited number of fishing

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years, 2) that new areas are now being explored, 3) the observed variability in CPUE and length-frequency distributions, and 4) questions around immigration/emigration of fish in the GVFZ, a biomass $\times 0.03$ (3%) exploitation rate of the lowest CI of the mean biomass estimate (currently 7269.7t biomass) might be considered a more precautionary approach. This suggests a provisional annual TAC in RB-A for 2027-2029 of 218t. A closer examination of CPUE and estimated biomass will be conducted prior to submission of exploratory toothfish fishing for the 2027-29 fishing season, and annual TACs will be proposed for RB-A and RB-B. This examination may include a sensitivity analysis of the effect of connectivity (immigration and emigration) with the wider area beyond the GVFZ.

6. References

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