12th MEETING OF THE SCIENTIFIC COMMITTEE

30 September to 05 October 2024, Lima, Peru

SC12 - DW 01_rev2

New Zealand Fisheries Operation Plan for Toothfish

New Zealand

Proposal for exploratory bottom longlining for toothfish by New Zealand vessels 2025-2027: Fisheries Operation Plan, Data Collection Plan, Impact Assessments, and Mitigation Summaries for Non-target, Associated or Dependent Species

Prepared by the New Zealand Ministry for Primary Industries for the consideration of the 12th meeting of the South Pacific Regional Fisheries Management Organization Scientific Committee in Lima, Peru, 30 September to 5 October 2024

Submitted 31 July 2024 – Rev 2 submitted 1 Oct 2024

Summary of proposal (two areas)

Fishing Procedures to be Adopted for Proposed Exploratory Fishery in NZSWRB1
1. Proposed fishing area is a single Research Block.
2. Target fishery locations focused on topographical features such as ridges and seamounts - no depth stratification proposed.
3. Use of specific fishing vessels and gear configuration.
4. Standardised fishing gear used - as for previous SPRFMO and CCAMLR exploratory fishing.
5. Potential use of pots to assess bycatch reduction and potentially improve the viability of toothfish for tagging. This may be later in the programme period pending approval of SC and Commission.
6. Effort limited to a maximum of 20,700 hooks in any one location. Multiple lines may be set in a cluster up to that number. Clusters of lines may be no closer together than 5 nautical miles (measured from the proximate lines of each individual cluster) in any calendar year.
7. Maximum catch limit of 50 tonnes per annum.
8. Tagging of toothfish at a rate of three fish per tonne for Patagonian toothfish (*Dissostichus eleginoides* and one per tonne for Antarctic toothfish (*D. mawsoni*).
9. Collection of fish, sharks and rays and other samples for analysis as required for identification, of interest, or on request by agencies.
10. Collection of tissue samples for analysis as required on request by agencies.
11. Collection of biological data from toothfish and bycatch species.
12. Focused collection and analysis of toothfish reproductive data and movement of tagged fish.
13. Sampling of toothfish stomach contents.
14. Use of Vessel Monitoring System (VMS) and on-board EMS.
15. Opportunistic observations, photography and identification of marine mammals.
16. Mitigation measures to reduce the impact on non-target fish bycatch.
17. Mitigation measures to minimise seabird interactions.
18. Use of video cameras for benthic studies, as available and feasible.
19. Standard reporting of catch and bycatch data.
20. Presence of a flag state observer with vessel EMS operating from entry to exit in SPRFMO Convention Area.
21. Operation of all vessel Simrad sounders to record acoustic information using the protocols already in place for operation within CCAMLR.
22. Continuous Plankton Recorder to be used, as available.
23. Moana (Mangōpare) sensors to be deployed on lines where loss potential is minimal to collect temperature-depth data to 1000 m.
24. Document and report any sighting of other (IUU) fishing or reefer vessels.
25. Submission of all collected data for review and analysis with interim reports submitted annually and a final report following the three years.
26. Presentation of results to working groups as indicated.
27. As always, compliance with all Conservation Management Measures.

Fishing Procedures to be Adopted for Proposed Exploratory Fishery Research Blocks A-H
1. Proposed fishing area divided into eight research blocks.
2. Sampling locations focused on topographical features such as ridges and seamounts - no depth stratification proposed.
3. Use of specific fishing vessels and gear configuration.
4. Standardised fishing gear used - as for previous SPRFMO and CCAMLR exploratory fishing.
5. Potential use of pots to assess bycatch reduction and potentially improve the viability of toothfish for tagging. This may be later in the programme period pending approval of SC and Commission.
6. Effort limited to a maximum of 20,700 hooks in any one location. Multiple lines may be set in a cluster up to that number. Clusters of lines may be no closer together than 5 nautical miles (measured from the proximate lines of each individual cluster) in any calendar year.
7. Maximum catch limit of 240 tonnes per annum with a maximum of 50 tonnes for any one RB
8. Tagging of toothfish at a rate of three fish per tonne for *D. eleginoides* and one per tonne for *D. mawsoni*
9. Collection of fish, sharks and rays and other samples for analysis as required for identification, of interest, or on request by agencies.
10. Collection of tissue samples for analysis as required on request by agencies.
11. Collection of biological data from toothfish and bycatch species.
12. Focused collection and analysis of toothfish reproductive data and movement of tagged fish,
13. Sampling of toothfish stomach contents.
14. Use of Vessel Monitoring System (VMS) and on-board EMS.
15. Opportunistic observations, photography and identification of marine mammals.
16. Mitigation measures to reduce the impact on non-target fish bycatch.
17. Mitigation measures to minimise seabird interactions.
18. Use of video cameras for benthic studies as available and feasible.
19. Standard reporting of catch and bycatch data.
20. Presence of a flag state observer with vessel EMS operating from entry to exit in SPRFMO Convention Area.
21. Operation of all vessel Simrad sounders to record acoustic information using the protocols already in place for operation within CCAMLR.
22. Continuous Plankton Recorder to be used, as available.
23. Moana (Mangōpare) sensors to be deployed on lines where loss potential is minimal to collect temperature-depth data to 1000 m.
24. Document and report any sighting of other (IUU) fishing or reefer vessels.
25. Submission of all collected data for review and analysis with interim reports supplied annually and a final report following the three years.
26. Presentation of results to working groups as indicated.
27. As always, compliance with all Conservation Management Measures.

Recommendations from these proposals

It is recommended that the Scientific Committee:

- Note these two proposals from New Zealand and the associated Fisheries Operation Plans for exploratory demersal longline fishery for toothfish (*Dissostichus* spp.), limited to:
    1. a maximum of 50 tonnes green weight in NZSWRB1 annually, and
    2. a maximum of 50 tonnes greenweight for each of the 8 research blocks (A-H) to a maximum combined total of 240 tonnes retained annually.
- Recognise the cautious and exploratory nature of the proposal, with a focus on minimising risks to target species, non-target species, bycatch species, species of concern, and vulnerable marine ecosystems (VMEs).
- Note New Zealand's commitment in the previously surveyed areas in the southeastern Pacific area of SPRFMO.
- Note that the current proposals are based on knowledge and experience gained from this previous work.
- Acknowledge the scientific benefits of the proposed data collection, particularly in understanding the distribution, movement, spawning dynamics, and stock structure of both *Dissostichus* spp.
- Note the commitment to use up to three vessels to maximised data collection over a wide area.
- Approve or make amendments to the Data Collection Plan included in the proposal.
- Advise the Commission that the proposal is acceptable in accordance with relevant articles and conservation measures.

1 Purpose

This document is the first stage of an application for New Zealand vessels to conduct exploratory fishing for toothfish (*Dissostichus* spp.) using demersal longline in the southern SPRFMO Convention Area in 2025, 2026 and 2027. To the best of our knowledge, there are no records of toothfish fishing in the proposed area.

The proposal was drafted to comply with the requirements of:

- Article 22 of the Convention
- CMM-13-2024: Conservation and Management Measure for the Management of New and Exploratory Fisheries in the SPFRMO Convention Area
- CMM-03-2023: Management of Bottom Fishing in the SPRFMO Convention Area
- Bottom Fishery Impact Assessment Standard (BFIAS) (version revised Oct 2019)
- The Fisheries Operation Plan included in this application was developed according to the Template for a SPRFMO Fisheries Operation Plan (version October 2021).

In accordance with CMM-13-2024, the proposal is submitted for consideration at the 12th Scientific Committee meeting (Peru 30 Sept – 5 Oct 2024) such that it can advise the Commission meeting in February 2025.

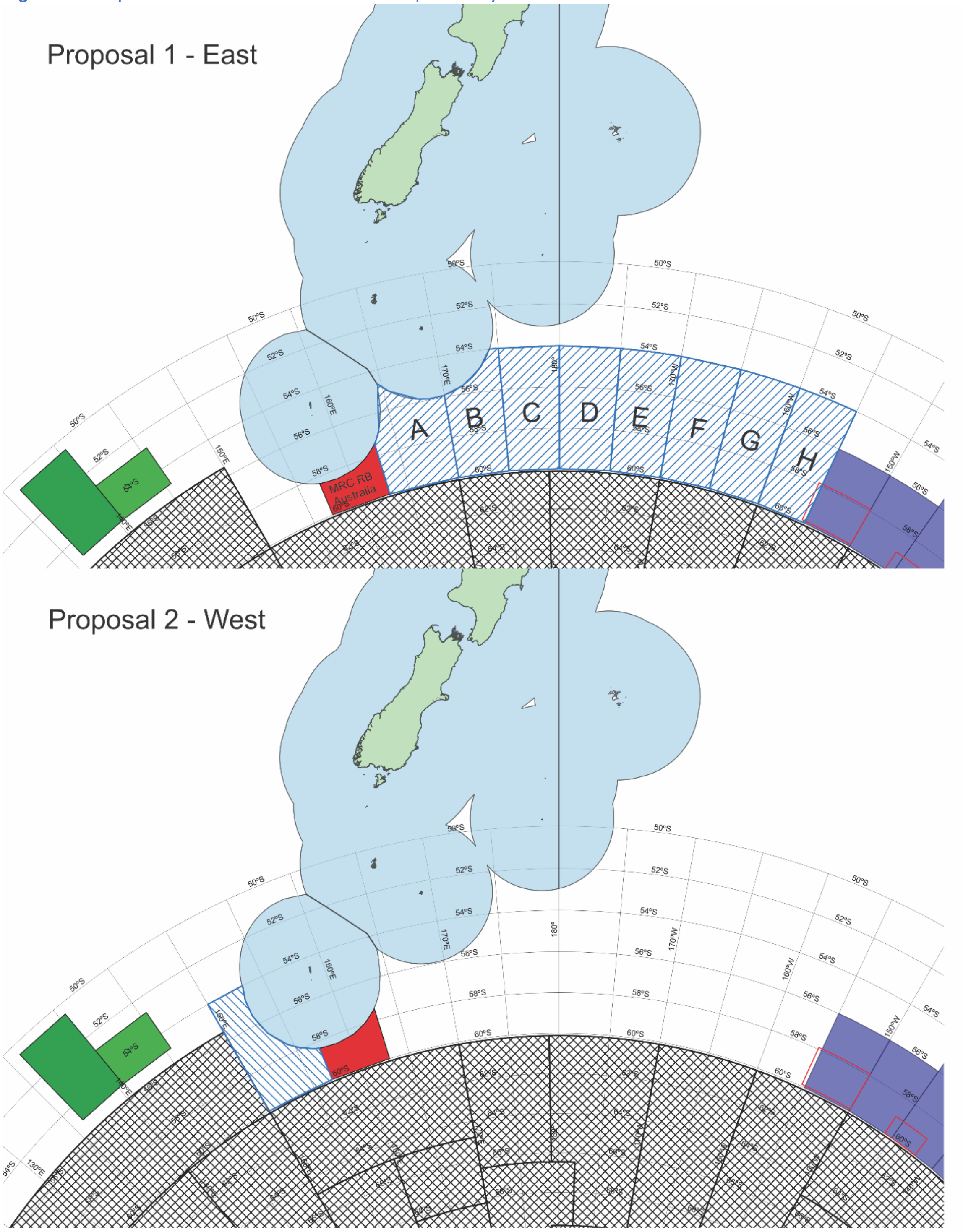
2 Introduction

New Zealand has previously undertaken seven successful exploratory fishing trips for toothfish on the South Pacific Ridge along the southern border of the SPFRMO Convention Area where it borders the CAMLR Convention Area (2016, 2017, 2019 – 2024; CMM 4.14, CMM 14a-2019, CMM 14a-2022). The final trip under CMM 14a-2022 is planned for September – October 2024.

The current applications are for two new proposed exploratory fisheries in areas south of the New Zealand EEZ; one extending east and another west of the current exploratory fishing area by Australia (CMM 14f-2024) extending south to the CAMLR Convention Area (Figure 1).

The proposal is to undertake exploratory fishing for toothfish (*Dissostichus* spp.) over three years (2025-2027) using autoline demersal longlining. Fishing is proposed on seamounts and features when found in depths ranging from 600 – 2,500 m where suitable habitat for toothfish may exist. The nominated vessels from Sanford Ltd and Talleys Group Ltd (TGL) *San Aspiring*, *San Aotea II* and *Janas* have all participated in the CCAMLR New and Exploratory fisheries in the Ross Sea Fishery (Subareas 88.1 and 88.2), in the Patagonian toothfish fishery in Subarea 48.3, and in the mixed *Dissostichus* spp. fishery in Subarea 48.4. *San Aotea II* and *Janas* have been active in the Subarea 88.1 exploratory fishery since the 1999/2000 season and *San Aspiring* since 2004. *San Aspiring* also undertook the previous seven SPRFMO trips (mentioned above) which have provided valuable information on the biology, geographical range and spawning behaviour of Antarctic toothfish. *Janas* has carried out specific mid-winter research in Subarea 88.1.

Figure 1. Proposed east and west areas for exploratory toothfish research. The blue hatch



boxes show the two proposed areas by New Zealand for the 2025-2027 period, green boxes show the area defined for Exploratory Fishing for Toothfish by European Union (CMM 14e-2024, the red box is the area defined for Exploratory Fishing for Toothfish by Australia (CMM 4f-2024) and the purple boxes show part of the area defined for the previous Exploratory Fishing for Toothfish by New Zealand (CMM 14a-2019, CMM 14a-2022)..

The main objective of these proposals is to assess the viability of sustainable fisheries for toothfish within the proposed exploratory fishery areas. We have identified the following key objectives:

- Map the bathymetry of the fishable area (shallower than about 2500 m).
- Document the spatial distribution, catch rates, and relative abundance of Antarctic and Patagonian toothfish in likely suitable habitat, by area and depth.
- Characterise the biology, life history and spawning dynamics of both species of toothfish if caught within the target area.
- Tag the appropriate number of toothfish to inform stock linkage and life history studies; and for use in the multi-area CCAMLR stock assessment model.
- Collect information on distribution, relative abundance, and life history of non-target fish species and other associated or dependent species; noting that fishing will be carried out using the appropriate mitigation measures.
- As feasible given availability of equipment, conduct Continuous Plankton Recorder (CPR) tows and/or plankton net tows for planktonic studies and potentially for the sampling of toothfish eggs.
- Collect acoustic data using existing documented procedures as carried out within the CAMLR Convention area.
- Collect information on marine mammals, seabirds, sharks, skates and rays, and other species of concern to better understand their presence in the region and their potential for interactions with fishing vessels.
- Provide details to annual Scientific Committee meetings on any encounters with VME species.
- Ultimately, 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.

The proposed exploratory fishing will continue previous studies within the SPRFMO Convention Area will build upon previous studies within the SPRFMO Convention Area to enhance the understanding of the distribution, life history, and spawning dynamics of the two toothfish species in the South Pacific. This information will be incorporated in stock assessment models for Antarctic toothfish used by CCAMLR to manage the adjoining area. It may also assist the stock assessment of Patagonian toothfish in the nearby McQuarrie Ridge fishery within the Australian EEZ by the Australian Fisheries Management Authority; particularly by extending the extent of toothfish tagging and tagging recaptures. As this area is likely to represent an important overlap area between the two *Dissostichus* species the proposed exploratory fishery and the associated Data Collection plan will assist in better identifying areas of distribution overlap and increase the understanding of the distribution of Patagonian and Antarctic toothfish within the SPRFMO and CCAMLR Convention areas.

3 Details of the vessels to be used

New Zealand nominates three vessels to conduct the exploratory fishing. These are the fishing vessels *San Aspiring*, and *San Aotea II*, owned and operated by Sanford Ltd and *Janas* owned and operated by Tallys Group Limited (TGL). The following sections include the vessel specifications for the nominated vessels, as required by CMM 05-2023 (Commission Record of Vessels Authorised to Fish in the SPRFMO Convention Area) Annex 1 Article 1 and 2. The vessels both appear on the list of approved SPRFMO vessels submitted by flag states to the SPRFMO Secretariat.

3.1.1 San Aspiring

Ice Classification:
DNV +1A1 Ice – 1C, built for operation in regions where ice floes of thickness 0.4m are anticipated.

Specifications of *San Aspiring* as required by CMM 05-2023 Annex 1 Article 2:

	Requirement	**Vessel specification**
a)	Current vessel flag	NZL
b)	Name of vessel	*San Aspiring*
c)	Registration number	900522
d)	International radio call sign	ZMGO
e)	UVI (Unique Vessel Identifier)/IMO number	9226528 (IMO)
f)	Previous Names	*Gudni Olafsson*
g)	Port of registry	Auckland
h)	Previous flag	Icelandic until late 2002
i)	Type of vessel	Demersal longliner (Autoline)
j)	Type of fishing method(s)	Demersal longline
k)	Length	51.20 m
l)	Length type	LOA
m)	Gross Tonnage	1508 GT
n)	Gross Register Tonnage – GRT (to be provided if GT not available; may also be provided in addition to GT);	Not provided
o)	Power of main engine(s) (kW)	1730 kW
p)	Hold capacity	Cargo Hold 1: 320 m^3 Cargo Hold 2: 360 m^3 Bait Hold: 60 m^3 Fuel Oil: 360 m^3 Lube Oil: 16 m^3 Fresh water: 22 m^3 Ballast water: 52 m^3
q)	Freezer type	Freon 404a
r)	Number of freezers units	5 blast freezers 2 plate freezers 2 main holds 1 bait hold
s)	Freezing capacity (if applicable);	Approximately 380 metric tonnes frozen product
t)	Vessel communication types and numbers	**Primary** Starlink: +6439272926 Certus Iridium: +881677105467 Inmarsat C Telex system: 451200644 E-mail: sanaspiringbridge@sanfordnz.net **Ancillary** 1 x Radio telephone MF / HF 500w – Furuno FS2575 C 2 x Radio telephones VHF-DSC - 2 x Radio telephones VHF-DSC - Sailor RT 4822 2 x VHF RT's – Sailor SP3110

		Inmarsat EGC receiver – Sailor H2095B Lloyds approved GMDSS Radio Installation Furuno AIS System, FA150-GPA
u)	VMS system details (brand, model, features and identification)	ALC 1. Triton Advanced IMN# 300534061730040 Serial number: Box AE1203600041 Dome AE3203700828 ALC 2. Triton Advanced IMN# 300534060234090 Serial number: Box AE1202500071 Dome AE3203000836
v)	Name of owner(s)	Sanford Limited
w)	Address of owner(s)	22 Jellicoe Street Freemans Bay Auckland Sanford Limited
x)	Date of inclusion into the SPRFMO Record	04 Jul 2023
y)	Flag authorisation end date	30 April 2025
z)	Flag authorisation start date	25 July 2024

Specifications of *San Aspiring* as required by CMM 05-2023 Annex 1 Article 3:

a)	External markings (such as vessel name and international radio call sign)	Blue hull with a white stripe, white upper works with blue around top of bridge and top of funnel, the vessel call sign ZMGO under bridge in large black letters. Sanford trademark on funnel, vessel name on bow both sides in blue over the white, vessel name and port of registry (Auckland) centre stern
b)	Types of fish processing lines	Headed and gutted trunks, collars, cheeks
c)	When built	2001
d)	Where built	Huangpu Shipyard, Guangzhou province, China
e)	Moulded depth	10.52
f)	Beam	12.21 m
g)	Electronic equipment on board (i.e., radio, echo sounder, radar, net sonde)	1 x Radio telephone MF / HF 500w – Furuno FS2575 C 2 x Radio telephones VHF-DSC - 2 x Radio telephones VHF-DSC - Sailor RT 4822 2 x VHF RT's – Sailor SP3110 Inmarsat EGC receiver – Sailor H2095B Lloyds approved GMDSS Radio Installation Furuno AIS System, FA150-GPA 1x Simrad ES80 echo sounder 1x Simrad ES70 echo sounder

		1x Furuno radar FS-2575 1x JRC radar JMA-5332-12
h)	Name of license owner(s) (if different from vessel owner)	Same as vessel owner
i)	Address of license owner(s) (if different from vessel owner)	
j)	Name of operator(s) (if different from vessel owner)	
K	Address of operator(s) (if different from vessel owner	
l)	Name of vessel masters	Alexander Patterson Shane Cottle
m)	Nationality of vessel masters	New Zealand
n)	Name of fishing master	Alexander Patterson Shane Cottle
o)	Nationality of fishing masters	New Zealand

San Aspiring starboard, port and stern views:

3.1.2 San Aotea II

Ice Classification:
DNV + 1A1 Ice – 1C, built for operation in regions where ice floes of thickness 0.4m are anticipated.

Specifications of *San Aotea II* as required by CMM 05-2023 Annex 1 Article 2:

	Requirement	**Vessel specification**
a)	Current vessel flag	NZL
b)	Name of vessel	*San Aotea II*
c)	Registration number	63631
d)	International radio call sign	ZM2534
e)	UVI (Unique Vessel Identifier)/IMO number	9057111
f)	Previous Names	*Kapitan Samoilenko*
g)	Port of registry	Auckland
h)	Previous flag	Russian flagged before purchase in August 1998
i)	Type of vessel	Demersal longliner (Autoline)
j)	Type of fishing method(s)	Demersal longline
k)	Length	46.5 m
l)	Length type	LOA
m)	Gross Tonnage	1079 GT
n)	Gross Register Tonnage – GRT (to be provided if GT not available; may also be provided in addition to GT);	Not provided
o)	Power of main engine(s) (kW)	802 kW
p)	Hold capacity	Cargo Hold 1: 515 m^3 Meal hold: 100 m^3 Bait hold: 50 m^3 Fuel Oil: 320 m^3 Fresh water: 10 m^3
q)	Freezer type	Ammonia
r)	Number of freezers units	2 plate freezers 1 blast freezer 1 bait hold
s)	Freezing capacity (if applicable);	Approximately 300 metric tonnes frozen product
t)	Vessel communication types and numbers	**Primary** Starlink: primary +6439272927 Certus Iridium: secondary +881677101565 E- mail: sanaoteabridge@sanfordnz.net (primary) E- mail sanaotea2@sanford.co.nz (secondary)
u)	VMS system details (brand, model, features and identification)	ALC 1. Triton Advanced IMN# 30053406176710 Serial number: Box AE1202900605

		Dome AE3203700808 ALC 2. Triton Advanced IMN# 300534060396030 Serial number: Box AE1201710052 Dome AE3202300170
v)	Name of owner(s)	Sanford Limited
w)	Address of owner(s)	22 Jellicoe Street Freemans Bay Auckland Sanford Limited
x)	Date of inclusion into the SPRFMO Record	25 July 2024
y)	Flag authorisation end date	30 Apr 2025
z)	Flag authorisation start date	25 July 2024

Specifications of *San Aotea II* as required by CMM 05-2023 Annex 1 Article 3:

a)	External markings (such as vessel name and international radio call sign)	Blue hull with a white stripe, white upper works with the vessel call sign ZM2534 under bridge in large black letters, blue "eyebrow" around bridge windows, Sanford trademark on funnel, vessel name on bow and at stern both sides in white over the blue, port of registry (Auckland) under stern label.
b)	Types of fish processing lines	Headed and gutted trunks, collars, cheeks
c)	When built	1993
d)	Where built	Vard Soviknes - Sovik, Norway
e)	Moulded depth	9.9
f)	Beam	10.8 m
g)	Electronic equipment on board (i.e., radio, echo sounder, radar, net sonde)	1 x Radio telephone MF / HF 500w – Furuno FS2575 C 2 x Radio telephones VHF-DSC - 2 x Radio telephones VHF-DSC - Sailor RT 4822 2 x VHF RT's – Sailor SP3110 Inmarsat EGC receiver – Sailor H2095B Lloyds approved GMDSS Radio Installation Furuno AIS System, FA150-GPA Furuno AIS System, FA150-GPA 1x Simrad ES80 echo sounder 1x Simrad ES70 echo sounder 1x Furuno radar FS-2575 1x JRC radar JMA-5332-12
h)	Name of license owner(s) (if different from vessel owner)	Same as vessel owner
i)	Address of license owner(s) (if different from vessel owner)	

j)	Name of operator(s) (if different from vessel owner)	
K	Address of operator(s) (if different from vessel owner	
l)	Name of vessel masters	Kesome Paasi Peter Lynch
m)	Nationality of vessel masters	New Zealand
n)	Name of fishing master	Kesome Paasi Peter Lynch
o)	Nationality of fishing masters	New Zealand

San Aotea II – Starboard, port and stern views:

3.1.3 Janas

Ice Classification:
DNV +1A1 Ice – 1C, built for operation in regions where ice floes of thickness 0.4m are anticipated.
Specifications of *Janas* as required by CMM 05-2023 Annex 1 Article 2:

	Requirement	**Vessel specification**
a)	Current vessel flag	NZL
b)	Name of vessel	*Janas*
c)	Registration number	63634
d)	International radio call sign	ZMTW
e)	UVI (Unique Vessel Identifier)/IMO number	9057109
f)	Previous Names	*Kapitan Kartashov*
g)	Port of registry	Auckland
h)	Previous flag	Russian flagged before purchase in August 1998
i)	Type of vessel	Demersal longliner (Autoline)
j)	Type of fishing method(s)	Demersal longline
k)	Length	46.5 m
l)	Length type	LOA
m)	Gross Tonnage	1079 GT
n)	Gross Register Tonnage – GRT (to be provided if GT not available; may also be provided in addition to GT);	Not provided
o)	Power of main engine(s) (kW)	790 kW
p)	Hold capacity	Cargo Hold 1: 515 m^3 Meal hold: 100 m^3 Bait hold: 50 m^3 Fuel Oil: 320 m^3 Fresh water: 10 m^3
q)	Freezer type	Ammonia
r)	Number of freezers units	2 plate freezers 1 blast freezer 1 bait hold
s)	Freezing capacity (if applicable);	Approximately 15-20 t/day
t)	Vessel communication types and numbers	**Primary** Iridium: 00881621463113 capt.janas@nzll.amosconnect.com
u)	VMS system details (brand, model, features and identification)	Device type: Iridium Manufacturer: CLS Product name: Triton Advanced Model: 535243 IMEI number: 300534061733470
v)	Name of owner(s)	Talley's Group Limited

w)	Address of owner(s)	Talley's Group Limited P.O Box 7064, Nelson
x)	Date of inclusion into the SPRFMO Record	29 April 2015
y)	Flag authorisation end date	30 April 2025
z)	Flag authorisation start date	31 July 2024

Specifications of *Janas* as required by CMM 05-2023 Annex 1 Article 3:

a)	External markings (such as vessel name and international radio call sign)	Vessel marked with name and international radio call sign. Red hull and white super structure
b)	Types of fish processing lines	Headed and gutted trunks, collars, cheeks
c)	When built	1993
d)	Where built	Vard Soviknes - Sovik, Norway
e)	Moulded depth	9.9
f)	Beam	10.8 m
g)	Electronic equipment on board (i.e., radio, echo sounder, radar, net sonde)	Simrad ES80 sounder 38khz Furuno DFF3 Network Sounder 38khz&50khz FURUNO Marine Radar/ARPA Model FAR-28X7 series FURUNO Marine Radar model FAR-1528BB FURUNO SSB Radiotelephone FS-2570/1570 FURUNO VHF Radio FM-8900S
h)	Name of license owner(s) (if different from vessel owner)	
i)	Address of license owner(s) (if different from vessel owner)	
j)	Name of operator(s) (if different from vessel owner)	
K	Address of operator(s) (if different from vessel owner	
l)	Name of vessel masters	Michael Rhodes Jeffery Pitt
m)	Nationality of vessel masters	New Zealand
n)	Name of fishing master	Michael Rhodes Jeffery Pitt
o)	Nationality of fishing masters	New Zealand

Janas – Starboard, port and stern views:

4 Fisheries Operation Plan

4.1 Description

New Zealand is proposing two areas for exploratory fishing, each considered a separate proposal. These proposals are for two areas south of New Zealand, research block (RB) NZSWRB1 (Figure 2) and research blocks (RBs) A-H (Figure 3). These areas lie immediately to the west and east, respectively, of the current exploratory fishing by Australia under CMM 14f-2024) and are described in more detail below.

4.1.1 Proposal 1: NZSWRB1

The first proposal relates to exploratory fishing area NZSWRB1 (Figure 2), which is positioned between the CAMLR Convention Area to the south and west, the Macquarie Island EEZ and the current exploratory fishing area by Australia (CMM 14f-2024) to the east. The northern boundary runs from NE corner (54°S 150°E) along the 54°S latitude to the intersection of the Macquarie Island EEZ (54°S and ~153 10.7°E). The eastern border of the area bounds the Macquarie Island EEZ as far east as ~58° 19.5' S at 157°E. The southern border runs along the boundary of the CAMLR Convention area from SW the corner at 60°S and 157°E to the SE corner at 60°S 150°E.

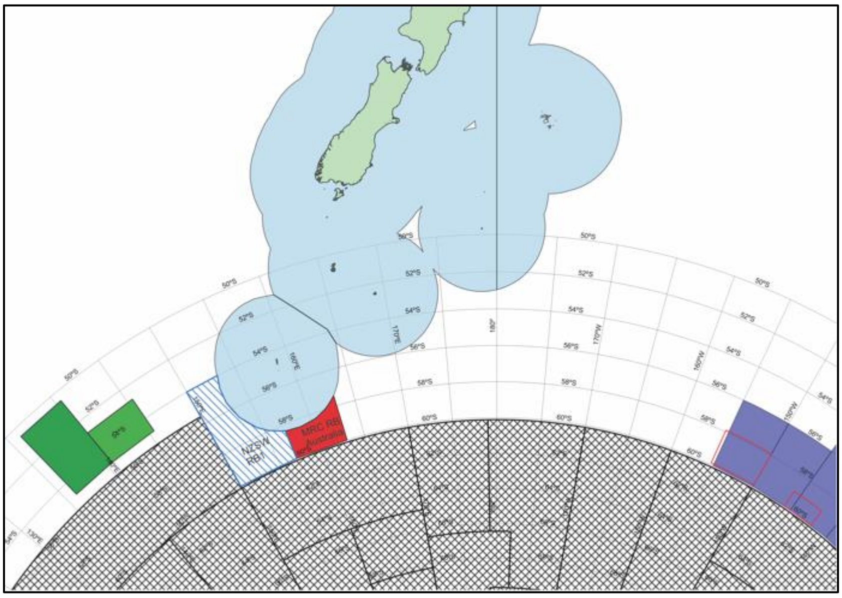


Figure 2. Proposed exploratory fishing area (blue hashed area) (NZSWRB1) in relation to the New Zealand and Australian (Macquarie Island) EEZ (blue areas), the current European Union exploratory fishery (CMM 14e-2024) (green boxes), the Australian exploratory fishery (CMM 14f-2024 (red box), and the previous exploratory fishery by New Zealand (CMM 14a-2019, CMM 14a-2022) (purple boxes).

4.1.2 Research Blocks A-H

The second proposed exploratory fishing area consists of research blocks (A – H) (Figure 3). To the south, these extend along the northern boundary of the CAMLR Convention Area at 60°S (from the SW corner at 163° E to the SE corner 155°W). To the west they follow the eastern margin of the existing exploratory fishery for toothfish by Australia (CMM 14f-2024), the eastern curved margin of the Macquarie Island EEZ, and the southern curved margin of the New Zealand EEZ. To the east the proposed area adjoins the previous New Zealand exploratory fishery area research block L (CMM 14a-2019) with SE corner at 60° S 155' W. The northern boundary runs along the 54 S latitude from the NE corner 54° S 155' W, to the intersection with the New Zealand EEZ at ~56° S 174° 16' E.

4.1.3 Fishing depth – Proposal 1 and 2

The total area of NZSWRB1 is approximately 182,801 km^2 and the total estimated area of RBs A-H is 1,575,300 km^2 (Table 1). Fishing in both areas is proposed on seamounts and features at depths between 600 – 2,000 m, which are known to provide suitable habitat for toothfish in other areas, and which partly covers the depth range of juvenile toothfish (which are generally found shallower). The actual areas within this depth range in the proposed areas are yet to be defined due to scarce bathymetric data. One of the first main objectives will be to carry out bathymetric surveys of the target areas as a precursor to fishing. While it is impossible at the moment with no exploratory or survey work having taken place, we are not in a position to estimate fishable area.

Our experience in working within the SPRFMO area in the far south (2017-2023) when looking for isolated and often small features that potentially support toothfish populations is that the existing GEBCO data has a limited use in identifying fine-scale bottom topography of this type. However, the data is of more use when identifying broad areas to prioritise the setting phase of the project. The proposed survey areas are shown in Figure 4 overlaid over recent GEBCO data.

As results become available during the exploratory fishing, estimates of the fishable area will be updated and reported.

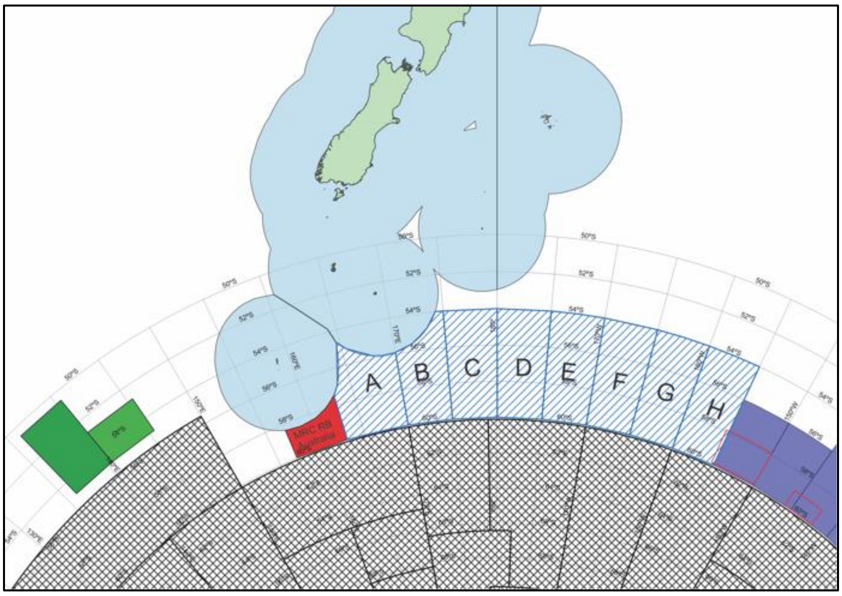


Figure 3. Proposed exploratory research blocks A-H (blue hashed area) in relation to the New Zealand and Australian (Macquarie Island) EEZ (solid blue areas), the green boxes show the European Union exploratory fishery (CMM 14e-2024) and the red box shows the Australian exploratory fishery (CMM 14f-2024), and the previous exploratory fishery by New Zealand (CMM 14a-2019, CMM 14a-2022) (purple boxes).

Table 1. Estimated area (ellipsoidal) for RBs A-H

Research Block	Estimated area km^2
A	193,600
B	163,700
C	203,000
D	203,000
E	203,000
F	203,000
G	203,000
H	203,000
Estimated total	1,575,300

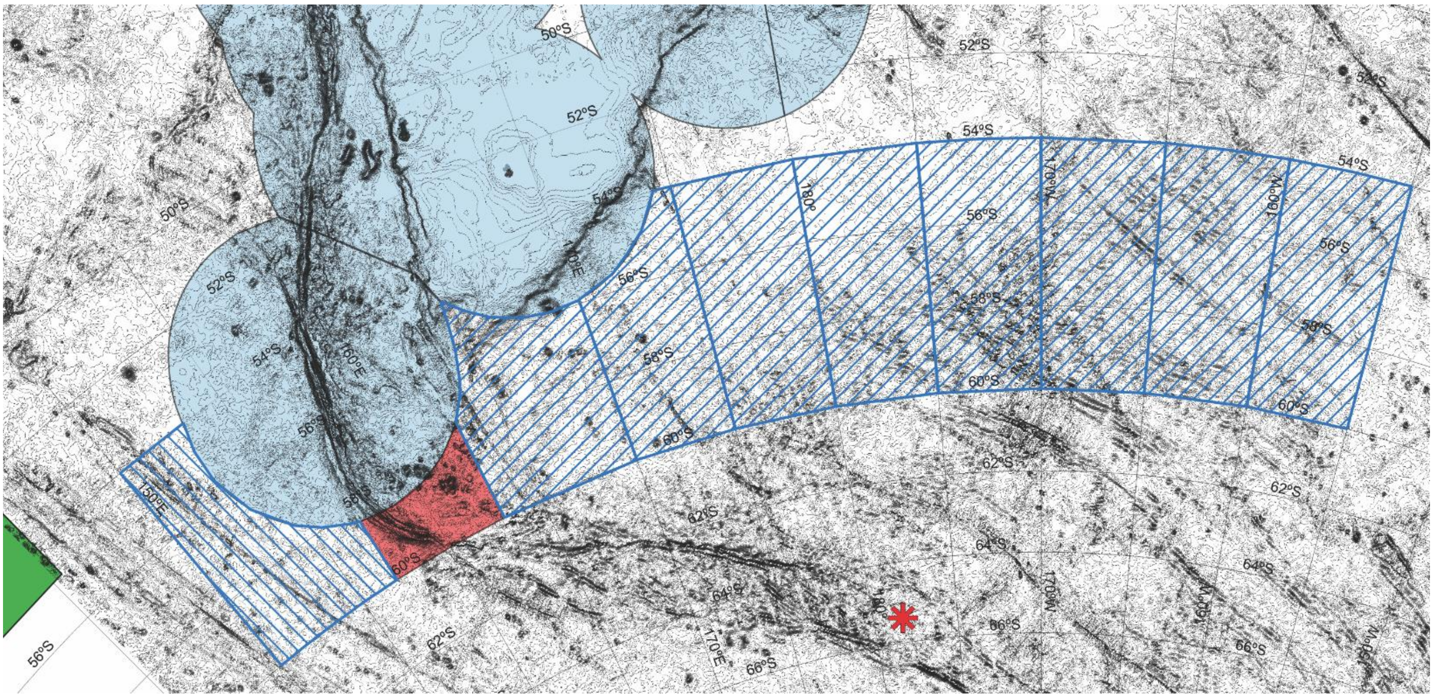


Figure 4. Proposed survey areas overlayed over existing GEBCO data.

4.1.4 Time periods – Proposals 1 and 2

The exploratory fishery is proposed for three consecutive calendar years, 2025, 2026 and 2027, consistent with CMM 13-2024, which allows a maximum period of three years for exploratory fishery applications. It is proposed that exploratory fishing trips may be associated with routine fishing operations for efficiencies. Fishing could take place at any time during a calendar year but where possible, the timing of trips will be additionally planned to take place both before and after the spawning period believed to be around July and August (see Section 4.2). Up to three of the three nominated vessels will participate in the exploratory fishery working within the annual catch allocation and Fishery Operation Plan.

4.1.5 Target species

The target species of the proposed exploratory fishery is Antarctic toothfish (*Dissostichus mawsoni*) and Patagonian toothfish (*Dissostichus eleginoides*), collectively referred to as 'toothfish' (*Dissostichus* spp.) in this document.

The distribution of the two toothfish species within the proposed exploratory fishing areas is currently unknown. Patagonian toothfish is the primary species caught in the nearby Australian domestic fishery at the Macquarie Ridge to the north and in the EU exploratory fishery to the west, while Antarctic toothfish is the most common species caught to the south in RSR70 in the CCAMLR exploratory fishery and in the previous New Zealand exploratory fishery to the east (see Section 4.2).

4.1.6 Catch limits

The proposed annual catch limits (Total Allowable Catch; TAC) for each proposed exploratory fishery area are given in Table 3. Fish that are tagged and returned alive to the sea shall not be counted against this limit.

The green weight of the catch will be calculated from the processed weight of each fish, by applying the annual conversion factors issued by the New Zealand Ministry of Primary Industries (see Section 5.1.2).

The masters and crews of the three proposed vessels have extensive experience working to catch limits and routinely monitor the retained catch closely. In the (unlikely) event a vessel is closing on a catch limit, the following measures are proposed:

1. Shorter lines will be set as the catch limit is approached to minimise the chance of an overrun,
2. Tagging rates (see Section 5.1.1) may be progressively increased during hauling as the catch limit is approached, and
3. A seawater tank will be maintained on board such that live fish in good condition can be retained in case they need to be tagged and returned alive to stay within the catch limit.

The proposed catch limits are consistent with the approach taken for the previous New Zealand exploratory fishery in the south-eastern Pacific from 2016 – 2024.

For context, Table 2 compares the proposed catch limits from existing and previous proposals for exploratory toothfish fishery within the SPRFMO Convention Area. Note that as was the case in the previous New Zealand exploratory fishery (CMM-14a-2022), accurate bathymetric data is not available for much of this region, meaning that the estimated fishable area cannot currently be calculated.

Table 2. Existing and previous proposals for exploratory toothfish fishing showing Total Allowable Catch (TAC), approximate survey area and, where available, the fishable area between 600-2500 m.

Research	Member	CMM	Approximate area of Exploratory fishery (km^2)	Estimated fishable area 600-2500 (km2)	Catch limit
Exploratory Fishing for Toothfish by New Zealand-Flagged Vessels in the SPRFMO Convention Area	New Zealand	14a-2022	1,932,600	Unknown	The TAC shall not exceed 240 tonnes (greenweight) in each of 2022, 2023, and 2024 unless the Scientific Committee at its 2022 or 2023 meetings advises a lower TAC. Fish that are tagged and returned alive to the sea shall not be counted against this limit. The annual catch limit of 240 tonnes will allow the collection of a significant amount of scientific information, will also allow for an adequate number of tagged fish to be returned to the sea. This catch limit is based on the individual research block catch limits (40 tonnes) and the ability to survey a maximum of 6 research blocks per year. This is a precautionary approach.
Conservation and Management Measure for exploratory fishing for toothfish by the European Union in the SPRFMO Convention Area	EU	14e-2024	222,770	17,564	The annual toothfish total allowable catches (TACs) shall not exceed 129 tonnes (greenweight) in RB-A, and 33 tonnes in RB-B, unless the Commission revises the TACs at its annual meeting based on advice of the Scientific Committee.
Conservation and Management Measure for Exploratory Fishing for Toothfish by Australia in the SPRFMO Convention Area	Australia	14f-2024	55,257	10,370	The annual toothfish total allowable catch (TAC) shall not exceed 40 tonnes (greenweight), unless the Commission revises the TAC at its annual meeting based on advice of the Scientific Committee. Fish that are tagged and returned alive to the sea shall not be counted against this limit.
Conservation and Management Measure for Exploratory Fishing for Toothfish by Chilean-Flagged Vessels in the SPRFMO Convention Area	Chile	CMM 14d-2020	68,267	unknown	The annual toothfish total allowable catch (TAC) shall not exceed 54 tonnes (greenweight) in 2020. The TAC for 2021 and 2022 shall not exceed 54 tonnes unless the Commission sets a higher TAC, taking into account any advice from the Scientific Committee and the previous year's performance and data collected during the same period.

Table 3. Proposed Total Allowable Catch (TAC) limits for the two exploratory fishing areas proposed by New Zealand

Proposed fisheries areas	No. of RBs	Annual TAC per RB	Maximum total annual TAC
NZSWRB1	1	50	50
RBs A-H	8	50	240

4.1.7 Fishing method

The proposed fishing methods are demersal longline using the autoline system with integrated weight mainline and potentially potting to investigate the potential of this fishing method to catch toothfish and reduce the catch of non-target fish.

In respect to any potting activity this is a fishing method currently being pioneered in several global fisheries including within the New Zealand EEZ. It is understood that to carry out any potential potting in this experimental fishery there will be an additional requirement in the form of a supplementary proposal which would identify methodology and provide a risk assessment on the bottom impact of the potting method. Thus, potting as an additional activity would only potentially take place later in the survey period (2026 or 2027) and only following SC and Commission approval.

Demersal longlining using the autoline system (Figure 5, Table 4) for toothfish is practiced by New Zealand vessels in the adjacent CAMLR Convention Area, and was also the fishing method for the New Zealand exploratory fisheries in the SPRFMO Convention Area in 2016 – 2024. The proposed method in this proposal is the same used in these fisheries. Integrated weight mainline (ca. 50 g of lead weight per metre of backbone) is used to prevent seabird bycatch. A longline set comprises joined magazines, with each magazine holding 857 hooks spread over a backbone line of 1,200 m. The hooks are J types size 15/0 and are connected to the backbone with snoods of about 30 – 40 cm length, spaced at 1.4 m and connected to rotors and swivels permanently attached to the backbone (Figure 4.).

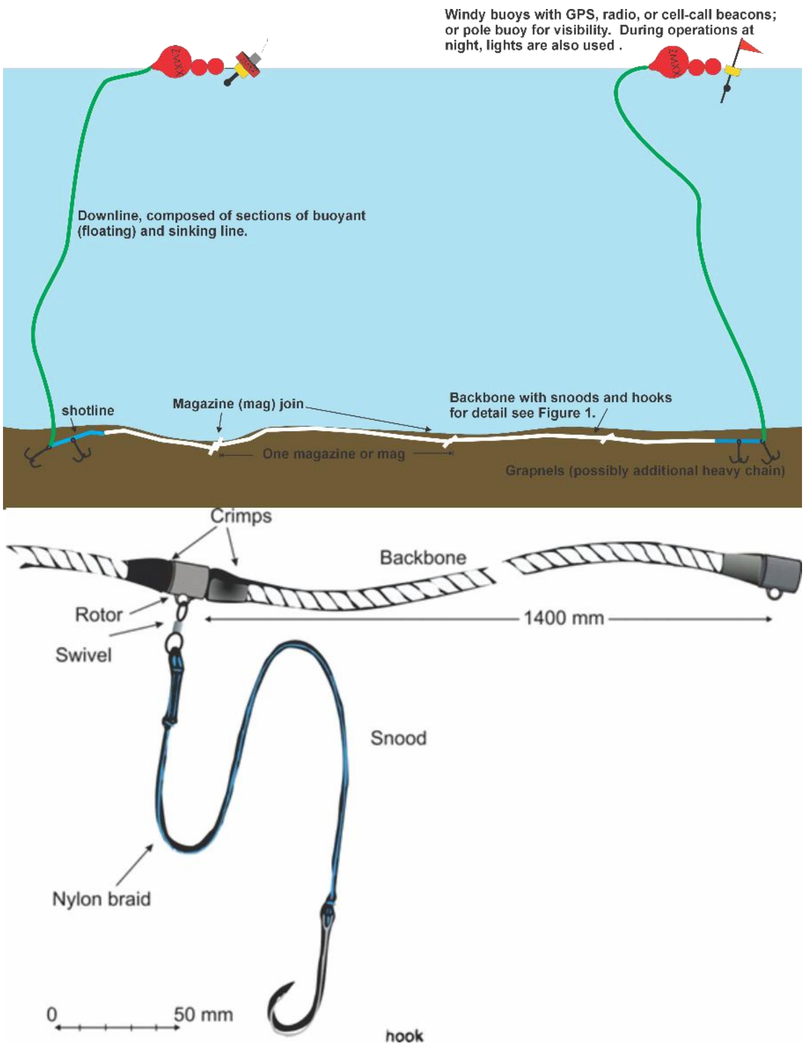


Figure 5. General arrangement for bottom longlining using an autoline system and the generic arrangement of backbone and snood. There may be very minor differences between vessels in the equipment deployed.

Table 4. Description of main bottom long line gear items.

Item	Description
Backbone	11.5–12.5 mm lead-core internally weighted polypropylene/nylon line at 50g/m (Fiskevegn AS or equivalent for sink rate purposes)
Grapnels	40 or 50 kg: two or four used per line depending on sea, bottom, and tidal conditions
Weights	About 5 kg: rarely used, tied to the line occasionally when setting in loose sea ice or when turning while setting
Hook type	15 mm straight shank 14/O or 15/O hooks (Fiskevegn AS or similar).
Chain	Lengths of heavy chain generally 20 or 40 kg used for additional weighting at the line ends.
Floats	Only surface floats, either inflatable or pressure floats depending on ice conditions
Snoods	45–50cm blue Capron™ or similar snoods spaced 1.4 m. apart

We propose a target soak time of between 8 to 36 hours depending on the fishing operation, presence (or absence) of sea lice, and accounting for weather and ice conditions. This exceeds CCAMLR's requirements for Research Lines in CM 41-01 (2023) Par. 5 (iii).

4.1.8 Cluster design

The concept of a cluster design was originally adopted by CCAMLR for a longline survey of toothfish in the northern Ross Sea region (in SSRUs 88.2 a and B) in 2014. A full description can be found in document WG-SAM-14/34 (Delegations of New Zealand, Norway, United Kingdom (2014)) available on the CCAMLR website (see also Bibliography).

The text below is reproduced from this initial proposal document and describes the reasons for adoption of this design well.

'Sampling small, isolated features is not typical of other longline survey designs within CCAMLR, such that some aspects of typical longline surveys elsewhere, for example using fixed longline lengths and minimum set separation rules, would not be feasible as a research design. The flexibility to deploy shorter sets closer together may be required to fish small or steep sided features, as is the option to efficiently fish longer sets along a single ridge. Therefore, operationally, we propose a survey design that uses clusters of sets with a wider separation rule between clusters to spread effort rather than shorter separation rules applied to each line individually. Further, we propose to limit the number of hooks that can be deployed in a single cluster, but to allow that the length of individual sets within the cluster can vary. Numbers of sets would still be tracked and total effort allocation can be made based on the average length of sets, following more typical survey designs.'

To implement this design, which has now been used in a number of CCAMLR research projects and additionally in the New Zealand work carried out within the SPRFMO area since 2017, clusters of sets are deployed having an limit on the maximum number of hooks that can be set in each cluster. As the hooks are evenly spaced along the fishing line this means that line length is also proportional to hook number. While there is no restriction on the number of lines that may be set within a cluster, operational considerations will generally restrict the number of lines to a practical level given the time taken to both set/haul individual lines and the additional (lost fishing) time involved in hauling unnecessary downlines (connecting the actively fishing longline with hooks on the bottom, to the surface for retrieval). Clusters and their associated lines will be clearly linked with a nominated feature (e.g. a small or steep sided underwater rise, ridge or seamount) with clusters having a minimum separation of at least five nautical miles between the midpoints of the closest lines between two clusters.

An example of a cluster of lines set on a seamount is shown in figure 5.

In summary a cluster design requires a limitation on the maximum number of hooks allowed per cluster and a minimum separation between the closest lines of two adjoining clusters. While the proposal does not contain any maximum or minimum number of lines to be set this will be dictated by both bottom conditions and by efficiencies in the fishing operation.

Following experience gained during New Zealand's previous toothfish exploratory fishing within the CAMLR and SPRFMO Convention areas, we propose the following approach to maximise fishing success when fishing on features in deep water.

- Clusters composed of multiple IWL lines are allowed with no rules for minimum separation between lines.
- No more than 20,700 hooks may be set in a cluster.
- clusters of lines may be no closer together than 5 nautical miles (measured from the mid-point of the proximate lines of each individual cluster) in any calendar year.
- A cluster may only be fished once during any calendar year by any of the vessels involved.

The proposed sampling regime reflects a small increase over the previous proposal based on experience from the past seven year of exploratory fishing (an additional 3250 hooks or 24 magazines in total, including an additional 132 hooks to cover minor potential errors in magazine length). Multiple lines may be set in a cluster up to that governing number of hooks. Such clusters of lines may be no closer together than 5 nautical miles (measured from the midpoint of the proximate lines of each individual cluster) in any calendar year. No further fishing will be allowed by any of the participating vessels on any fished cluster during each calendar year of the project. The proposed 5 nm is consistent with CCAMLR move on rules for bycatch in CM 33-33 (2023) par 5. and exceeds the requirements of CM 41-01 (2023) par. 5 and CM 22-07 (2013) Par. 2 (v).

The cluster design allows increased flexibility of operation in these types of fisheries and enhances the efficiency of the survey, the productive use of vessel time, and reduces potential for losing gear by allowing more focused setting on suitable ground.

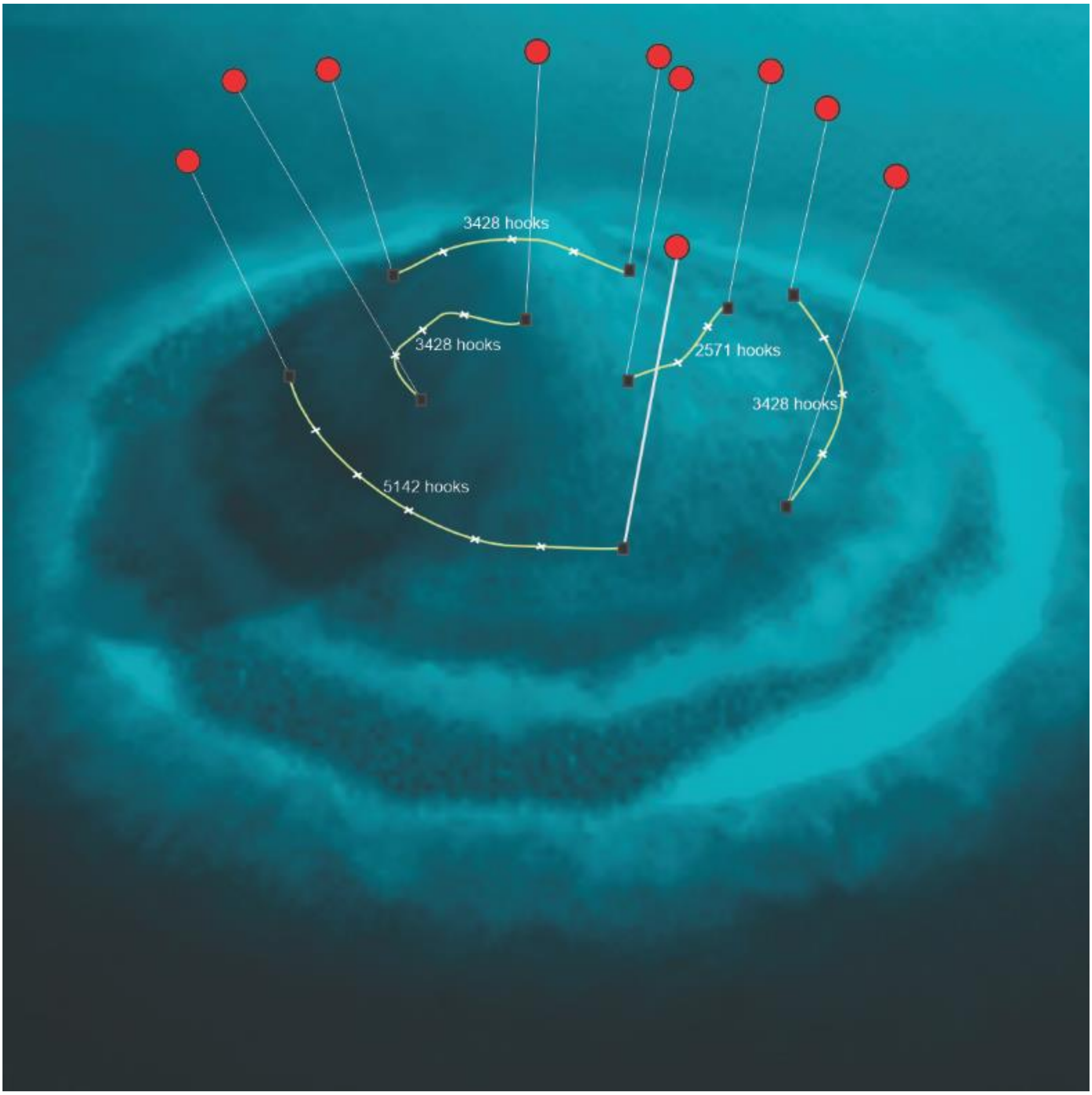


Figure 5. An example of a cluster set on a seamount. In this example there are five lines (shown in yellow) with the magazines separated by a white cross (each magazine being 857 hooks for ease of compliance with the CCAMLR VME sampling regime). Total number of hooks for each line are shown in white. In this example the total number of hooks set on the feature would be 17, 997 hooks.

4.2 Biological information

Limited information is available regarding either toothfish species in the proposed exploratory fishing areas, but information is available from the adjacent Australian domestic fishery at McQuarrie Ridge (Patagonian toothfish), the current SPRFMO exploratory fishery by the European Union (EU) to the west (Patagonian toothfish), the previous New Zealand SPRFMO exploratory fishery to east (Antarctic toothfish) and the ongoing toothfish fishery in the CAMLR Convention Area to the south (Antarctic toothfish, Patagonian toothfish).

Patagonian and Antarctic toothfish are largely separated in distribution by latitude due to their differing thermal tolerances (Collins et al., 2010; Hanchet et al., 2015), however, they are known to overlap at the extremes of their southern and northern distributions, respectively. The proposed exploratory fishing areas likely include both *Dissostichus* species, and a key objective of this proposal is to identify important overlap areas as well as to increase the understanding of the biogeography of both species within the SPRFMO and CCAMLR Convention areas.

4.2.1 Australia – Macquarie Ridge

The Australian domestic fishery for Patagonian toothfish has been operating for 28 years (since 1996/97) and is primarily based around the Macquarie Ridge (Hillary & Day, 2021). Over 21,000 tagged Patagonian toothfish have been released in this fishery (SC11-DW03-rev3) to understand the movements of the stock, and toothfish recaptures form an important statistic along with the biological data for stock assessments. Tag recaptures suggest limited movement with high site fidelity (Hillary & Day, 2021), although recent tag recaptures by the exploratory fishery in the George V Fracture zone by EU exploratory fishing (SAERI (Falklands) Ltd., 2022) indicates that some longer range movement does occur (see further information below). Aging data is available from the Macquarie fishery from 1996 to 2019 with different growth rates observed for males and females, with females generally being longer at age than males, and with 50% female maturity occurring at 97 cm and 13-15 years of age (Hillary 2021). The fishery is in a healthy state and estimated to be at 84% of unfished spawning biomass ((Hillary & Day, 2021). The average extraction rate from the open area of this fishery has been 16 kg per km^2 (SC11-DW03-rev3).

4.2.2 European Union - George V Fracture Zone

The EU exploratory fishery in the George V Fracture Zone started in 2021, with results from two trips available at the time of writing (Oct/Nov 2021 and Oct 2022) (SAERI (Falklands) Ltd., 2022, 2023). All fish caught (74,889 kg and 74,898kg, respectively) were Patagonian toothfish, which comprised most fish catches (98.6% by weight). In 2022 toothfish catches ranged between 74 – 6620 kg per line (average 2340 kg per line). In 2021 most individuals were in reproductive Stage 3 ('developing'), with some females in Stage 5 ('spent'). In 2022 most individuals were in reproductive Stage 2 ('developing/Resting') with a large proportion of males in Stages 3 ('developed') and 4 ('ripe'). Tag recoveries included four Patagonian toothfish previously tagged at Macquarie Ridge in 2004, 2008, 2013 and 2019 – over 600 km away – indicating connectivity between these two areas. Antarctic toothfish

4.2.3 New Zealand – SPRFMO RBs L-S

New Zealand is currently in the last year of the exploratory fishery in research blocks L-S (CMM 19a-2022), to the east of the current proposal. A total of seven trips have been undertaken, with the last trip upcoming in October 2024 (Table 5). Across trips, localised high catch rates of Antarctic toothfish were found towards the southern border of the exploratory fishing area, with only sporadic catches of Patagonian toothfish. The catch rates were of similar magnitude to catch rates in the north region of the CAMLR Convention Subareas 88.1 and 88.2. Four trips were undertaken during austral autumn (Feb – Apr), and three trips during austral spring

(Aug – Sep) (Table 5), prior to and following, respectively, the peak spawning period for Antarctic toothfish in the Ross Sea region (austral winter months; Hanchet et al., 2015)). The sex ratio for Antarctic toothfish was consistently skewed towards males, except in 2023, where the sex ratios were almost even. On average, females were larger than males. During austral autumn trips (Feb – Apr) Antarctic toothfish of both sexes were generally found to be in a pre-spawning/developing gonad stage. During austral spring trips (Aug – Oct), the fish were either stage 5 ('spent') or stage 2 ('recovering/resting'). Overall, the results provide compelling evidence that Antarctic toothfish also spawn north of 60° south latitude in the Southern Ocean (the CCAMLR - SPRFMO boundary). Biometrics collected during the exploratory fishing trips, from which body conditions were calculated, were consistent with previous information and analyses from the northern regions of CCAMLR Subarea 88.1, indicative of spawning in that region (e.g., Fenaughty, 2006; Fenaughty et al., 2008) and a conclusion that Antarctic toothfish spawning may extend over a wider geographic area than has been initially thought.

Table 5. Previous exploratory fishery trips by New Zealand in research blocks L-S

Year	Month	CMM	Reference
2016	Aug	CMM-14-2016	SC-06-DW-03-rev2: Proposal for Exploratory Bottom Longlining for Toothfish in the SPRFMO Area New Zealand
2017	Aug/Sep	CMM-14-2016	
2019	Sep/Oct	CMM-14a-2019	SC9-DW04: Report on the New Zealand exploratory bottom longline fishing for toothfish in the SPRFMO Convention Area 2019 to 2021
2020	Feb/Mar		
2021	Feb/Mar		
2022	Mar	CMM 19a-2022	SC10-DW07: Interim research report from the New Zealand bottom longline research carried out in the SPRFMO area 2022
2023	Mar/Apr	CMM 19a-2022	SC11-DW11_rev1: Interim research report from the New Zealand bottom longline research carried out in the SPRFMO area 2023
2024	Oct (upcoming)	CMM 19a-2022	-

4.2.4 CCAMLR - Subareas 88.1 and 88.2

In addition, there is excellent information from the CCAMLR fishery in the Ross Sea (Subareas 88.1 and 88.2) immediately bounding the southern limits of the two proposed exploratory fishing areas. This fishery has been operation for over 25 years, and the main catch species is Antarctic toothfish although Patagonian toothfish are also taken. CCAMLR conducts regular (biennial) stock assessments of Antarctic toothfish; the current population status in the Ross Sea is estimated to be 64.4% of unfished biomass (Mormede et al ., 2023). Genetic studies point to a well-mixed single gene pool with a circumpolar distribution (Choi et al., 2021).

Catches of Patagonian toothfish *D. eleginoides* have mainly come from the northwest of the Ross Sea region in SSRUs 881 A– C (WG-FSA-13/48). Catches of Patagonian toothfish were quite high in the early part of the fishery, particularly in 2001, but have been relatively low since then, mainly due to changes in open areas. Catch rates of *D. eleginoides* have been much higher in SSRU 88.1 A than the other SSRUs and this SSRU has been closed to fishing since 2008. In 2022 for example 14 tonnes of Patagonian toothfish were recorded in CCAMLR Subarea 88.1.

4.3 Non-target and associated or dependent species

There is little available information on non-target species from proposed fishing areas but there is information available from the Australian and EU projects, the previous New Zealand exploratory fishery and from CCAMLR.

The Australian proposal for exploratory fishery within the SPRFMO Convention Area (SC11-DW03_rev3) lists Macroridae, Moridae, and Anguilliformes as the common non-target fish caught in the Macquarie Ridge fishery to the north. The Australian proposal notes that there is evidence for changes in community composition north to south, and it is likely that the Macquarie Ridge provides “stepping stones” linking Sub-Antarctic and polar faunas. However, the proposal also reports that “S*pecies inventories for the benthic and pelagic habitats are absent for this region. Analyses of the benthic communities of the Macquarie Ridge, primarily focused near Macquarie Island, remain preliminary due to uneven sampling effort and incomplete analysis*.” The report also notes that capture of unspecified sharks and skates is possible.

Non-target fish bycatch from the EU exploratory fishery was reported from the 2022 fishing operations as being very low (1093 kg or 1.44% of the total catch) comprising mainly Blue Antimora (1093 kg or 1.44% of the total catch), *Macrourus holotrachys* (581 kg or 0.76%), and unspecified *Macrourus* spp. (342 kg or 0.45%) (SPRFMO SC11–DW14). These results are commensurate with the findings from the 2021 exploratory fishing trip (SAERI (Falklands) Ltd., 2022, 2023)

Non-target fish bycatch from the previous New Zealand Exploratory fishery has generally been very low and similar to the results of the EU exploratory fishery. In 2023, 99.95% of the catch was Antarctic toothfish with Blue Antimora (9.1 kg or 0.03%), *Macrourus holotrachys* (7.3 kg or 0.02%) and stone crabs (0.3 kg or less than 0.01%) the main species recorded (SC11-DW11_rev1. NZ (2023)).

The northern section of the CCAMLR fishery immediately bounding the southern limits of the two proposed areas also provides useful information on non-target fish catch. Bycatch is generally very low in this fishery. For example, during the 2023/24 season, 1118 kg of unspecified *Macrourus* and 750 kg of other species (not specified) were reported by CCAMLR for the northern section of the Convention Area defined as RSR North 70 (SC11-DW11_rev1). This was for a target catch of 681,280 kg of Antarctic toothfish. This trend of very low non-target fish catch in the northern CAMLR Convention Area is common through all years of the fishery.

4.4 Cumulative impact of all fishing activity

Description of Impact: This exploratory fishery will target toothfish, a relatively fast growing and short-lived species (Horn 2002). Toothfish grow at a similar rate to temperate-water species such as hoki and hake. They reach about 60 cm long after 5 years, about 100 cm after 10 years, and about 150 cm after 20 years. The maximum age recorded is almost 50 years, but few fish older than about 30 years are caught. It is thought that fish mature at about age 10 (Hanchet et al 2003).

The catch of non-target fish species is likely to be a very small proportion of the total catch. Fish in the previous New Zealand Exploratory fishery to the east has been generally less than 1% by weight and comprised mostly rattails. No sharks were caught.

Extent – Given the circumpolar distribution of both species of toothfish and the substantial distances travelled, the extent of impacts stemming from this lining is regional, but potentially oceanic, in scale.

Duration – At the proposed levels of exploratory fishing effort and catch, duration of impacts is likely to be minimal to medium.

Intensity – Low, for the proposed exploratory fishing, given the low impact method of bottom long line fishing effort and the level of effort proposed.

Management and Mitigation – The proposed low effort and catch levels for this exploratory fishing are not considered to require any active management or mitigation measures. The exploratory fishing has a survey design that focusses on information gathering that will facilitate assessment of any subsequent fishing. Eventually, it is anticipated that the information from this exploratory fishery will support a joint stock assessment with CCAMLR that will allow ongoing management or evaluation of the need for mitigation.

Monitoring – In addition to the current reporting using the CCAMLR C2 forms for longline reporting, existing New Zealand commercial catch return systems are already specifically designed to collect the necessary high-resolution catch and effort data for such species. Scientific observers will monitor catch and effort for the target species and supplement this with length- frequency and biological sampling (gonad staging and otoliths) as per the survey design.

Although any bycatch of larger sharks[1] is not expected, should the opportunity arise, larger live sharks that are able to be safely brought aboard will be identified and released. Additionally, having regard to crew and observer safety and practicality, larger sharks may be measured, and some may be fitted with pop-up archival transmitting tags[2]. Large sharks that are dead and can be safely brought aboard will be retained for identification ashore, large specimens that cannot be brought aboard will be photographed and discarded.

4.5 Anticipated cumulative impact

Cumulative impacts of fishing are dependent on exploitation rates, the geographical scale, and the intensity of fishing. There are no other bottom fisheries in the proposed area but some toothfish are known to migrate substantial distances and any potential Antarctic toothfish stock is probably shared with CCAMLR where fishing also occurs. Although tagging studies have shown occasionally larger distances in migration, the most records for *Dissostichus* spp. fisheries suggest these are outliers with movement generally limited to less than 50 km.

Patagonian toothfish catch is likely to represent part of the more northern distribution of this species. In the general area proposed catches of Patagonian toothfish are recorded in 2023 during the EU Exploratory fishery, generally from the Macquarie Island fishery and catches have been made within the New Zealand EEZ. In addition, some Patagonian toothfish are also caught within CCAMLR, notably from the northwest of the Ross Sea region.

4.6 Similar Fisheries

Similar fisheries in the area are reviewed in Section 4.2.

We are unaware of any overlapping toothfish fisheries inside the proposed exploratory fishing areas, neither established, planned or undertaken during the previous 10 years.

Any Antarctic toothfish stock is probably shared with CCAMLR where fishing also occurs. Patagonian toothfish catch is likely to represent part of the more northern distribution of this species. In the general area proposed catches of Patagonian toothfish are recorded in 2023 during the EU Exploratory fishery, generally from the Macquarie Island fishery and catches have been made within the New Zealand EEZ.

The proposed approach mirrors that used in the previously approved New Zealand proposal (CM 14a-2022 and Fisheries Operation Plan for CMM 14a) and is very similar to the other two toothfish exploratory fisheries by Australia and the EU (Table 2). As in this and other proposals the Commission has the option of revising the TAC at its annual meeting based on advice of the Scientific Committee.

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[1] See section 2 of table 11.

[2] Wildlife Computer survival (sPAT) tags. The primary goal is tagging gulper sharks (which may not be caught) and sleeper sharks if the opportunity arises.

4.7 Bottom fishing (if applicable)

The bottom impact of line fishing methods is typically low (e.g., Pham et al. 2014, Clark et al. 2016), depending largely on the extent to which lines move laterally during hauling. Tethered camera observations by the UK (UK 2010) suggest that the frequency of lateral longline movement in contact with the ocean floor is likely to be negatively correlated with depth. In three deployments in shallow water (531–541 m; mean = 537 m) lateral movement was observed during hauling immediately prior to lift-off from the sea floor, whereas in two observed deployments in deeper water (1528 and 1390 m) the line was seen to lift vertically from the sea floor without any lateral movement. Australian work in the Heard and McDonald Islands fishery (Welsford et al. 2014) suggested some lateral movement of longlines (median ~3 m, mean ~6 m) and some indication that lateral movement decreased with depth although a review of the paper during WG-FSA discussed the possibility that the relatively large camera setup in use may have induced line movement due to current moving the camera which was attached to the line.

A negative correlation of lateral line movement with depth is to be expected due to trigonometric considerations (Sharp 2010). Experience from NZ exploratory fishing in SPRFMO and the limited bathymetry information suggest that fishing depths are likely to be in the range 900 to 2400 m so limited lateral movement and consequently a low benthic impact is expected.

Notwithstanding the low expected impact, New Zealand government observers will record all benthic bycatch and will carry appropriate detailed identification guides to facilitate identification to a useful taxonomic level (see Section 5.1.5). VME indicator taxa associated with “structural VMEs” can be identified from the guides normally used by New Zealand government observers (e.g., see pages 96 and 97 of New Zealand’s Bottom Fishery Impact Assessment) and the CCAMLR VME Guide can be used to identify hydrothermal vent fauna (if encountered). No hydrothermal vents are known to occur in the proposed exploratory fishing area, but search effort has been minimal, and the habitat appears broadly suitable.

Because the proposed exploratory fishery is a bottom fishery, an assessment of the impact of the proposed fishing activities is provided in Appendix 1 as per Para 22. of CMM-03-2023.

At the 2015 Commission Meeting (19-30 October 2015), the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) adopted a draft Memorandum of Understanding (MoU) with SPRFMO for consideration by the SPRFMO Commission at its 2016 Meeting. The MoU was ratified by SPRFMO with the aim of facilitating cooperation between the two Organisations, in particular the exchange of documents, data and scientific information including fishery data, the harmonisation of approaches in areas of mutual interest and concern including biological resources, VMS, research, mutual support of each other’s CMMs etc. The MoU also implemented a consultative process between the two Secretariats.

This Arrangement between SPRFMO and CCAMLR to facilitate cooperation to advance objectives, particularly regarding stocks and species of mutual interest was renewed on 17 February 2022 (for 3 years).

Areas of cooperation are listed as follows in Paragraph 2 of the MoU:

The Organisations will establish and maintain consultation and cooperation in respect of matters of common interest to both organisations. In particular the Organisations will:

- *I. exchange meeting reports, information, documents and publications regarding matters of mutual interest, consistent with the information sharing policies of each Organisation.*
- *II. exchange data and scientific information in support of the work and objectives of both Organisations, consistent with the information sharing policies of each Organisation including, but not limited to, information on:*

a. *vessels authorised to fish in accordance with conservation and management measures adopted under the SPRFMO Convention and conservation measures adopted under the CAMLR Convention;*
b. *vessels suspected of illegal, unreported and unregulated (IUU) fishing activity and the IUU Vessel Lists established by each Organisation;*
c. *catch, bycatch and vessel information and/or data consistent with data use, access and confidentiality rules of each Organisation;*

III. *cooperate to harmonise approaches in areas of mutual interest and concern, including, but not limited to:*
IV. *target species and bycatch of non-target, associated and dependent species (ecologically related species),*
V. *monitoring, control and surveillance policies and systems, including with respect to Vessel Monitoring Systems;*
VI. *where appropriate, collaborate on analyses and research efforts relating to species of mutual interest;*
VII. *consider methods of recognising and supporting conservation and management measures adopted under the SPRFMO Convention and conservation measures adopted under the CAMLR Convention; and*
VIII. *consistent with each Organisation's rules of procedure, grant permanent reciprocal observer status to representatives of the respective Organisations in relevant meetings of each Organisation.*

Paragraph VI details the agreement for the two organisations to collaborate on analyses and research efforts relating to species of mutual interest. Any additional data required for consistency with CCAMLR will be collected at the appropriate scale (see Section 5.2.3). Data will be recorded and reported to SPRFMO and shared with CCAMLR upon request using the CCAMLR fine-scale catch and effort data (C2 longline fisheries) forms and CCAMLR observer forms and species codes for maximum consistency. This facilitates integration between the vessel catch-effort and observer biological data ensuring that the data can be prepared, error checked, and combined with CCAMLR data for use in CCAMLR stock assessment and reporting. All three nominated vessels have demonstrated this capability in reporting and electronically transmitting this information, daily when required when these vessels operate within the CAMLR Convention Area.

4.8 **Para** 9 and 10 of CMM 13.

9. Where two or more SPRFMO Members or CNCPs are seeking to participate in an exploratory fishery for the same or overlapping fishery, area and timeframe, all reasonable efforts shall be made by all the participants of the proposed fishery to jointly submit the Fisheries Operation Plan described in paragraph 8.

10. Paragraph 9 shall not apply to Fisheries Operation Plans for the same or overlapping fishery, area and timeframe already approved by the Commission that have not expired, except with the agreement of all the participants in the fishery which recognise ongoing efforts by the current participant.

There are no other applications currently in progress or existing programmes for research in the area defined.

4.9 IUU Detection and Reporting

In undertaking the proposed exploratory fishing New Zealand vessels will document and report any sighting of fishing or reefer vessels to the New Zealand Government and to the SPRFMO Secretariat. Any lost, abandoned or retrieved fishing gear will be photographed, and reported with all relevant details using the SPRFMO report form “REPORT: Abandoned, Lost or otherwise Discarded Fishing Gear (or Retrieval)”. This is normal operating practice under CCAMLR CM 10-02 Annex 10- 02/A while fishing in the CCAMLR Convention Area.

5 Data collection Plan

CMM 13-2024 Paragraph 14 outlines the objectives of a Data Collection Plan for new and exploratory fisheries. These objectives include identification and description of the data needed and any operational research actions necessary to obtain data from the exploratory fishery to enable an assessment of the stock, the feasibility of establishing a fishery and the impact of fishing activity on non-target, associated or dependent species and the marine ecosystem in which the fishery occurs.

During the proposed fishing operations, data collection will be conducted in accordance with SPRFMO CMMs on data collection and any other elements suggested by the SPRFMO Scientific Committee during the consideration of this application.

New Zealand will ensure that all observations from its vessels will comply with relevant SPRFMO data collection requirements, including those related to seabird and marine mammal observations as well as any other data recordings and opportunistic observations.

Data collection will focus on SPRMO required data and any additional information required to enable an assessment of the stock, the feasibility of establishing a fishery and the impact of fishing activity on non-target, associated or dependent species and the marine ecosystem. This Data Collection Plan outlines the proposed sampling during the proposed exploratory fishery to fulfill these requirements. The sampling and data gathering will predominantly be undertaken by fisheries observers; however, the crew of both vessels have extensive experience in assisting fisheries observers in collecting detailed biological information during fishing and research voyages in both the SPRFMO and CAMLR Convention areas. In addition, a dedicated Scientific Company Representative will be onboard to assist the observer in fulfilling the sampling requirements.

5.1 Data required

The New Zealand nominated vessels will fulfil the requirement of data collection and reporting detailed in CMM 02-2022 (Conservation and Management Measure on Standards for the Collection, Reporting, Verification and Exchange of Data) Annex 3, and relevant sections of Annex 7.

In accordance with Annex 3 (Standard for Bottom long lining fishing activity data) high resolution data will be collected for each set (i.e., on an un-aggregated basis):

- Vessel flag;
- Vessel name;
- Vessel call sign;
- Registration number of vessel;
- UVI (Unique Vessel Identifier)/IMO number;
- Set start date and time (UTC format);
- Set end date and time (UTC format);
- Set start position (1/100th degree resolution – decimal format), latitude and longitude;
- Set end position (1/100th degree resolution – decimal format), latitude and longitude;
- Intended target species (FAO species code);
- Number of hooks;
- Bottom depth at start of set;
- Incidental captures of species of concern (marine mammals, seabirds, reptiles or other species of concern) or benthic taxa (Yes/No/Unknown);
- FAO species code and estimated live weight of catch retained on board for all species caught by the set including target, bycatch and species of concern;

- FAO species code and estimation of the amount of all living marine resources discarded by species to the extent practicable, including any marine mammals, seabirds, reptiles, species of concern, and benthic taxa.

Further, data collection will meet or exceed the requirements of all relevant sections of CMM-02-2022 Annex 7, which specify a wide variety of information to be collected by observers on board fishing vessels:

- Vessel & Observer Data to be Collected for Each Observer Trip (Section A)
- Catch & Effort Data to be Collected for Bottom Long Line Fishing Activity (Section D)
- Length-Frequency Data to Be Collected (Section F)
- Biological Sampling to be Conducted (Section G)
- Data to be Collected on Incidental Captures of seabirds, mammals, reptiles (turtles) and other species of concern (Section H)
- Data associated with Vulnerable Marine Ecosystems (where relevant for long lining) (Section I)
- Data to be collected for all Tag Recoveries (Section J)

CMM-02-2022 recognises that observers may not be able to collect all the data described in the CMM on each trip, and suggests that, where no trip- or programme-specific priorities have been specified, a generalised hierarchy of priorities be applied as set out in Section K of Annex 7. Briefly, this priorities data collection of 1) vessel and fishery data, 2) catch and bycatch data, 3) biological data. These priorities are broadly appropriate for the proposed exploratory fishing and the New Zealand observer will be briefed accordingly.

The following is a summary of the data collection which will take place to meet or exceed CMM 02-2022.

5.1.1 Toothfish tagging

New Zealand proposes a minimum tagging rate of three fish per greenweight tonne retained for Patagonian toothfish. Consistent with the CCAMLR requirement to the south, a minimum tagging rate of one fish per greenweight tonne for Antarctic toothfish.

To harmonise with CCAMLR tagging measures, a minimum tagging size overlap statistic of 60% (for each species separately) will be implemented, once ≥30 toothfish have been successfully released with tags. The overlap statistic is a comparison between the observed length frequency of the biological information collected by the observer, and the size composition of fish returned alive with tags.

The tagging programme will be overseen by the Scientific Company Representative in collaboration with the Scientific Observer. Tagging may be undertaken by either of these, or by trained fishing crew. At the start of each voyage all crew and observers involved in tagging will take part in a tagging orientation to ensure consistent tag insertion and recording, and consistency in the biological length measurement of toothfish.

All fish brought onboard the vessel will be inspected thoroughly for tags. This includes all toothfish and skates. Where tags are found, full biological sampling will be undertaken (Section 5.1.3), alternatively, the entire specimen will be retained and brought ashore for examination. If tagged Antarctic toothfish are caught, these reports will also be provided to CCAMLR as part of the joint MOU.

Detailed information, including tag releases, recaptures and other associated data will be provided to the CCAMLR secretariat by the end of the current fishing month. If tagged Patagonian toothfish are caught New Zealand is happy to share this information with CSIRO, who conduct the Macquarie Island stock assessment, including AFMA, Australia’s Commonwealth fisheries regulator, who manage the Macquarie Island Toothfish Fishery.

5.1.2 Catch

All specimens caught will be identified to the lowest possible taxon using both FAO codes (for reporting to SPRFMO) and CCAMLR codes (for reporting to CCAMLR). If an ID is uncertain, the specimen will be either retained (where practical) or photographed for species verification ashore by taxonomic experts.

The number and green weight of all caught specimens (target and by-catch) will be recorded. For target species, the green weight is back-cast from the weight of the processed product using a vessel-specific conversion factor issued annually by the New Zealand government.

New Zealand vessel specific conversion factors are calculated using a running four-year average for each process state for each species – currently from the Ross and Amundsen Sea fisheries. The data for the same process state for vessel over the previous 4 years are pooled to derive a simple mean rounded to 2.d.p. to be used as the conversion factor for the vessel/process state/species in the next season.

If the vessel has not utilised a process state in recent years, a New Zealand fleet wide conversion factor is applied. The data for the same process state from the different vessels and years have then been pooled to derive a simple mean rounded to 2.d.p. to be used as the conversion factor for the fleet in the next season. This conversion factor has been updated annually with the addition of the most recent season's data to the data pool. As the three vessels in this project are all long time participants in the Ross Sea Fishery they are allocated conversion factors by toothfish species and state annually. This information is confidential to the Flag state and vessel. Additional data from SPRFMO will be incorporated in this calculation.

5.1.3 Biological sampling – target species

Standard biological data will be collected from the target species (when present) by randomly subsampling each line. A suggested representative sampling rate of catches could be up to 50 of each toothfish species present. Any retained fish will be counted against the catch allocation.

- Total length: mouth closed, caudal fin relaxed (not fanned out), to the nearest cm below
- Total weight, using a digital hanging scale, to the nearest 10 g
- Sex, assessed macroscopically
- Maturity stage, assessed macroscopically (see Appendix 1 of SC9-DW04 for details)
- Gonad weight, using an electronic sea-compensated scale, to the nearest 10 g
- Stomach content, examined *in situ*

Otoliths will be collected from a subset of the sampled fish. Contingent on the catch, five pairs will be collected for each species and sex (cumulatively for the trip) for each five cm length class between 100 – 150 cm. In addition, otoliths from all specimens < 100 cm will be collected.

Other information and data will be collected, as requested by relevant institutions, e.g. tissue samples for genetic analysis, non-empty stomachs for diet analysis, muscle samples for stable isotope analysis, etc.

From toothfish tag-recoveries (regardless of duration at liberty), a full set of data will be obtained (length, weight, sex, maturity stage, gonad weight), and a full set of samples will be retained (gonads, otoliths, stomach, muscle tissue (stable isotopes), tissue (genetic analysis)).

5.1.4 Biological sampling – bycatch

Standard biological data and otoliths will be collected from main bycatch species, when present. For each set, up to ten specimens of each main bycatch species will be sampled, contingent on catch and other observer tasks.

Sharks, skates and rays and other species of concern that are hooked and unlikely to survive will be retained onboard and brought back to shore as whole specimens for research purposes and/or for inclusion in museum collections. In the event whole specimens cannot be stored, photographs and full biological data will be obtained, the number of foetuses/pups (in each uterus) will be recorded (for elasmobranchs), and tissue samples for genetics will be sampled from the mother and each foetus/pup. Following collection of any initial specimens of sharks (capture is considered unlikely for other than small *Etmopterus* spp.) those considered suitable for live release will be returned to the sea.

5.1.5 Benthic invertebrates

Any benthos on a line segment will be sampled according to CCAMLR protocols, identified to the lowest possible taxa, weighed to the nearest 10 g using motion-compensated scales and reported as either VME, or as part of the catch. For identification of VME, the following two ID guides are to be used:

- Classification Guide for Potentially Vulnerable Invertebrate Taxa in the SPFRMO Area, and
- CCAMLR VME Taxa Classification Guide 2023

For reporting jointly to SPRFMO and CCAMLR both FAO and CCAMLR species codes will be used. SPRFMO procedures follow the CCAMLR benthic sampling protocol for bottom longline, lines are divided into numbered segments of 1200 m (equivalent to one magazine of 857 hooks). Any benthos found on a segment are placed by the crew into a 10-litre bucket marked with that segment's number. Benthic species are then identified to taxa level by the observer and weighed to the nearest 10 grams.

Pending availability of equipment, we propose the use of a deep-water video camera to examine species occurrence, density and species relationships with habitat (recommended by the BFIAS). This will also provide objective data to assess impact of demersal longline fishing on VME species and habitats.

5.1.6 Marine mammals, seabirds, turtles, and other species of concern

New Zealand observers are trained to identify seabirds and marine mammals whether these are captured or attending the vessel. The following information will be collected for marine mammals, seabirds, turtles, and other species of concern:

- Opportunistic observations, photography and identification of marine mammals will be undertaken by observers in collaboration with vessel crew and scientific staff.
- A target to observe at least 10% of hooks hauled for marine mammal, seabird and turtle captures, and for comparison with a sample of recorded video observations will be set for scientific observers.
- The existing multi-camera EM systems will record both set and haul operations during the entire voyage. Should the EM system fail, the vessel will notify New Zealand officials as soon as possible for advice on replacement requirements.
- All marine mammals, seabirds, turtles, and other species of concern caught will be identified and recorded, and photographs will be taken of any live birds released as well as of any birds colliding with the ship that can be recovered without compromising the safety of the crew regarding the current bird flu (H5N1) outbreak.
- Any dead birds will be photographed and identified as far as possible without comprising the safety of the crew (H5N1), then discarded.
- For benthic species and VME indicator taxa refer to Section 5.1.5
- For fish species of concern refer to Section 5.1.4

5.2 Other research data (as appropriate)

5.2.1 Estimating fishable area and habitat

All vessels will operate high quality echosounders during the time they are within the SPRFMO Convention Area (Simrad ES60 or ES70, 38 kHz, or equivalent) and record all soundings and tracklines. These data will be provided to the New Zealand government for confidential storage. Analyses will be carried out to estimate fishable area and potential suitable habitat for toothfish as data becomes available. Vessels will operate their Simrad sounders to record acoustic information using the protocols already in place for operation within CCAMLR. The recorded information will potentially be available to the NIWA acoustic group using the existing confidentiality agreement and general protocols for the existing program within CCAMLR.

5.2.2 Depth-temperature collection

As opportune in having regard to equipment safety, depth-temperature profiles may be obtained using *Mangōpare* sensors, as part of the wider New Zealand Moana Project (https://www.moanaproject.org). The *Mangōpare* sensor is a robust and simple device that attaches to fishing gear for data collection. The logger has a maximum depth tolerance of 1,000 m. It wirelessly and autonomously offloads data to a solar powered deck unit after hauling. The deck unit automatically sends the data to a shore-side server.

5.2.3 Additional data requirements for consistency with CCAMLR

All data will be collected to the CCAMLR standard (in addition to the SPRFMO standards where this differs) to enable sharing data with CCAMLR using the CCAMLR fine-scale catch and effort data (C2 longline fisheries) forms and CCAMLR observer forms and species codes for maximum consistency. This will enable integration between the vessel catch-effort and observer biological data ensuring that the data can be prepared, error checked, and combined with CCAMLR data for use in CCAMLR stock assessment and for reporting. The nominated vessels are both capable of reporting and electronically transmitting this information daily if necessary.

5.2.4 Additional sampling - continuous plankton recorder (CPR)

A continuous plankton recorder (CPR) will be towed during the exploratory fishing trips, subject to availability. In addition to planktonic organisms, this device may also capture toothfish eggs (if present). The CPR silks (=samples) will be sent to NIWA for analysis and inclusion in their continuous research. Alternatively, a plankton net may be towed for potential sampling of toothfish eggs. See Robinson et al, 2014 and 2018 for more detail.

5.2.5 Additional sampling – specimens

Supplementary to the SPRFMO sampling and reporting requirements, additional samples and information will be collected (where feasible) to support research projects and museum collections in both New Zealand and overseas. Such additional data and samples will be collected by the observers, supported by the senior Sanford crew and the Company Scientific Representatives.

5.3 Due dates

All mandatory reporting will be provided to SPRFMO within stipulated timeframes.

Following CM 02-2022, data from Jan – Dec will be provided no later than 30 September the following year. All data will be reported using the relevant SPRFMO data templates (available on the SPRFMO website).

As required by CMM 02-2022, annual interim reports will be submitted to the SPRFMO SC. As this proposal covers the three calendar years 2025 – 2027, it is anticipated that reports will be submitted in 2026 and 2027 with a final, more detailed report submitted in 2028. These reports will follow best practice report formats and will include information pursuant to paragraph 44 of CMM 16-2024 (Observer Programme). A 'nil' report will be submitted in the event no fishing occurred. These reports will also be provided to CCAMLR.

Environmental data (bathymetry and temperature-depth profiles) will be analysed as part of the reporting and raw data may be made available to SPRFMO and NIWA under appropriate circumstances.

5.4 A plan for directing fishing effort

Collection of bathymetric data (Section 5.2.1) will take place in an exploratory fashion across the proposed exploratory fishing areas. Once suitable fishing ground is identified, trial fishing will take place with the restrictions listed in Section 4.1.7 to ensure the spread of effort and to broaden data collection.

As noted in Section 5.2.1 accurate bathymetric data will also provide the basis for one of the two independent stock assessment methods to be used.

5.5 Time scales

As the current proposals are limited to the three year requirements of SPRFMO (CM-13-2024, Par 8,iii.) given the wide area to be surveyed any preliminary stock assessment will be limited to accurate data on the fishable area (for use in a CPUE by seabed area analogy and to tag and recover sufficient toothfish for an integrated stock assessment using that method.) It is likely that the first three years of this work will be an investigative phase providing baseline bathymetric data, preliminary data of *Dissostichus* spp. biology and distribution, and commencing a comprehensive tagging programme. We would see this as the first step in a longer programme, similar to the second application by the EU under the second EU FOP for an exploratory Patagonian and Antarctic toothfish fishery in the SPRFMO Area (SC11 – DW04).

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7 Annex 1 Updated from Annex 2 of SC9-DW01_rev1. bottom fishery impact assessment (in accordance with FAO's Guidelines for the Management of Deep-sea Fisheries, considering the SPRFMO Bottom Fishery Impact Assessment Standard, BFIAS).

- *What impacts are likely to result from the fishing gears to be used? All impacts should be identified, characterised and quantified or ranked.*

The likely impacts from the fishing gears to be used include:

1. Non-target fish:
    - Macrouridae, Moridae, and other Gadiformes have a high spatial overlap and catchability, resulting in a high risk of mortality.
    - Based on information from previous fishing within SPRFMO at the same range of latitudes and from the more southern CCAMLR Convention area other Teleosts are considered to have a low spatial overlap and catchability, resulting in a low risk of mortality.
    - Mitigation measures proposed for the project include setting a relatively low number of lines in each area, separating line clusters five nautical miles or more apart from each other, and not setting at previous locations during the same season.
    - The residual risk after mitigation is low.
2. Chondrichthyans (sharks and skates):
    - Skates have a low spatial overlap and high catchability, resulting in a low risk of mortality.
    - Sharks have a very low spatial overlap and high catchability, resulting in a very low risk of mortality.
    - Mitigation measures include releasing sharks and skates alive when judged in suitable condition (see 5.14) , and if possible (skates potentially with tags attached) and implementing a move-on rule if trigger levels are exceeded (based on CCAMLR CM 33-03 (2013). The residual risk after mitigation is low.
3. Seabirds:
    - Albatrosses, fulmars, and petrels have a high spatial overlap and catchability, resulting in a high risk of mortality.
    - Penguins and prions have a low spatial overlap and catchability, resulting in a low risk of mortality.
    - Mitigation measures include using tori lines, managing offal discards, managing vessel lights at night, and avoiding overlap with breeding areas.
    - The residual risk after mitigation is low.
4. VME and benthic impacts:
    - The fishing gear in use only expected to have minimum direct impact on the benthic habitat or VMEs in the area proposed.
    - While there is a high risk of impact on VME indicator taxa directly encountering the fishing gear, this gear type has a very low footprint and mitigation measures are in place to avoid cumulative impacts.
    - VME move-on rules using the CCAMLR protocol as set out in CM 22-07 (2013) were not triggered at any time during the previous New Zealand research and the catch of benthic material was very low (Table 7), indicating that the fishing activities did not significantly impact VMEs.

5. Marine mammals and turtles:
    - Whales are likely to be at risk at or near the surface during setting or hauling when entanglement could result in injury or drowning. Catchability of whales is thought to be very low and varies with species (Werner et al., 2015). Killer whales and Sperm whales have a very high degree of association with toothfish longline vessels in some areas (South Georgia and Kerguelen) , where interactions are more damaging economically to the vessel in terms of lost or damaged gear and depredation of catch off the line. Damage to individuals may occur, with mortalities low to near-zero. Similarly, dolphin mortalities are thought to be very rare among toothfish longline vessels.

Overall, while there are likely to be varying impacts on non-target fish, chondrichthyans, seabirds, and VME. Mitigation measures are in place to reduce these impacts, but some residual risk remains.

Summary of VME impacts from previous work.

New Zealand has carried out cumulative impact assessments on bottom longline gear (autoline) in the CCAMLR area since 2008. Although still a low risk factor, relative to other interactions the complete or partial loss of gear was identified as the most important consideration. A direct relationship between the amount of gear loss and the presence of, and operating within, sea-ice has been established. For example, the same vessels working in the CCAMLR sub area 48.3 fishery where there is no sea ice have very little gear loss. Additional risks involve the potential of rough bottom to snag lines with an increased chance of gear loss. Table 6 shows the degree of gear loss by season averaging overall 6%. Note the increase in the strength of backbone used for the longline was made in 2018 and significantly reduced the gear losses to 4.3%. *San Aotea II* and *Janas* also use the heavier backbone now.

Table 6. Gear loss by season from NZ Exploratory fishing in SPRFMO 2016-2023 (note no fishing took place in 2018)

Fishing season	Hooks lost	line lost (m)	No of hooks set	Total line set (m)	% of line lost	Backbone used	Comments
2016	5570	7798	25710	35994	21.7%	11.5 mm	First exploratory trip fishing in mid-winter on unknown ground with sea ice in area.
2017	6128	8579	41193	57670	14.9%	11.5 mm	
2019	10607	14850	124129	173781	8.5%	12 mm	
2020	1600	2240	98126	137376	1.6%	12 mm	
2021	0	0	106422	148991	0.0%	12 mm	
2022	2992	4189	89128	124779	3.4%	12 mm	

2023	3248	4547	15515	21721	20.9%	12 mm	Due to an issue with microbial fuel contamination the vessel was compelled to return to port prematurely - few lines were able to be set making the lost proportion higher.
TOTALS	**30145**	**42203**	**500223**	**700312.2**	**6.0%**		

VME indicator species will be impacted by demersal longline fishing to a minor extent through impact from anchors, chain/weights, and hooks. The overall footprint of a demersal longline is thought to be relatively low (BFIA SWG-10-DW-01A).

More information is available from the revised assessment of the cumulative footprint and impact on VME taxa presented to CCAMLR as paper WG-SAM-10/20 (Sharp 2010). The cumulative fishing effort in the Ross Sea region from 1997 to 2009 was summarised at a spatial scale of pixels measuring 0.05° latitude by 0.177° longitude. The mean New Zealand effort density in these fished pixels was reported as 0.53 km line/km^2. Fishing effort by New Zealand fishing industry in the Ross Sea region was assessed as being highly concentrated in preferred locations, with 94% of the fished pixels having effort densities less than 1.5 km of line per km2. The analysis concluded that the total cumulative impact on VMEs of New Zealand effort in the Ross Sea fishery is very low (see Table 4 from that paper below).

Table 4. Estimated cumulative footprints and impacts associated with all New Zealand effort in the history of the Ross Sea fishery (Areas 88.1 and 88.2, 1997-2009), within 17 benthic bioregionalisation groups (from Sharp 2010) and at the scale of the two most heavily impacted pixels (0.05° lat x 0.177° long). Mean and upper bound confidence interval (95th quantile) values are shown. Estimates are obtained by multiplying fishing effort from Table 2 [not shown here] by the footprint index and impact index posterior distribution statistics in Table 3 [not shown here] (* 100%). Numbers referred directly in the text are bolded.

		SIMULATION 1: NORMAL INPUT DISTRIBUTIONS				SIMULATION 2: LOGNORMAL INPUT DISTRIBUTIONS			
		% area in footprint		% lethal impact		% area in footprint		% lethal impact	
Bioregion Group	effort density (km of line /km2)	mean	95th quantile	mean	95th quantile	mean	95th quantile	mean	95th quantile
1	0.0270	0.0097	0.0175	0.0058	0.0120	0.0079	0.0166	0.0050	0.0117
2	0.0199	0.0071	0.0129	0.0042	0.0088	0.0058	0.0122	0.0037	0.0086
3	0.0049	0.0017	0.0031	0.0010	0.0021	0.0014	0.0030	0.0009	0.0021
4	**0.0689**	0.0247	0.0446	0.0147	0.0305	**0.0201**	**0.0424**	**0.0127**	**0.0297**
5	0.0014	0.0005	0.0009	0.0003	0.0006	0.0004	0.0009	0.0003	0.0006
6	**0.06947**	0.0249	0.0449	0.0148	0.0308	**0.0203**	**0.0427**	**0.0128**	**0.0299**
7	0.0003	0.0001	0.0002	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001
8	0	0	0	0	0	0	0	0	0
9	0.0008	0.0003	0.0005	0.0002	0.0004	0.0002	0.0005	0.0002	0.0004
10	0.0083	0.0030	0.0054	0.0018	0.0037	0.0024	0.0051	0.0015	0.0036
11	0.0262	0.0094	0.0170	0.0056	0.0116	0.0077	0.0161	0.0048	0.0113
12	0	0	0	0	0	0	0	0	0
13	0.0198	0.0071	0.0128	0.0042	0.0088	0.0058	0.0122	0.0037	0.0086
14	0.0068	0.0024	0.0044	0.0015	0.0030	0.0020	0.0042	0.0013	0.0029
15	0	0	0	0	0	0	0	0	0
16	0.0073	0.0026	0.0048	0.0016	0.0033	0.0022	0.0045	0.0014	0.0032
17	0.0015	0.0005	0.0010	0.0003	0.0007	0.0004	0.0009	0.0003	0.0006
highest Pixel A	**9.836_**	3.5213	6.3639	2.0951	4.3574	**2.8721**	**6.0492**	**1.8098**	**4.2393**
highest Pixel B	7.114_	2.5471	4.6032	1.5154	3.1518	2.0775	4.3756	1.3091	3.0665
Mean fished effort	**0.5363**	0.192	0.347	0.1142	0.2376	**0.1566**	**0.3298**	**0.0987**	**0.2311**

The planned level of effort (and hence impact) for the proposed exploratory fishing will be much lower than reported by Sharp above noting the conservative TAC and effort spreading mechanisms proposed.

Autoline operators additionally minimise any impact on bottom fauna by 'peeling' the line off the bottom directly over the path of the set line to minimise lateral movement during hauling, which may cause a snag or increase the chances of fish loss.

A higher number of Antarctic benthic organisms tend to occur in shallower depths; this is recognised by CCAMLR in Conservation Measure 22-08 (2009) where longline fishing is prohibited in depths shallower than 550 m to protect benthic communities. The minimum depth proposed for this research is 600 m. Previous New Zealand exploratory fishery carried out under the (current) CMM 14a-2022 between 2016 and 2023 caught in total just less than 90 kg of benthic organisms, for 545,909 hooks set at depths ranging from 780-2340 m (average fishing depth 1550 m). While the proposed exploratory fishing areas are not yet surveyed, it is a reasonable assumption that a similar result would be reached in these more westerly areas lying within the same latitudes.

Summary

In summary, assuming no mitigation, the likely impacts from fishing gear on all species groups potentially impacted by fishing are as follows:

1. Macrouridae, Moridae, and other Gadiformes
    - Spatial Overlap: High
    - Catchability: Medium
    - Risk of mortality: Med-High
    - Residual Risk after mitigation applied: Low
2. Skates
    - Spatial Overlap: Low
    - Catchability: Medium
    - Risk of mortality: Med-High
    - Residual Risk after mitigation applied: Low
3. Sharks
    - Spatial Overlap: Low
    - Catchability: Medium
    - Risk of mortality: Med-High
    - Residual Risk after mitigation applied: Low
4. Other teleosts
    - Spatial Overlap: Low
    - Catchability: Medium
    - Risk of mortality: Med-High
    - Residual Risk after mitigation applied: Low
5. Seabirds (Albatrosses, fulmars, and petrels)
    - Spatial Overlap: High
    - Catchability: medium-high
    - Risk of mortality: high
    - Residual Risk after mitigation applied: Low (with appropriate evidence-based mitigation)
6. Marine Mammals
    - Spatial overlap: High
    - Catchability: Low (possibly medium for some Phocids)

    - Risk of mortality: Low
    - Residual Risk after mitigation applied: Low

7. Demersal longline fishing operations can cause damage to the seabed, but the footprint is much lower relative to demersal trawl. Demersal longlines can still catch or impact benthic organisms but these impacts on the benthos are limited to the very small areas directly damaged by the fishing gear.
8. There is a risk of loss of bottom-line fishing gear, which may impact benthic communities and habitats.
9. The likely impacts from fishing gear without mitigation are high for most of the listed species, however evidence-based mitigation measures will be in place for VME, seabirds, and nontarget fish species.

- *What will the probability, likely extent (% of habitat targeted) and intensity of the interaction between the proposed fishing gear / targeting practices on the VMEs in the proposed fishing areas be?*

There is little evidence that such fishing focusses on VMEs in other target toothfish fisheries. Parker and Smith (2011) compared indices of toothfish presence and abundance with the presence of VME organisms among bycatch. They concluded that toothfish indices were not useful in predicting the occurrence of any of the six common VME indicator taxa captured on individual longline segments and toothfish catch never explained more than 4% of the null model deviance when forced into the model. Parker and Mormede (2009) explored the catch of VME indicator organisms collected during the 2008/09 Ross Sea longline fishery for any correlation with toothfish catch-rate. They also concluded that there was no evidence of a functional relationship. These studies suggest that CCAMLR fisheries for toothfish are unlikely to focus on VMEs. The proposed exploratory fishing areas are immediately to the north of the CAMLR Convention Area and are likely to be very similar. Additionally, there is evidence from New Zealand's previous exploratory fishing further east within the SPRFMO Convention Area indicating a very low catch of VME indicator taxa (Table 7) and no relationship with toothfish. In fact, results from this exploratory fishing indicated that more VME indicator taxa were caught during sets when toothfish catch was negligible or nil, due largely to the exploratory nature of the programme.

- *What are the characteristics of the habitats and benthic communities which may be impacted? Are the fished seabed features likely to support VMEs?*

This is largely unknown as there is little information available on topographic features likely to support VMEs in the proposed exploratory fishing areas. However, models that predict the likelihood of VME habitat or features (i.e. seamounts) and VME indicator taxa which include the SPRFMO Convention Area have been built (e.g., seamounts - Kitchingman & Lai 2004; Allain et al 2008; Yesson et al. 2011; VME indicator taxa Tittensor et al. 2009, Davies & Guinotte 2011, Yesson et al. 2012). Penney (2010) showed several maps predicting habitat suitability for scleractinian corals based on broad-scale data (for the depth range 750–1000 m). These predictions suggests that, at a very broad scale, there is a low-moderate likelihood of stony corals (a key VME indicator taxon) occurring in the general vicinity of the proposed exploratory fishing areas. Boosted Regression Tree (BRT) and Maximum Entropy (MaxEnt) habitat suitability models were constructed specifically for the SPRFMO area and for the New Zealand EEZ. Details of these models and the results of a field validation exercise are contained within Anderson et al. 2016. That validation exercise showed that models predicting a suite of four stony coral VME indicator taxa (combined) did not perform very well, primarily because many of the environmental predicator variables used were scaled to 1 km resolution using a global bathymetry data set that was found to be very imprecise in the validation area (sometimes biased by many hundreds of metres of erroneous depth). However, the authors considered that the models predict the likelihood of suitable habitat for coral VME indicator taxa at a more coarse-scale (i.e., at the scale of a large topographic feature such as a seamount or ridge), but not at within-feature scale.

Table 7 lists Marine invertebrate captures recorded from New Zealand exploratory fishing in the southeastern Pacific Area (currently managed under CMM 14a-2022) between 2016 and 2023. This was for a total of 545,909 hooks set for all years.

Gorgonians were the main species taken being over 75% of the total weight of invertebrate captures. In total, less than 90 kg of invertebrate material (including non-sessile organisms such as basket stars) were taken over the seven years of exploratory fishery in that more easterly area in which 545,909 hooks were set over the period 2016-2023. The average depth of fishing was between 780-2340 m with the average fishing depth 1550. The catchability for individual or all VME taxa by longline is not quantified but is unlikely to fully represent the toral impact.

Parker (2011) reported that there was evidence from densely sampled areas that the determination of presence by longline, for at least several VME taxa, is consistent. For example, several risk areas have now been designated within a few kilometres of each other in the Ross Sea Region of CCAMLR all by the same taxonomic group (SC-CAMLR, 2010). In addition, by-catch consistently occurs in areas where these taxa are known to occur (Parker et al., 2010). Both observations indicate that, at least for some taxa, longlines may be reliable sampling tools. He noted that further analysis would be required to show this for all vulnerable taxa pending further data collection.

While it is difficult to conclusively link these two areas given the lack of accurate bathymetry prior to any exploratory fishing in the area we suggest it is likely that catches of marine invertebrate are going to be similar. Any fishing activities will continue the accurate reporting of all marine invertebrate as has been the case over the past seven years of the previous SPRFMO work as required under CMM-03-2023 Par. 37.

Table 7. Marine invertebrate captures recorded from New Zealand exploratory fishing in the southeastern Pacific Area currently managed under CMM 14a-2022 between 2016 and 2023. This was for a total of 545,909 hooks set.

Code	Class	Common name	Total weight kg	% of total invertebrate captures	Average depth of capture
CSS	Demospongiae	Gorgonians	68.00	75.6%	1215.1
CWD	Euryalida	Hard corals, stony corals	6.15	6.8%	1702.9
BZN	Crinoidea	Glass sponge	4.91	5.5%	1373.5
ZOT	Zoanthidea	Zoanthids	2.81	3.1%	1179.8
AQZ	Alcyonacea	Basket stars	1.91	2.1%	1386.0
BVH	Bryozoa	Feather stars and sea lilies	1.89	2.1%	1470.5
OEQ	Stylasteridae	Siliceous sponges	1.46	1.6%	1456.6
NTW	Scleractinia	Sea anemones	1.01	1.1%	1346.2
DMO	Gorgoniidae	Hydrocorals	0.95	1.1%	1646.5
AJZ	Actiniaria	Alcyonacea soft corals	0.35	0.4%	1313.9
ATX	Anthoathecatae	Black corals and thorny corals	0.25	0.3%	1593.7

AZN	Brachiopoda	Bryozoans	0.08	0.1%	1328.6
HXY	Pennatulacea	Sea pens	0.07	0.1%	1528.8
GGW	Hexactinellida	Hydroids, hydromedusae	0.06	0.1%	1477.5
AXT	Antipatharia	Brachiopods, lamp shells	0.02	0.0%	1589.3
		Grand Total	**89.92**		

- *How diverse is the ecosystem in the proposed fishing areas, and will the fishing activity reduce this biodiversity? Do the proposed fishing areas contain rare species which do not occur elsewhere?*

Other than the information collected during New Zealand's exploratory fishing further to the east in similar latitudes between 2016 - 2023, little precise bathymetric data is available to provide information on the characteristics of the habitats and benthic communities potentially impacted by this proposal. It may be possible by analogy to look at information available from the northern Ross Sea and Amundsen Sea regions. Generally, numbers of VME organisms recovered in the Northern Hills area, proximate to the proposed research region, are lower than observed further south. CCAMLR 5-day reports indicate that, of the 78 VME risk areas notified under Conservation measure between 2009 and 2015, only two are north of 69° S at 65° 23.01' S and 65°08.13' S.

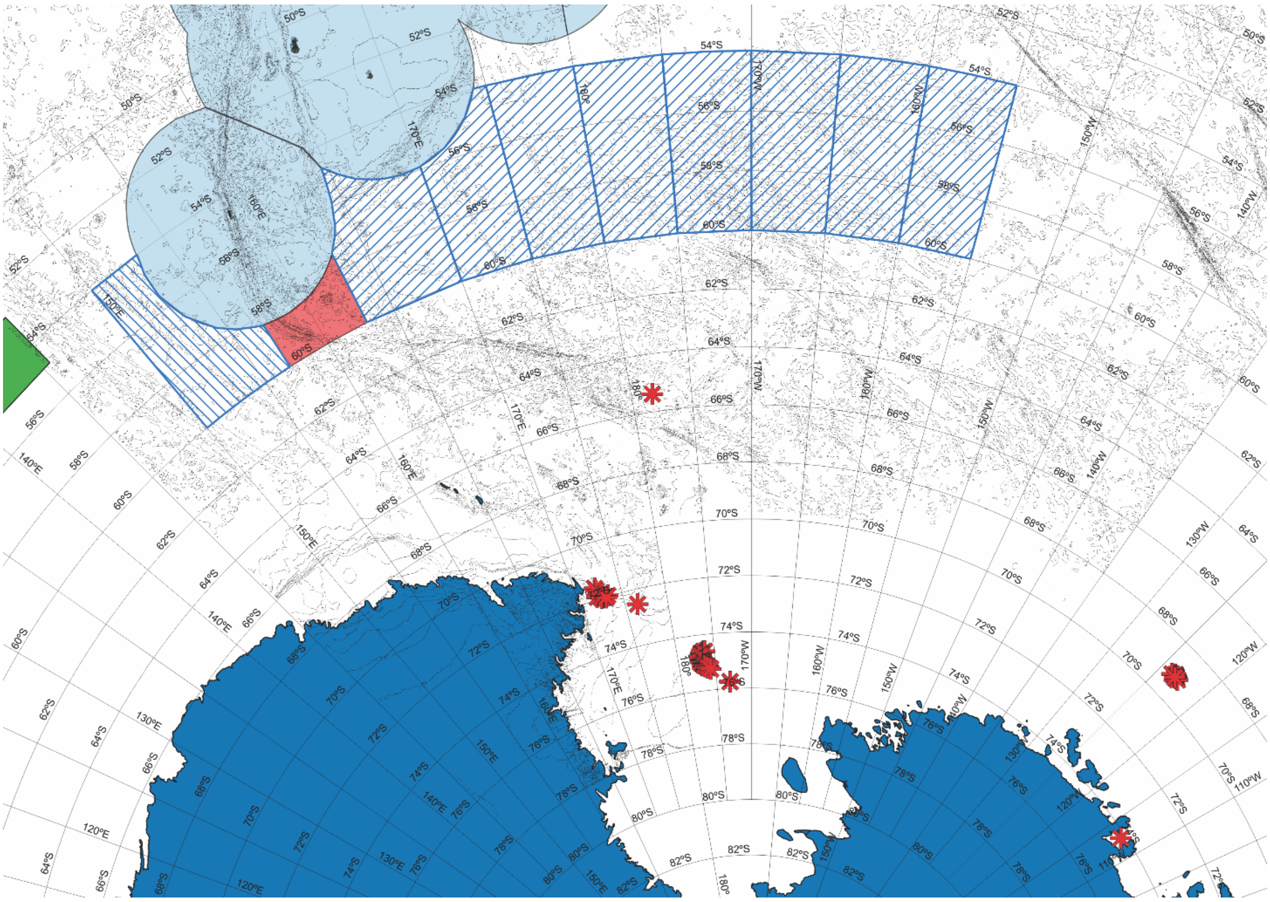


Figure 6. VMEs as recorded under CM 22-07 (2013) (pars. 6 and 9) within the CAMLR Convention Area shown as red markers showing the higher distribution in the area south of 70°S.

Given the fact that there is no available information from fishing or sampling within the proposed areas it is impossible to identify whether there are rare species which do not occur elsewhere.

Standard sampling procedures will be carried out and any unknown or an identifiable species will be brought ashore for expert identification.

- *What is the likely spatial scale and duration of the impacts? The overall scale of impact will be the product of spatial scale, duration and cumulative impact on VMEs and low productivity resources. To the extent possible, rates of recovery, regeneration and re- colonisation should be quantified or estimated.*

The current proposal mirrors previous SPRFMO exploratory fishing by New Zealand being a stepwise research plan involving preliminary searching and investigation of potential bathymetric features that may constitute habitat for toothfish. Note that the most current information indicates that any fishing is likely to be deep resulting in very limited sideways movement of the line. In such cases the maximum impact width is likely to be in the order of 1 m (given a snood length of 0.5 m between the hook and the mainline).

The proposed exploratory fishing represents an area of the immediately north of the CAMLR Convention Area. New Zealand fishing companies' knowledge of similar areas in the Southern Ocean and Antarctica suggest it is unlikely that much of this area (estimated less than 5%) will be within the depth ranges suitable for fishing.

The proposed fishing plan includes a maximum number of hooks per cluster (when fishing on topographical features) and a minimum separation between clusters of five nautical miles.

Methods used to assess the impacts of fishing, including uncertainties

The proposed demersal longline fishing method is used in the CAMLR Convention Area, and its impact was extensively reviewed by Sharp (2010) to estimate the likely impacts of bottom longline fishing on vulnerable benthic invertebrate taxa and, generically, VMEs. This work was consistent with the requirements of CCAMLR Conservation Measure 22-06 (Bottom fishing in the Convention area).

***Intensity**.* Sharp noted that effort densities associated with the New Zealand fishing effort as represented by fished pixels within the Ross Sea region was overall very low. Even within fished areas over his 12-year time series it is clear that fishing effort is highly concentrated in preferred locations, i.e. 94% of the fished pixels had effort densities less than 1.5 km of line / km^2, and only 13 individual pixels (0.7%) had effort densities in excess of 4 km of line per km^2. Applying the mean lognormal-input impact index estimate (1.84×10^{-3}) as calculated in the paper to the effort density distribution (Figure 15) implies that VME taxa in 94% of historically fished locations have experienced lethal impacts less than 0.28%, and in only 0.7% of fished locations have VME taxa experienced impacts of greater than 0.74%, to a maximum lethal impact (on VME organisms) of 1.8%.

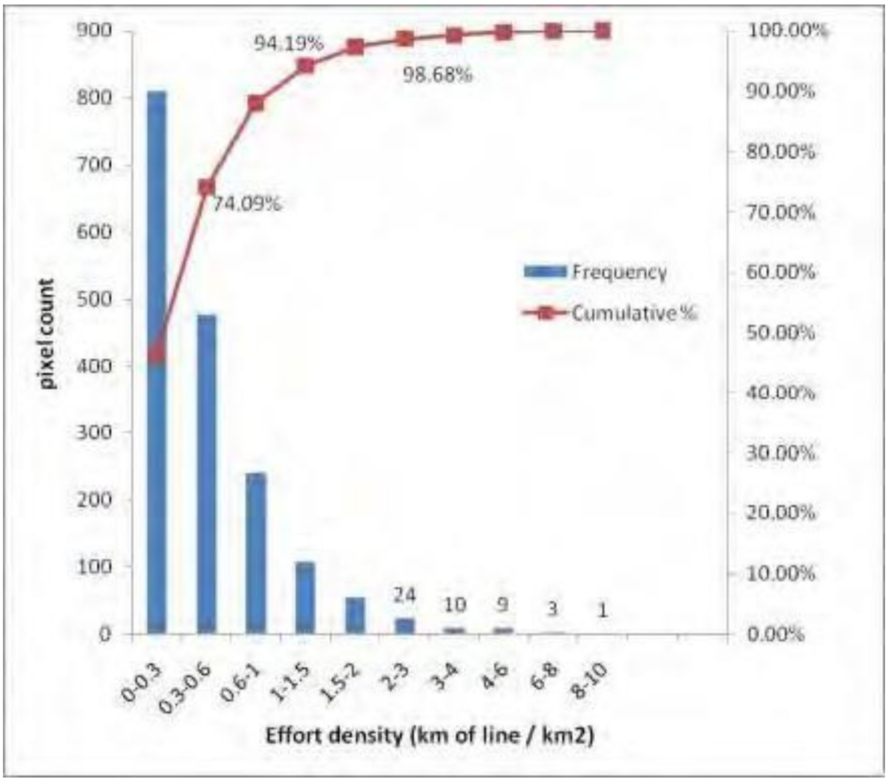
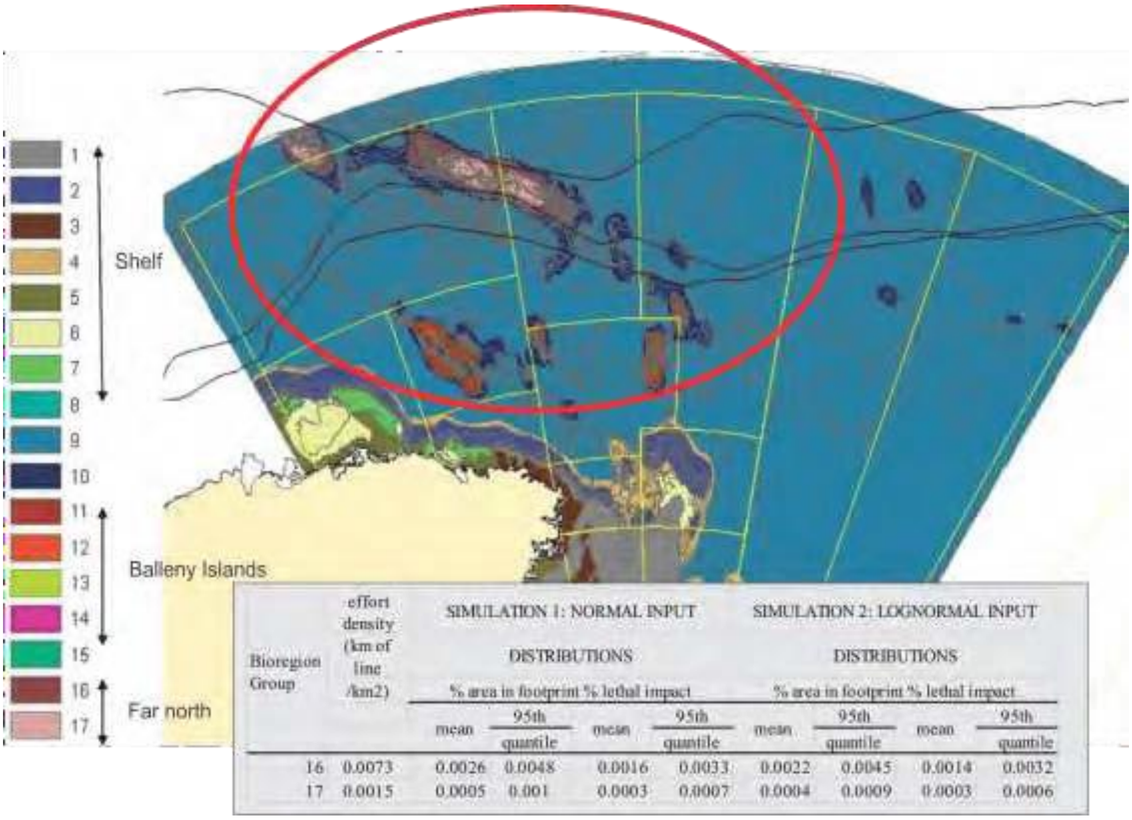


Figure 15: (after Sharp 2010): Spatial concentration of all historical New Zealand fishing effort in the Ross Sea. The histogram sorts 1737 non-zero-effort pixels (0.05° latitude x 0.177° longitude) as a function of cumulative effort density (in km of line per km^2). Note that the horizontal scale is not linear and that an additional 115 296 pixels in the Ross Sea with zero New Zealand effort (98.4% of the total) are not shown.

Limited knowledge of the proposed bathymetry and fauna as being an extension of the Pacific Antarctic Ridge suggests that this is likely to be similar to the northern hills area of the Ross Sea. Mean and maximum lethal impacts could be estimated based on the expected fishing pattern.

Sharp's (2010) assessment of the impacts of this comparable area (88.1 northern hills) which are shown in Figure 16 as bioregional categories 16 and 17. Intensity is likely to be much less during this proposed exploratory project than would be common in an operational fishery such as The Ross Sea due to the cluster design and limitation on hook numbers on any fished ground over a calendar year imposing a spreading of fishing effort. Full monitoring of VME indicator and other benthic organisms will take place during all fishing operations.



Bioregion Group	effort density (km of line /km2)	SIMULATION 1: NORMAL INPUT DISTRIBUTIONS				SIMULATION 2: LOGNORMAL INPUT DISTRIBUTIONS			
		% area in footprint		% lethal impact		% area in footprint		% lethal impact	
		mean	95th quantile	mean	95th quantile	mean	95th quantile	mean	95th quantile
16	0.0073	0.0026	0.0048	0.0016	0.0033	0.0022	0.0045	0.0014	0.0032
17	0.0015	0.0005	0.001	0.0003	0.0007	0.0004	0.0009	0.0003	0.0006

Figure 16: The benthic bioregionalisation of the Ross Sea region showing the analogous northern hills area (termed "far north" by Sharp) and the estimated cumulative footprints and impacts associated with all New Zealand effort in the history of the Ross Sea fishery (Areas 88.1 and 88.2, 1997-2009), within the northern hills bioregionalisation groups (16 and 17). Mean and upper bound confidence interval (95th quantile) values are shown. Modified from Sharp et al. (2010).

Duration *– how long the effects of the impact are likely to last.*
The duration of impact at the scale of individual organisms or communities is taxon-dependent (Table 8). Some VME indicator taxa like stony and gorgonian corals are very long-lived and effects at sites where these are common or dominant can be expected to endure at least several years to decades. Conversely, some other benthic taxa are more productive and mobile and effects where these are dominant will be more transient. Collection of samples taken by fishing gear to improve this information will be one of the priority objectives of the project.

Spatial extent *– The spatial impact relative to the extent of the VMEs (e.g. will fishing impact 5%, 30% or 80% of the VME distribution) and whether there may be offsite impacts (e.g. will reproduction be impacted at a broader spatial scale).*
The spatial risk assessment approach summarised here uses the CCAMLR approach as detailed in Sharp et al (2009) and Sharp (2010). In a preliminary assessment of known and anticipated impacts on proposed bottom fishing activities on VMEs in 2012/13 by the CCAMLR Secretariat (CCAMLR 2012) New Zealand reported that: *Consistent with the assumptions adopted by WG-FSA in 2010 and described in the Report on Bottom Fisheries and Vulnerable Marine Ecosystems (SC-CAMLR XXX, Annex 7, Appendix D), we apply an estimated footprint index of 6.67 x* 10^{-3} km^2 *of seabed area per km of longline deployed. This index is likely to over-estimate impact because it assumes a mean lateral movement frequency of 0.5 (i.e. lateral movement occurring in 50% of all deployments) irrespective of depth, whereas the only instances of lateral movement actually observed by the UK in tethered camera deployments in 2010 (WG-EMM-10/30) were shallower than fishable depths (observed deployments at typical fishable depths for longlines were observed to lift vertically from the seafloor with no lateral*

movement). Adopting the assumptions of WG-FSA in 2010 is therefore conservative (precautionary). In the absence of any current accurate bathymetry data for the target research areas a precautionary estimate of impact could be estimated using the footprint index above of 6.67 x 10^{-3} km^2 of seabed area per km of longline deployed.

The indications from Sharp (2010) were that an area in the northern Ross Sea (suggested as being analogous) has had very low fishing footprints (a mean value of 0.00142% across the two identified bioregions) and mortality/lethal impact had a mean value of 0.0009%. Based on experience in similar areas, New Zealand fishing companies estimate that less than 5% of the proposed research areas identified for exploration in the SPRFMO area will be fished and may have a similarly low footprint. However, the distribution of VMEs and the association between toothfish and VMEs is poorly known so the proportion of VMEs potentially impacted is less predictable.

There are unlikely to be any offsite or far-field effects from bottom longlining because such gear disturbs only a small amount of sediment relative to a bottom trawl tow.

Cumulative impact: Given the small footprint of individual demersal longline sets, multiple fishing events in the same location are unlikely even in the most intensively fished areas. Sharp (2010) indicated that even at the scale of the most heavily fished areas and impacted bioregionalisation groups in the Ross Sea simulations showed that the impacted bioregionalisation groups had experienced approximately 0.013% lethal impact of the most vulnerable VME taxa, with an upper bound (95th quantile) estimate of 0.03% lethal impact.

Evaluation of the occurrence, scale and duration of likely impacts on VMEs

At the level of fishing proposed and with the small footprint and impact of demersal longline gear, the overall risk is suggested to be low, and the impact will probably have a negligible influence on the overall benthic environment. While there is considerable information to suggest that fishing effort on toothfish is not associated with VME, even if toothfish and fishing effort were closely associated (noting these are predicted to take up only a very small fraction of the exploratory fishing area) then information collected during these exploratory programmes will enable additional analyses to better define the area likely to be affected; improving information on the bathymetry, benthic fauna, and likely distribution of VMEs are all objectives of this exploratory work.

Discussion on the risk assessment of likely impacts of the proposed exploratory bottom longlining for toothfish in the SPRFMO Area in 2025-2027.

The proposed fishing activity entails the use of demersal bottom longline using integrated weight line. New Zealand's previous proposals have noted the following potential impacts of longline is on the ecosystem:

- where equipment associated with bottom autoline fishing directly impacts VMEs
- potential over-exploitation of bottom lined species
- potential loss of benthic long-line fishing gear
- incidental capture and mortality of seabirds

Each of the four potential impacts above was assessed, based on the FAO Deepwater Guidelines (FAO 2008), using specific definitions for the various rating criteria taken from New Zealand's 2008/09 bottom fishery impact assessment. To the extent possible in what is largely a qualitative, expert-based assessment, allocation to ranks was based on quantifiable criteria. Elements of risk evaluated were:

- Description of Impact - Provides a brief description of the expected impacts, answering the question, "What will be affected and how?"

- Extent - Indicates whether the impact will be: Site Specific (limited to within one kilometre of the fished site); Local (limited to within one fished 20’ block, or 50 km of the fished site); Regional (limited to the fishing area ~200-500 km radius); or Oceanic (extending across a significant proportion of an ocean basin, or of the SPRFMO Area).
- Duration - Gives the expected duration of the effects of the impact, being: Short (months, <1 year); Medium (years, 5-20); or Long (> 20 years, decades to centuries).
- Intensity - Provides an expert evaluation of whether the magnitude of the impact is destructive or innocuous and whether or not it exceeds set standards, and is described as: None (no impact); Low (where environmental processes are slightly affected); Medium (where environmental processes continue to function but in a noticeably modified manner); or High (where environmental functions and processes are altered such that they temporarily or permanently cease and/or exceed established standards / requirements).
- Cumulative Impact - An assessment of whether the impact is cumulative over time or space or not, and is expressed as being: Unlikely (the event is either a low-impact rare event, or recovery is rapid, such that effects will not accumulate over time or area); Possible (depending on extent, severity, natural disturbance levels and recovery rates); or Definite (at the intensities occurring, effects will endure such that, over time or space, impacts from a number of separate operations will accumulate).
- Overall Significance - The overall significance of each impact is then evaluated from the combination of duration, extent, intensity and cumulative effects. Overall Significance is determined as follows:
    - Low: Where the impact will have a negligible influence on the environment and no active management or mitigation is required. This would be allocated to impacts of low intensity and duration, but could be allocated to impacts of any intensity, if they occur at a local scale and are of temporary duration.
    - Medium: Where the impact could have an influence on the environment, which will require active modification of the management approach and / or mitigation. This would be allocated to short to medium-term impacts of moderate intensity, locally to regionally, with possibility of cumulative impact.

- High: Where the impact could have a significant negative impact on the environment, such that the activity causing the impact should not be permitted to proceed without active management and mitigation to reduce risks and impacts to acceptable levels. This would be allocated to impacts of high intensity that are local, but last for longer than 5-20 years, and/or impacts which extend regionally and beyond, with high likelihood of cumulative impact.

The separate assessments against these criteria for New Zealand's proposed exploratory bottom longlining for toothfish were summarised in 2016 with details of the assessment are contained in the larger tables below). Although some of the deepwater benthic taxa and seabirds potentially impacted are long-lived, and both the target species and most seabirds range over regional to oceanic distances, the exploratory fishing activity was assessed as having low to medium risk. Significant mitigation and monitoring will be in place for the entirety of the exploratory fishing and information will be collected during the first exploratory fishing trip that will decrease the uncertainty in impact and risk assessments for any subsequent exploratory trips or commercial fishing.

Table 8. Summary of risk assessment for New Zealand proposed exploratory bottom longlining for toothfish in the SPRFMO Area in 2019–2021.

	Extent	**Duration**	**Intensity**	**Cumulative**	**Overall**
Direct impact of bottom lines on VMEs	Site-specific	Long	Low	Possible[3]	Low / medium
Over-exploitation of bottom lined fish species	Regional-oceanic	Medium	Low	Possible	Low / medium
Loss of bottom line fishing gear	Site-specific	Short	None-low	Unlikely	Low
Incidental mortality of seabirds (species dependent)	Oceanic	Medium	Low-medium	Possible	Medium

[3] fishing can occur in the same areas over multiple years because effort spreading only occurs within the same year. However, any potential area will be reported to and reviewed by SPRFMO-SC as part of the annual reporting process enabling management if required. Noting that In cases where a VME occurs and that site is revisited cumulative impacts will likely be 'definite' given the slow growth and long-lived nature of some VME taxa, particularly stony corals.

Impact of bottom long line fishing on VMEs

Description of Impact: Bottom line fishing operations make some catches of benthic organisms, including vulnerable hard corals, gorgonians and sponges. Bottom line operations can either catch benthic organisms directly on the fishing hooks or may cause damage to benthic communities if lines are dragged laterally across the seabed by currents, or during hauling.

Extent: Site specific	*Duration*: **Long**	*Intensity*: **Low**
Cumulative impact: **Possible**	*Overall significance*: **Low / Medium**	

Extent – Seabed impacts will be limited to areas directly damaged by the fishing gear, including areas across which it may move during hauling. In the absence of accurate bathymetry, an estimate of impact using CCAMLR's footprint index of 6.67 x 10^{-3} km^2 of seabed area per km of longline deployed. With a realistic lateral movement of 1 m, a cluster of 22,700 hooks could disturb up to 0.193 km^2 compared with the area of the proposed exploratory fishing expected fishable area of NZSWRB1 is approximately 182,801 km^2 and a total estimated area of 1,575,300 km^2 for RBs A-H (Table 1).

Duration – Given the very low growth rates of some deepwater benthic organisms which may be impacted, a duration of 'Long' is assumed. However, at the proposed low fishing effort levels, the duration of ecosystem level impacts are likely lower. For the areas damaged by bottom lining, re-colonisation from adjacent areas would be expected to be more rapid than for a larger impact area.

Intensity – Considered 'Low' at the proposed exploratory fishing effort levels and spatial scales.

Cumulative Nature – Considered 'Possible', given poor knowledge and that the spreading of effort rules potentially allow the same area to be fished in subsequent years. However, VME bycatch will be reported to the SPRFMO SC each year providing a mechanism for an area with high VME bycatch to be closed to fishing in subsequent years. There are no other bottom fisheries in the area.

Overall significance: Potentially 'Medium' because of the possible low recoverability of the benthic species concerned but given the constrained nature of the proposed exploratory fishing, the significance is considered to be 'Low-medium'.

Management & Mitigation – At the proposed low levels and spatial scale of exploratory fishing effort and the spatially dispersed fishing design, active management or mitigation measures are not thought necessary. However, should a substantive fishery develop, fishing effort intensity and spatial scale, as well as benthic bycatch rates and composition would need to be monitored to ascertain whether effort or impacts rise to levels requiring active management.

Monitoring – Catch and effort returns will include start and end positions for bottom longline operations to allow the spatial scale of fishing effort to be monitored and analysed. Observer coverage will provide information on benthic bycatches, using the Benthic Materials form, to monitor and evaluate composition of benthic bycatches by bottom lines.

Table 9. from ANNEX 5, CMM-03-2023: List of VME Indicator Taxa

Taxonomic Level	Common Name	Qualifying taxa
Vulnerable taxa		
Phylum Porifera	Sponges	All taxa of the classes Demospongiae and Hexactinellidae
Phylum Cnidaria		
Class Anthozoa		
Order Scleractinia	Stony corals	All taxa within the following genera: *Solenosmilia; Goniocorella; Oculina; Enallopsammia; Madrepora; Lophelia*
Order Antipatharia	Black corals	All taxa
Order Alcyonacea	True soft corals	All taxa excluding Gorgonian Alcyonacea
Informal group Gorgonian Alcyonacea	Sea fans octocorals	All taxa within the following suborders: Holaxonia; Calcaxonia; Scleraxonia
Order Pennatulacea	Sea pens	All taxa
Order Actiniaria	Anemones	All taxa
Order Zoantharia	Hexacorals	All taxa
Class Hydrozoa	Hydrozoans	All taxa within the orders Anthoathecata and Leptothecata, excluding Stylasteridae
Order Anthoathecatae		
Family Stylasteridae	Hydrocorals	All taxa
Phylum Bryozoa	Bryozoans	All taxa within the orders Cheilostomatida and Ctenostomatida
Habitat indicators		
Phylum Echinodermata		
Class Asteroidea		
Order Brisingida	Armless stars	All taxa
Class Crinoidea	Sea lilies	All taxa

Modelled habitat suitability is available for most of the 13 VME indicator taxa, following work done for the BFIA in 2020, but models do not extend into the exploratory fishing area, both because of the scarce overlap between the two areas and the lack of suitable habitat (or environmental coverage).

Of all these taxa, Porifera, Scleractinia, Antipatharia, Alcyonacea, Gorgonian Alcyonacea, Actiniaria and Zoantharia have defined weight thresholds, and all taxa have biodiversity threshold weights under CMM-03-2023 but note that these do not apply to the exploratory fishery area. Encounter protocols in the proposed exploratory fishery follow those in CCAMLR and are therefore more restrictive in terms of cluster weights and move-on distance than those prescribed by CMM-03-2023.

8 Annex 2. Mitigation of Fishing Impacts on Seabirds

Birds observed during fishing activities in the research areas over the seven survey seasons within the SPRFMO Exploratory area further east have been mainly cape petrels, snow petrel, Antarctic petrel, giant petrels, wandering albatross or non-specified great albatross, black browed albatross, grey petrel, and blue petrel, light mantled sooty albatross, sooty shearwaters, and Antarctic fulmar. Less commonly recorded were white chinned petrels, Salvin's albatross, Westland petrel, Buller's albatross, and grey headed albatross.

No seabirds have been killed or injured from of fishing operations during New Zealand SPRFMO operations between 2016 and 2023. One blue petrel was found alive on deck and released unharmed in 2019 and a mottled petrel (identification based on wingspan, beak morphology, plumage, and species geographical distribution) was found dead due to a deck strike while the vessel was in transit during stormy weather in 2022.

CMM 09-2017 Conservation and Management Measure for minimising bycatch of seabirds in the SPRFMO Convention Area, Annex 1 states:

1. To minimise incidental interactions with seabirds in demersal longlines, demersal longline vessels shall:

   a) Prohibit discharge of any biological material during shooting and hauling, where possible[1], to avoid attracting seabirds to the vessel, and

   b) Either:

      i. Implement the combined use of the following measures:

         a. a line weighting regime, as specified in paragraph 6. Noting the objective of this measure is to maximise hook sink rates close to vessel sterns to reduce the availability of baits to seabirds;

         b. bird scaring lines, as specified in paragraph 7. Noting the objective of this measure is to actively deter birds from baited hooks;

         c. setting at night, between the times of nautical dark and nautical dawn.

Or:

      ii. Where a Member or CNCP has maintained spatially and temporally appropriate observer coverage for the previous 5 consecutive years at levels greater than 10% and recorded a seabird mortality rate less than 0.01 birds/ 1000 hooks, that Member may choose to:

         a. require its vessels to apply only one of the three measures specified in paragraph 1; and

         b. ensure a minimum of 10% observer coverage that is adequately representative of the spatial and temporal distribution of the fishing fleet.

2. Should a flagged vessel of Member or CNCP applying paragraph 1(b) exceed a seabird mortality rate of 0.01 birds/ 1000 hooks, they will be required to:

   a) apply at least one additional measure detailed in paragraph 1 for at least one year from the time of the mortality;

   b) report details of the event to the Secretariat within seven days; and

   c) report details of the event in their national report.

The New Zealand vessel *San Aspiring* has carried out approved exploratory longline fishing within the SPRFMO area over seven years. These seven years include fishing five consecutive years between 2019 and 2023 which meets the requirement under Annex 1 (ii). Over that period, no seabird mortality has occurred during fishing operations. Additionally, the vessel has maintained the appropriate observer coverage. *San Aotea II* and *Janas* have not yet carried out exploratory fishing within SPRFMO, but both vessels have extensive experience with seabird mortality mitigation further south in the CAMLR Convention Area. *San Aotea II* has also worked in the South Georgia (CCAMLR Subarea 48.3) fishery for two seasons in an area with high seabird numbers with no captures resulting from their fishing operations.

The project area is in a relatively high latitudes between 54° south and 60° south (Figure 7). As the figure any line setting between November and February would be impossible if restricted to night setting when working close to 60° south. Even at the more northern limit of 54° south nighttime hours are relatively few for many months of the year. The ability to be able to set lines during the daytime would considerably enhance the efficiency of research and maximise vessel time and fuel on the grounds. Daytime setting is consistent in this area with CCAMLR Conservation Measures (CM-41-09 and CM41-10, 2023) which allow daytime setting under strict conditions. Only one seabird mortality has ever been reported by vessels in the more southern CCAMLR toothfish fishery: a Southern giant petrel (*Macronectes giganteus*) reported in 2014.

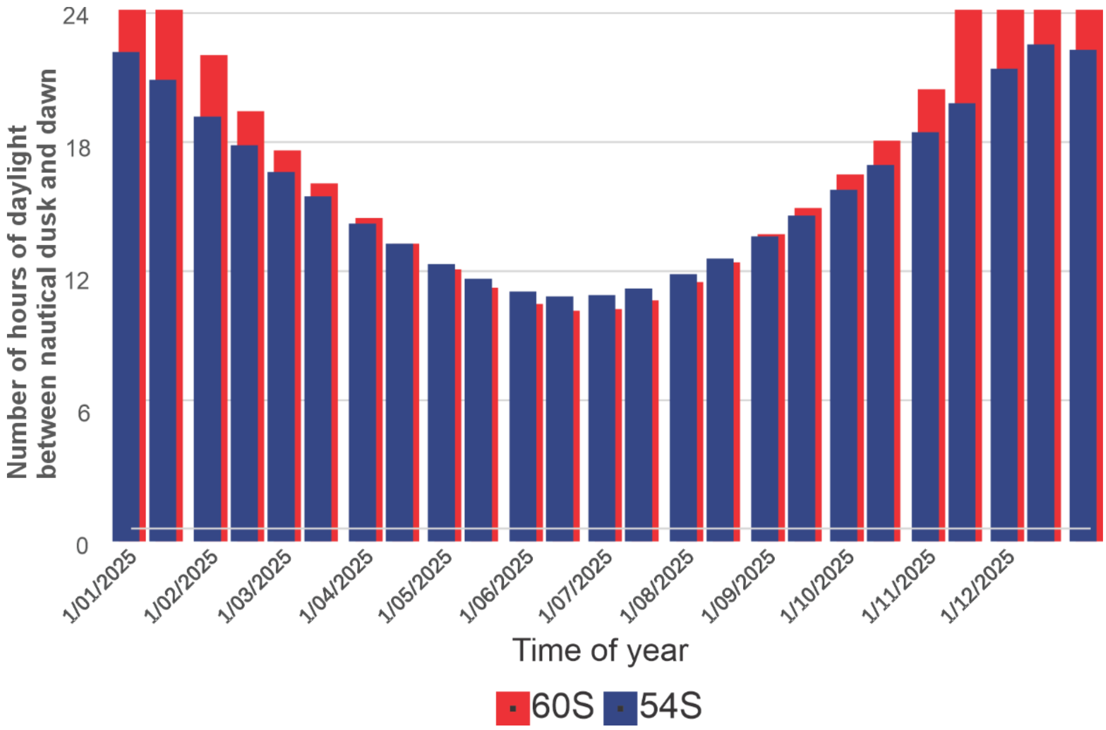


Figure 7. Daylight and nighttime hours (between nautical dusk and dawn) over a calendar year for latitudes 54° and 60° south. Calculated using the CCAMLR Nautical twilight calculator (https://www.ccamlr.org/node/84096)

Noting above the fulfilment of the requirement under CMM-09-2017, Annex 1, ii we propose the following mitigation measures for New Zealand vessels.

Measure	Description	Rationale and comments	SPRFMO Management Measure	Consistency with CCAMLR Measures2
1	Integrated weight line (incorporating 50 g of lead in the core of each metre of longline backbone to facilitate fast sinking of the lines).	Standard practice when working in the CAMLR Convention area immediately south and has proved successful for over 20 years.	CMM 09-2017. Annex 1, Par 6.	Conservation Measure 24-02 (2014) - Longline weighting for seabird conservation (Protocol C) and Conservation Measure 25-02 (2023)- Minimisation of the incidental mortality of seabirds in the course of longline fishing or longline fishing research in the Convention Area, Par 2.
2	Tori (streamer) lines deployed above all lines set	To deter birds from approaching or diving on the lines	CMM 09-2017. Annex 1, Par 7.	Conservation Measure 25-02 (2023)- Minimisation of the incidental mortality of seabirds in the course of longline fishing or longline fishing research in the Convention Area. Par 8.

3	Strict offal management (to reduce the attractive effect of discarded material).	No offal and discards will be released while longlines are being set . Offal or discards will either be discharged on the non-hauling side of a vessel or reduced to fishmeal with no discharge. All fishhooks will be removed from offal or discards prior to discharge.	CMM 09-2017. Annex 1, Par 1 a.	Conservation Measure 25-02 (2023)- Minimisation of the incidental mortality of seabirds in the course of longline fishing or longline fishing research in the Convention Area. Par 6.
4	The use of a brickle curtain as appropriate	A seabird exclusion device (BED) designed to discourage birds from accessing baits during the hauling of longlines shall be employed. The use of a BED will be dependent on the number, behaviour and type of seabird, the weather and the potential presence/absence of sea ice		Conservation Measure 25-02 (2023)- Minimisation of the incidental mortality of seabirds in the course of longline fishing or longline fishing research in the Convention Area. Par 9.
5	NZ will exceed the minimum of 10% observer coverage. The vessel will carry a scientific observer and, in addition, a dedicated video recording system (EMS) to observe the setting and hauling of all hooks,	Vessels will carry a scientific observer who will record, in conjunction with the crew, the number and identity of birds attending the vessel, the application of mitigation measures, and the capture of any seabirds. All dead seabirds will be retained by the observer for identification and necropsy. Birds returned alive (and any birds landing on the deck or colliding with the vessel) will be photographed.	CMM 09-2017. Annex 1, Par 1 b,ii,b.	NA

6	Daytime setting: Should any participating vessel exceed a seabird mortality rate of 0.01 birds/ 1000 hooks, they will be required to revert to night setting for at least one year from the time of the mortality; NZ will report details of the event to the Secretariat within seven days; and NZ will report details of the event in their national report.	New Zealand is applying the option 1. b, ii. Of the CMM (Where a Member or CNCP has maintained spatially and temporally appropriate observer coverage for the previous 5 consecutive years at levels greater than 10% and recorded a seabird mortality rate less than 0.01 birds/ 1000 hooks, that Member may choose to: a. require its vessels to apply only one of the three measures specified in paragraph 1; and b. ensure a minimum of 10% observer coverage that is adequately representative of the spatial and temporal distribution of the fishing fleet). In this case the requirement to set at night is removed under strict monitoring.	CMM 09-2017. Annex 1, Pars. 2,3,and 4	CMs 41-09 (2023) and 41-10 (2023)

9 Annex 3. Mitigation of Fishing Impacts on non-target fish and Chondrichthyes

1. Non-target fish

New Zealand's exploratory fishing in the northern Ross Sea region within CCAMLR suggests that fish bycatch will constitute much less than 1% of the total catch (by weight) and comprise small numbers of relatively common and cosmopolitan species. During the 2022/23 Season in the northern Ross Sea (RSR N70), the total fleet *Macrourus* spp. catch was only 1.18 greenweight tonnes (t) of the total 681.3 t of target toothfish. Other non-target fish totalled 0.75 t and skates were recorded as 27.4 kg (one or two animals only). In the immediate last 2023/24 season for that same northern area bordering SPRFMO only 0.6 t of *Macrourus* spp. and 0.33 t of other fish species were reported by the fleet with no skates recorded. This for a total catch of 579 t of target toothfish[4].

From New Zealand's Exploratory work within SPRFMO further east for seven years between 2016 and 2023 (excluding 2018 when no fishing was approved) the main bycatch was of rattails, *Macrourus* spp. with the species composition probably varying with depth but totalling less than 2.5% of the total catch by weight in any year and overall, 1.4% of all fish caught by weight over the entire period (Table 10).
Even smaller amounts of violet cod *Antimora rostrata* and *Lepidion* sp. (Morid cods or *Muraenolepis* spp.) were taken in each year. There are other potential fish bycatch species recorded from previous exploratory work but all other fish species amount to a very small proportion of the total catch by weight (67.3 kg for the seven years of exploratory fishing). Catch limits for all bycatch species will meet and exceed CCAMLR CMM 33-03 (2023) and SPRFMO CMM 02-2020 (Data Standard) Annex 14 (see table).

2. Chondrichthyes

There is potential to catch skates (although none yet have been caught by NZ vessels within SPRFMO) and very few catches have been reported from the CCAMLR Management (RSR N70) area directly to the south. There is a working and tried protocol for live release of skates which are known to have high survival following capture and release.
Deepwater sharks are uncommon at these latitudes. Between 2016 and 2023, 38 kg of *Etmopterus* spp. were caught – identified by the observers as predominantly blue-eyed lantern sharks *Etmopterus viator* and 6.6 kg of deepwater catsharks *Scyliorhinus* spp. All were very small.

[4] Fishery Notice 60 for Exploratory longline fishery for Dissostichus mawsoni in Subarea 88.1 and SSRUs 882A–B for 2022/23 and Fishery Notice 61 for Exploratory longline fishery for Dissostichus mawsoni in Subarea 88.1 and SSRUs 882A–B for 2023/24 (CCAMLR).

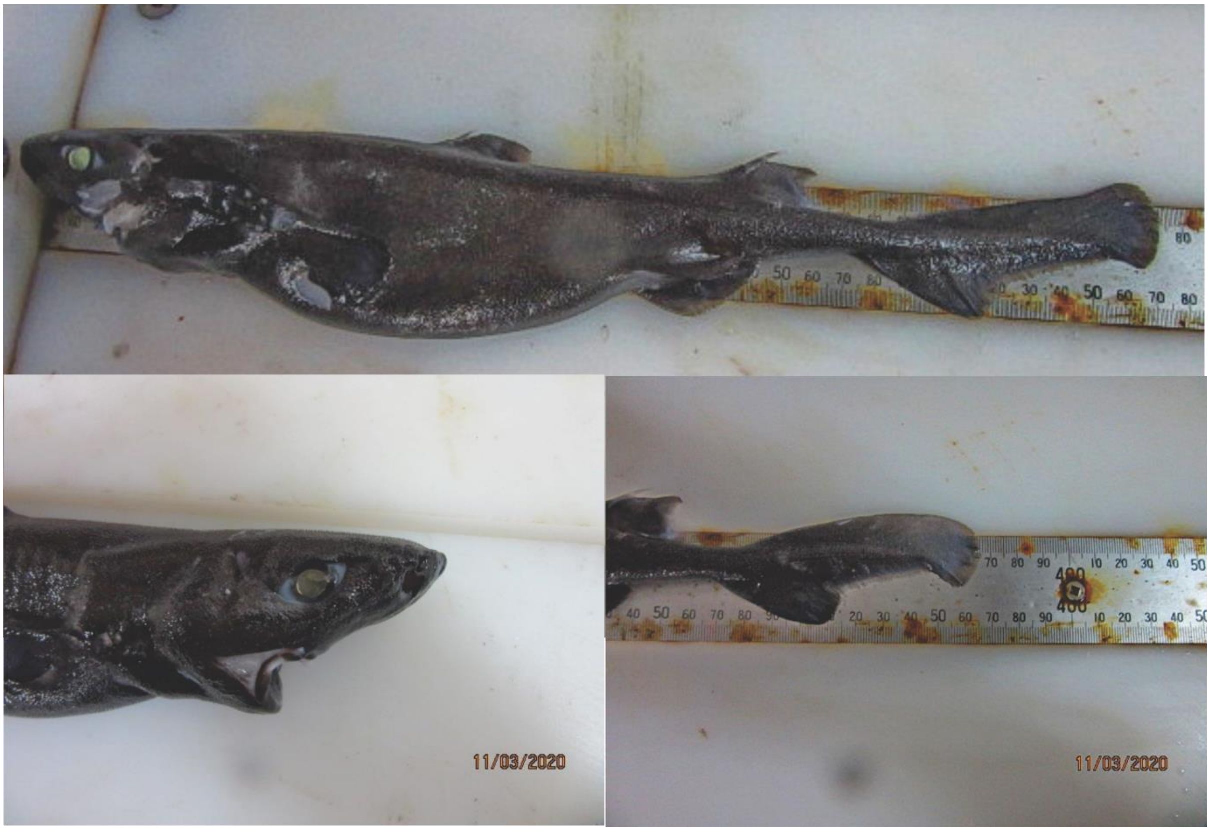


Figure 8. Etmopterus spp.– identified by the observers as a blue-eyed lantern shark Etmopterus viator

Four small sleeper sharks (likely *Somniosus pacificus*) estimated weight about 30 kg each were recorded well to the east in the northern sector of Research Block Q during 2022. Three were lost at the surface and the other was dead and kept as a sample for identification ashore.

The total catch of *Macrourus* and fish by-catch shall not exceed the following limits:16% of the catch limit for *Dissostichus* spp. The total catch of skate by-catch shall not exceed the following limits: 5% of the catch limit for *Dissostichus* spp. Skate, while not considered a high catch component can often be recovered and released alive. CCAMLR CM 33-03 (2023) paragraph 3 and 5, states that if the by-catch of only one species is equal to, or greater than 1 tonne in any one haul or set, then the fishing vessel shall move to another location at least 5 nautical miles distant. In the case of the New Zealand fishing plan should more than 1 tonne of fish bycatch be taken on any cluster there is already a mechanism to separate the clusters by a minimum of 5 nm in any calendar year.

Table 10. Total catch composition from New Zealand's Exploratory Fishery within SPRFMO for 2016 and 2017, 2019 to 2023. The weights and numbers are all captures including releases and discards.

Common name	FAO Species code	FAO code	Total captured weight (kg)	Numbers caught	% of total captures by weight
Antarctic Toothfish	*Dissostichus mawsoni*	TOA	236248.9	7793	96.67%
Rat tails, Grenadiers	*Macrourus* spp	GRV	3297.0	1643	1.35%
Blue Antimora	*Antomora rostrata*	ANT	2518.1	1437	1.03%
Lepidion codlings	*Lepidion* spp	LEV	1476.8	251	0.60%
Patagonian Toothfish	*Dissostichus eleginoides*	TOP	198.0	8	0.08%
Pacific Sleeper Shark	*Somniosus pacificus*	SON	120.0	4	0.05%
Chimaera	*Chimaeras, etc. nei*	HOL	117.8	14	0.05%
Lantern sharks	*Etmopterus* spp	SML	88.0	320	0.04%
Abyssal grenadier	*Coryphaenoides armatus*	CKH	69.7	72	0.03%
Whitson's rattail	*Macrourus whitsoni*	WGR	61.9	98	0.03%
Lantern sharks	*Etmopterus* spp	SHL	37.9	77	0.02%
Goiter blacksmelt	*Bathylagus euryops*	BBE	30.6	15	0.01%
Bigeye grenadier	*Macrourus holotrachys*	MCH	29.1	26	0.01%
Moray Cods	*Muraenolepis* spp	MRL	28.8	44	0.01%
Cusk-eels, brotulas	*Ophidiidae*	OPH	18.6	7	0.01%
Fathead sculpin	*Psychrolutes macrocephalus*	PEF	13.2	8	0.01%
Deep-water catsharks	*Apristurus* spp	API	10.0	9	0.00%
Crab spp.	*Lithodidae*	KCX	5.4	13	0.00%
Morid cods	*Moras nei*	MOR	4.1	11	0.00%
Starfish	*Asteroidea*	STF	3.3	13	0.00%
Cutthroat eels	*Synaphobranchidae*	SVY	2.2	3	0.00%
Basketwork eel	*Diastobranchus capensis*	SDC	1.9	2	0.00%
Sea cucumbers	*Holothurioidea*	CUX	1.3	5	0.00%
Pearleyes	*Benthalbella elongata*	BEE	0.3	1	0.00%
Icefish	*Channichthyidae* spp	ICX	0.3	1	0.00%
Lumpfishes and snailfishes	*Cyclopteridae*	ZLS	0.1	1	0.00%
			244383.3		

Chondrichthyans caught alive with high probability of survival should be recovered from the line and released alive, especially juveniles and gravid females. Safe handling practises will be used which may include cutting the animal off at the water line to help ensure better post capture survival. Primary mitigation for reducing risk to chondrichthyans is through precautionary bycatch limits and allowed fishing gear, including the use of nylon rather than wire traces.

Noting above the fulfilment of the requirement we propose the following non-target fish and Chondrichthyan mitigation measures for New Zealand vessels in this proposed area.

Measure	Description	Rationale and comments	SPRFMO Management Measure	Consistency with CCAMLR Measures
1	The total catch of *Macrourus* and other fish by-catch, excluding individuals released alive, shall not exceed the following limits: 16% of the catch limit for *Dissostichus* spp.	Standard practice when working in the CAMLR Convention area immediately south and has proved successful for over 25 years.	SPRFMO CMM 02-2020 (Data Standards) Annex 14	CCAMLR CM 33-03 (2023)
2	Any by-catch of large sharks (as listed in Annex 14, see Table 11), especially juveniles and gravid females, taken accidentally in other fisheries, shall, as far as possible, be released alive. Any sharks unsuitable for release and not conclusively identified may be retained for later identification as practical. Specific sampling may be carried out for other research agencies on request.	Most sharks captured during previous work in SPRFMO have been small sharks - predominately *Etmopterus* spp. and deepwater catsharks *Scyliorhinus* spp. Release is impractical both due to the small size and the poor condition of these small sharks after hooking.	SPRFMO CMM 02-2020 (Data Standards) Annex 14	Conservation Measure 32-18 (2006)
3	The total catch of skates, excluding individuals released alive, shall not exceed the following limits: 5% of the catch limit for Dissostichus spp. on each line. Any skates captured will be brought on board or alongside the vessel to be checked for tags and for their condition to be assessed. Recaptured tagged skates and rays, as per CCAMLR Conservation Measure 41-01, Annex 41-01/C, paragraphs 2(vii) and (ix), should not be re-released. Unless	Standard practice when working in the CAMLR Convention area immediately south, although skate are unlikely to be caught in number any captured skates may also be tagged using the appropriate CCAMLR tags and protocol.		CM 41-09 (2023) Par.6 (iii) and CM 41-10 (2023) Par 5., CCAMLR CM 33-03 (2023) Report of the COLTO–CCAMLR Tagging Workshop 2023 (WS-TAG-2023) (Hobart, Australia, 14 to 17 March 2023)

	otherwise specified by scientific observers, all other skates and rays caught alive and with a high probability of survival should be released alive, by cutting snoods, and when practical, removing the hooks, and the number should be recorded and reported.		Appendices E and F
4	The total catch of shark by-catch, excluding those released alive (large sharks as listed in Annex 14) , shall not exceed the following limits: 16% of the catch limit for Dissostichus spp.	SPRFMO CMM 02-2020 (Data Standards) Annex 14	CCAMLR CM 33-03 (2023)

Table 11. From CMM 02-2022 Annex 14. Definition of "other species of concern". As advised by the Scientific Committee and informed by Appendix 1 of the Convention on the Conservation of Migratory Species of Wild Animals (a.k.a. CMS or Bonn Convention), the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species, Appendix 1 and 2 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), "other species of concern" are defined, as of January 2017, as:

Scientific name	English name	3-alpha code[30]
Carcharhinus longimanus	Oceanic whitetip shark	OCS
Carcharodon carcharias	Great white shark	WSH
Cetorhinus maximus	Basking shark	BSK
Lamna nasus	Porbeagle shark	POR
Manta spp.	Manta rays	MNT
Mobula spp.	Mobula nei	RMV
Rhincodon typus	Whale shark	RHN

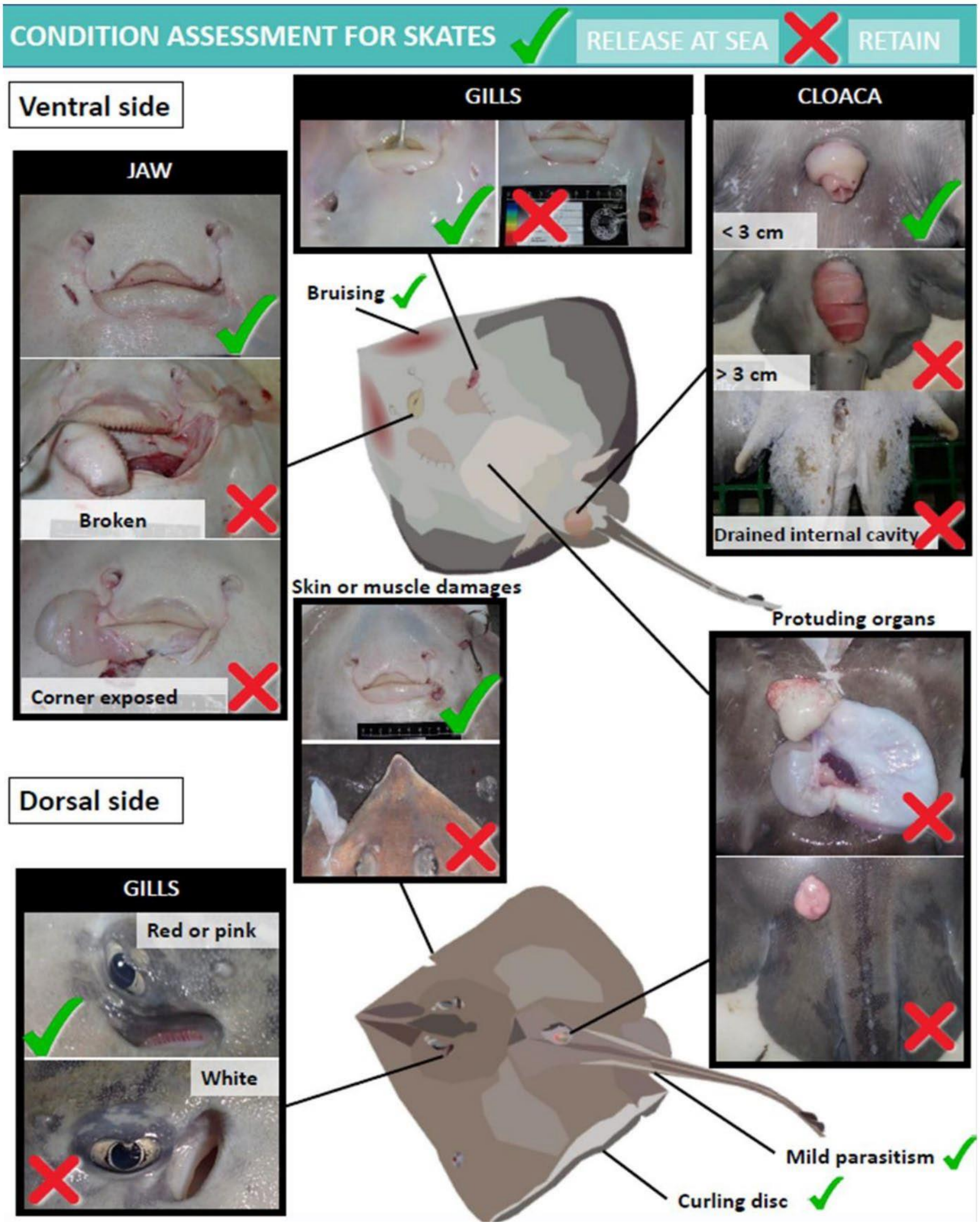


Figure 9. CCAMLR Condition assessment for Skates will be used to determine skates for release of tagging.

10 Annex 4. Mitigation of fishing impacts on VME indicator species

There is likely to be some impact to VME indicator species when fishing from demersal longline fishing operations through the impact from anchors and weights, hooks, and the line. Demersal longline operations can either snag benthic organisms directly onto fishing hooks or could potentially cause damage to benthic communities if lines are dragged laterally across the seabed either by currents or during hauling.

The footprint of a demersal longline is assessed as low in comparison to demersal trawl and most other fishing methods. For this reason, CCAMLR has allowed this method to be used and restricted the use of bottom trawling gear in the high-seas areas of the CAMLR Convention Area (with exceptions for conducting scientific research), CCAMLR CM 22-05 (2008). In addition, CCAMLR CM 22-06 (2019) Bottom Fishing in the Convention Area requires Members to provide additional information and review of the impacts of any fishing activity by CCAMLR's Scientific Committee (SC-CAMLR) before any fishing activity is permitted. CCAMLR defines the term 'vulnerable marine ecosystems' to include seamounts, hydrothermal vents, cold water corals and sponge fields and 'bottom fishing activities' includes the use of any gear that interacts with the bottom.

All bottom fishing activities are assessed by SC-CAMLR based on the best available scientific information to determine if such activities would contribute to having significant adverse impacts on VMEs (taking account any historical of bottom fishing in the areas). The objective is to ensure that should fishing activities cause contributions, that they are managed to prevent such impacts or are not authorised to proceed. The assessments require any Contracting Party proposing to participate in bottom fishing activities to submit information and a preliminary assessment based the best available data of the known and anticipated impacts of its bottom fishing activities on VMEs, including benthos and benthic communities. These submissions also include the mitigation measures proposed by the Contracting Party to prevent such impacts.

A very similar approach is taken by SPRFMO (CMM-03-2023 Conservation and Management Measure for the Management of Bottom Fishing in the SPRFMO Convention Area, Pars. 22-33).
New Zealand has carried out cumulative impact assessments on bottom longline gear (autoline) in the CCAMLR area since 2008 with the last update by Sharp 2010. These have been referenced in all previous New Zealand proposals to SPRFMO[5]. Although still a low risk factor relative to other interactions, the complete or partial loss of gear was identified as the most important potential impact. A direct relationship between the amount of gear loss and the presence of, and operating within, sea-ice has been established. For example, the same vessels working in the CCAMLR sub area 48.3 fishery where there is no sea ice had very little gear loss. Additional risks are involved with the potential of rough bottom to snag lines with an increased chance of gear loss.

[5] A full summary was presented to SPRFMO SC in 2015 as SC-03-DW-01_rev as part of the initial submission for New Zealand's exploratory toothfish longlining within the SPRFMO area and has not changed in any major respect.

In summary, Sharp 2010 summarised the cumulative fishing effort in the Ross Sea region from 1997 to 2009 at a spatial scale of pixels measuring 0.05° latitude by 0.177° longitude. The mean New Zealand effort density in these fished pixels was reported as 0.53 km line/km^2. Fishing effort by New Zealand fishing industry in the Ross Sea region was assessed as being highly concentrated in preferred locations, with 94% of the fished pixels having effort densities less than 1.5 km of line per km^2. The analysis concluded that the total cumulative impact on VMEs of New Zealand effort in the Ross Sea fishery is very low.

An additional objective analysis from camera footage from UK vessels in the Ross Sea between 2008 and 2010 in depths between 600-2000 m suggested that previous analyses of footprint were likely overestimated with the actual value of impact width of a longline lying between being between 0.5 and 2.5m (UK 2010).

Lateral line movement decreases with depth due to trigonometric considerations. (Sharp 2010). Experience from NZ exploratory fishing in SPRFMO and the limited bathymetry information suggest that fishing depths are likely to be in the range 900 to 2400 m so limited lateral movement and consequently a low benthic impact is expected. Previous experience indicates that most fishing is likely to be deeper. The recorded average depth of fishing in New Zealand's exploratory fishing was between 780-2340 m with the average fishing depth 1550. Autoline operators additionally minimise any impact on bottom fauna by 'peeling' the line off the bottom directly over the path of the set line to minimise lateral movement during hauling, which may cause a snag (increasing the chances of a broken line) or increase fish loss from hooks.

Antarctic benthic organisms trend to higher density and number of taxa in shallower depths; this is recognised by CCAMLR in Conservation Measure 22-08 (2009) where longline fishing is prohibited in depths shallower than 550 m to better protect benthic communities. The minimum depth proposed for this research is 600 m. Previous New Zealand exploratory fishery carried out under the (current) CMM 14a-2022 between 2016 and 2023 caught in total just less than 90 kg of benthic organisms (Table 12) for 545,909 hooks set at depths ranging from 780-2340 m (average fishing depth 1550 m). While the proposed exploratory fishing areas are not yet surveyed, it is a realistic assumption that a similar result would be reached in these more westerly areas lying within the same latitudes. In addition, most VMEs reported and recorded in the CAMLR Convention Area are much further south – generally below 70°S (Figure 10) although fishing operations have also taken place between 60° and 70°S since reporting was required in 2011.

The EU reported in 2013 (SC11-DW14, Table 3.1) from their more westerly exploratory fishing that only 4.3 kg of VME indicator taxa were recovered from 8 out of 32 lines being comprised of small amounts of sea fans/bamboo corals (Gorgoniidae), stony corals (Scleractinia) and a small amount of black coral (Antipatharia). The most commonly caught VME were dead stony coral fragments. Similar results were reported from earlier EU exploratory fishing.

Table 12. Marine invertebrate captures recorded from New Zealand exploratory fishing in the southeastern Pacific Area currently managed under CMM 14a-2022 between 2016 and 2023. This was for a total of 545,909 hooks set.

Code	Class	Common name	Total weight kg	% of total invertebrate captures	Average depth of capture
CSS	Demospongiae	Gorgonians	68.00	75.6%	1215.1
CWD	Euryalida	Hard corals, stony corals	6.15	6.8%	1702.9
BZN	Crinoidea	Glass sponge	4.91	5.5%	1373.5
ZOT	Zoanthidea	Zoanthids	2.81	3.1%	1179.8
AQZ	Alcyonacea	Basket stars	1.91	2.1%	1386.0
BVH	Bryozoa	Feather stars and sea lilies	1.89	2.1%	1470.5
OEQ	Stylasteridae	Siliceous sponges	1.46	1.6%	1456.6
NTW	Scleractinia	Sea anemones	1.01	1.1%	1346.2
DMO	Gorgoniidae	Hydrocorals	0.95	1.1%	1646.5
AJZ	Actiniaria	Alcyonacea soft corals	0.35	0.4%	1313.9
ATX	Anthoathecatae	Black corals and thorny corals	0.25	0.3%	1593.7
AZN	Brachiopoda	Bryozoans	0.08	0.1%	1328.6
HXY	Pennatulacea	Sea pens	0.07	0.1%	1528.8
GGW	Hexactinellida	Hydroids, hydromedusae	0.06	0.1%	1477.5
AXT	Antipatharia	Brachiopods, lamp shells	0.02	0.0%	1589.3
		Grand Total	**89.92**		

The gear used by New Zealand vessels for the proposed programme is still the same as originally assessed by CCAMLR and SPRFMO with small potential changes in hook size (14/O and 15/O) and line thickness (ranging between12.5 to 13mm).

As in NZ's previous SPRFMO exploratory work, this is a stepwise process involving preliminary searching and investigation of potential bathymetric features that may constitute habitat for toothfish. This preliminary phase historically takes much of the time in the survey area. When a suitable location for fishing is found, up to a maximum of 20,700 hooks can be set in any calendar year as a cluster in any one location with clusters separated by 5 nm measured from the proximate lines of each individual cluster (see 4.1.7).

The planned level of effort (and hence impact) for the proposed exploratory fishing will be much lower than reported by Sharp for the CCAMLR directed fishery immediately south due to both the conservative TAC and effort spreading mechanisms proposed (as opposed to commercial operations allowing an area to be more intensively fished).

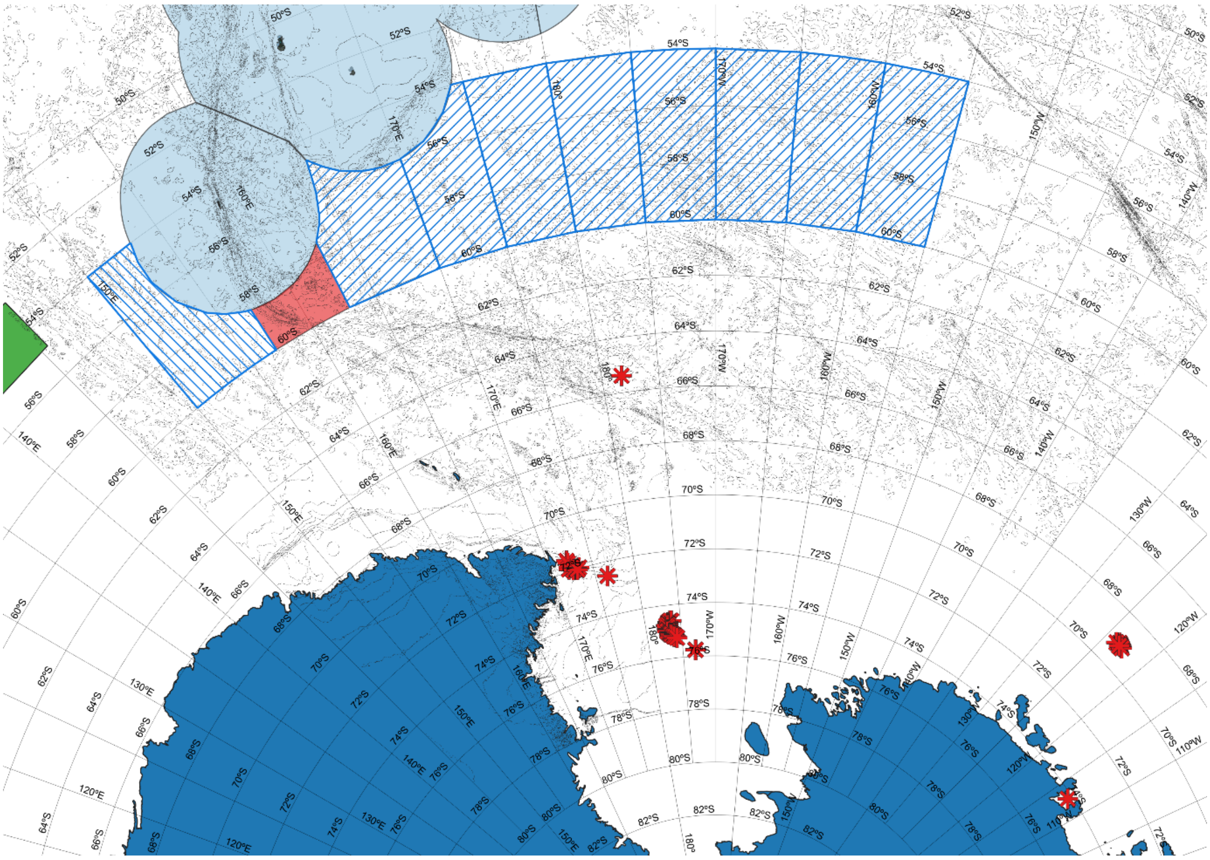


Figure 10. VMEs as recorded under CM 22-07 (2013) (pars. 6 and 9) within the CAMLR Convention Area shown as red markers showing the higher distribution in the area south of 70°S.

Noting above the fulfilment of the requirement under CMM-09-2017, Annex 1, ii we propose the following mitigation measures to minimise VME impact by New Zealand vessels during the proposed exploratory work.

Measure	Description	Rationale and comments	SPRFMO Management Measure	Consistency with CCAMLR Measures
1	Comprehensive sampling and monitoring: All information specified in CMM 03-2023 (Bottom Fishing) relating to bottom fisheries and all data necessary to assess encounters with VMEs shall be collected to enable assessment and monitoring of the distribution of VMEs in the areas fished. Data will be recorded and reported to SPRFMO and shared with CCAMLR using the CCAMLR fine-scale catch and effort data (C2 longline fisheries) forms and CCAMLR observer forms and species codes for maximum consistency.	Catches (including weights to the nearest 0.1 kg) of all benthic invertebrates, including VME indicator taxa, will be recorded using standard SPRFMO protocols and codes (ref CM 22-07 (2013). There are benthic invertebrate guides available from both SPRFMO and CCAMLR to assist identification.	SPRFMO CMM 02-2020 (Data Standards) Annex 14. CMM-03-2023 including Annex 7	CCAMLR CM 22-07 (2013)
2	Reporting annually for review: All benthic invertebrate data will be summarised and presented in the interim and final reports to SPRFMO SC annually for review.		SPRFMO CMM 02-2020 (Data Standards) Annex 14. CMM-03-2023 including Annex 7	
3	Minimum direct impact: The degree of fishing impact will be minimal taking into account the area of survey, the general depth of fishing.	The impact of demersal longlines is relatively low and available information indicates at the proposed depths lateral movement on hauling is likely to be minimal due to trigonometric considerations. The survey area is very large in relation to the planned fishing effort.		CCAMLR CM 22-07 (2013)

4	Cumulative impact: There is already an effective annual restriction from fishing a location more than once each calendar year allowing review by SPRMO-SC (move-on).	The cluster design proposed imposes an automatic and effective move on rule in place, meaning fishing will not be able to continue in a set location until the following year which will enable review by SPRFMO of any potential VME areas. VME move-on rules were not triggered at any time during the previous New Zealand research over seven years and the catch of benthic material was very low. (Table 1), indicating that the fishing activities did not significantly impact VMEs.	SPRFMO CMM 02-2020 (Data Standards) and CMM-03-2023 including Annex 7. Note there are no VME threshold levels specified for longline fisheries within SPRFMO.	CCAMLR CM 22-07 (2013)
5	As practicable considering bottom rugosity and weather(ice) and pending availability of equipment seabed video monitoring will be carried out to provide objective data to SPRFMO on the benthos.	NZ (NIWA) designed underwater 'lollipop' camera, first trialled on the 2020 survey, have been deployed on as many sets as possible during the Ross Sea shelf survey. Pending timing we will use the current re-designed model with strengthened fins.	SPRFMO CMM 02-2020 (Data Standards) and CMM-03-2023 including Annex 7.	

11 Annex 5. Mitigation of Fishing Impacts on Marine Mammals and Turtles

Major Interactions with killer whales, other marine mammals and turtles are considered unlikely based on experience in New Zealand's SPRFMO exploratory fishing (during which few marine mammals were observed from the vessel) and from 24 years' experience in the northern parts of the nearby CCAMLR area. The EU (in SC11-DW04-EU-FOP) also notes that no mammals were caught or observed during their 2021 or 2022 exploratory fishing campaigns in the GVFZ.

Observers and on-board industry science support will continue to record all sightings and interactions. Should any depredation by marine mammals (sperm whales or killer whales in particular) is observed or suspected, the crew will take appropriate action to prevent such interactions. Killer whales and Sperm whales have a very high degree of association with toothfish longline vessels in some toothfish fisheries (e.g. South Georgia and Kerguelen) where interactions are more damaging economically to the vessel, both in terms of lost or damaged gear and depredation of catch. While the potential exists for physical damage to individual mammals to occur this has not been observed by NZ vessels fishing in that South Georgia Fishery and in those fisheries mortalities are low to near-zero. Dolphin mortalities are also considered to be very rare among toothfish longline vessels (Werner et al 2015).

Figure 11. Hourglass dolphins close to San Aspiring *on 20/03/2023.*

Extensive experience from these fisheries shows that the most effective mitigation in such circumstances as halting the haul and buoying off the line, then moving away from the area until the whales have left. Both Sanford vessels and crews have considerable experience operating in the South Georgia fishery where such depredation has been a major issue. Offal and waste management is also a consideration and will already be in place for the protection of seabirds.

The EU has identified (SC11-DW04-EU-FOP, Appendix 4) at least 30 Marine Mammals whose distributions potentially overlap the two proposed areas to some degree.

Figure 12. Fin whale identified based on the white chin (left), dorsal fin shape (middle), subtle body pattern, body size, and shape of blow (right).

Table 13. Examples of previous opportunistic observations of marine mammals from the 2023 SPFRMO Exploratory Fishery. Asterisk denotes observations where photos were taken. All records are in Coordinated Universal Time.

Date/time	Confidence in identification	Position	Species	*n*	Behaviour	Vessel activity
20/03/23 02:15*	Excellent	59°20.8'S 160°54.3'W	Hourglass dolphin (*Lagenorhynchus cruciger*)	3	Following vessel, starboard side	Steaming
25/03/23 22:25*	Good	59°41.3'S 143°46.5'W	Fin whale (*Balaenoptera physalus*)	1	Straight towards vessel, veered off within 50-100m. Rested at surface 300-400 m from vessel, disappeared.	Hauling downline (not yet on hooks)
27/03/23 21:45*	Good	59°44.8'S 143°37.3'W	Fin whale (*B. physalus*)	1	Presumably feeding (repeated diving) in area around vessel.	Laying to (no gear in water)
27/03/23 21:45*	Good	59°44.1'S 143°40.1'W	Fin whales (*B. physalus*)	≥12	Observations over several hours. Presumably feeding (repeated diving) in area around vessel.	Laying to (no gear in water)
28/03/23 00:54*	Tentative	59°44.1'S 143°40.1'W	Southern bottle nose whale (*Hyperoodon planifrons*)	2-5	Dolphin-sized, clear spots; porpoised past vessel (within 50 m)	Laying to (no gear in water)
29/03/23 21:30	Good	58°06.2'S 137°56.0'W	Fin whales (*B. physalus*)	2	Spouts	Steaming

31/03/23 17:00	Good	54°56.6'S 128°11.9'W	Pilot whales (*Globicephala* sp.)	100 estimated	Very large group travelling north	Steaming

Should sightings of marine mammals occur, a standardised marine mammal form will be complete will be filled out by the vessel (observers in collaboration with industry science support, and vessel crew). An example is given here in table 1 from 2023. This will be accompanied by any recorded observations of behaviour and photography including video as practicable (See Figures 1 and 2; and Table 1 for examples from previous SPRFMO exploratory work. It is highly unlikely that marine turtles will be encountered this far south but should they be encountered full records will be made and included in reports.

The observer shall have a target of observing at least 10% of hooks hauled for any potential marine mammal, seabird and turtle captures. In addition, all vessels in this programme will operate fully functional electronic monitoring systems (EMS), recording both set and haul operations.

Whales are most likely to be at risk at or near the surface during setting or hauling, where entanglement could result in injury or drowning. However, the catchability of whales is thought to be very low given the relatively light gear in use and the fact that there are no observations of occurrence that we know of in the nearby CCAMLR area during setting and hauling observations.

While Otariid seals have been associated with toothfish longline vessels and observed infrequently to depredate on catch, mortalities of fur seal and sea lions in relation to toothfish fishing appear to be very rare. Some isolated depredation has been recorded in the more southern CCAMLR SSRUs by Leopard seals (*Hydrurga leptonyxl*). Southern Elephant (*Mirounga leonina*) seals may be at risk to incidental mortality. Van Den Hoff, Kilpatrick and Welsford (2017) summarised recent and historic reports of Elephant seal bycatch. These reports include video evidence of interactions with caught toothfish on the seabed as well as reports made by Scientific Observers of Elephant seal mortalities by drowning related to longline fishing in the Macquarie Island toothfish fishery. Fabien et al., 2018 suggest that elephant seals may primarily travel south from Macquarie Island However, elephant seals have been tracked on occasion within the proposed areas. (See SC11-DW04-EU-FOP Figure 23).

Sources of risk
Risk to mammals comes from entanglement in the longline leading to drowning. If caught, it is highly unlikely that the animal can be recovered and set free. However, entanglement is very rare among all groups.

Consequences to populations
After evaluation of spatial overlap, catchability and mitigation, it is considered that the consequences to the mammal populations are low with a high likelihood of recovery over medium time frames.

Noting above the fulfilment of the requirement under CMM-09-2017, Annex 1, ii we propose the following mitigation measures for New Zealand vessels in respect to Marine Mammals.

Measure	Description	Rationale and comments	SPRFMO Management Measure	Consistency with CCAMLR Measures
1	For Killer whales and Sperm whales, the vessel will naturally aim to avoid interactions due to depredation on toothfish and the need to avoid 'training'.	Halting the haul and buoying off the line, then moving away from the area until the whales have left. Pre- setting and hauling assessments of mammal abundance in the vicinity will be made on a case-by-case basis as to whether any risk is involved. Any such interaction and response to be recorded and reported in the annual trip report to SPRFMO	CMM 4.02 (Data Standards; 2016), Annex D.	
2	For all other Marine Mammals	Pre- setting and hauling assessments of mammal abundance in the vicinity will be made on a case-by-case basis as to whether any risk is involved.		
3	Should any mortality arise as a result of fishing activities.	Any seal or whale by-catch will trigger a re-evaluation of fishing strategy. Any such interaction or mortality to be recorded and reported in the annual trip report to SPRFMO and reported in the Vessel C2 form. This would also be reported to the NZ Government within 24 hours.	CMM 4.02 (Data Standards; 2016), Annex D.	Conservation Measure 23-04 (2016), Par 4.
4	Strict offal management (to reduce the attractive effect of discarded material).	No offal and discards will be released while longlines are being set . Offal or dscards will either be discharged on the non-hauling side of a vessel or reduced to fishmeal with no discharge. All fishhooks will be removed from offal or discards prior to discharge.	CMM 09-2017. Annex 1, Par 1 a.	Conservation Measure 25-02 (2023)-Minimisation of the incidental mortality of seabirds in the course of longline fishing or longline fishing research in the Convention Area. Par 6.

12 Annex 6. Acoustic data collection

Set-up of ES-70 and ES-80 echosounders for recording data during 2023/24 toothfish season

Pablo Escobar-Flores Pablo.Escobar-flores@niwa.co.nz +64 4 3821610

Since 2006/07, all New Zealand vessels have collected acoustic data during their fishing operations. New Zealand leads the way in industry involvement and cooperation in data collection, and accordingly, we would request you to again record and store acoustic data from your entire trip to the Ross Sea in 2023/24. Regular calibrations of the systems are important (preferably at least once every two years); they provide information on changes in the performance of systems over time and help to identify issues such as physical damage of the transducers.

Table 1: Summary of acoustic data collection and calibration

Vessel name	Years of data collection	Calibrations
San Aotea II	2007-20, 2022	2009, 13, 17, 18, 20, 22
San Aspiring	2005, 2007-20, 2022	2009, 10, 12, 14, 18, 21, 22
Janas	2002, 2006-11, 2013-20, 2022	2009, 12, 13, 16, 19, 22
Antarctic Chieftain	2010-11, 2013-14	2009, 12

[1] Includes 2016 & 2019 winter surveys.

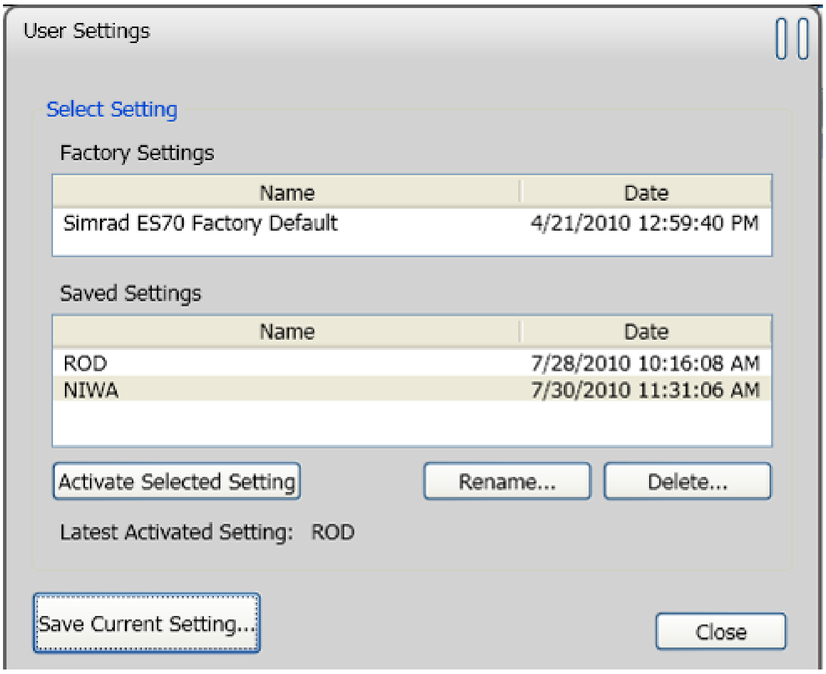
Our results from previous seasons have suggested that acoustic methods might provide a means of estimating rattail abundance. This work was published in 2012 in *Journal of Ichthyology* and an updated analysis (including data up to 2013/14) was presented to CCAMLR WG-FSA in 2014. Acoustic data to estimate rattails were looked at again in 2022 as part of Fisheries New Zealand project ANT2019/01.

The international interest in collecting and processing acoustic data from the world's oceans to help describe pelagic ecosystems, and in particular the role of mid-trophic level (forage) fish, still continues. We are collaborating in three international programmes: the Southern Ocean Network of Acoustics (www.sona.aq); the Integrated Marine Observing System (http://imos.org.au/); and the EU-funded Mesopelagic Southern Ocean Prey and Predators (MESOPP) project (https://www.mesopp.eu/). Acoustic data collected by the industry vessels in the New Zealand sector of the Southern Ocean, was used in a PhD research (Pablo Escobar-Flores from University of Auckland, PhD completed in December 2016). From this research, two scientific articles were published in *Marine Ecology Progress Series* in 2018 and one in *Polar Biology* in 2020. This research highlighted the value of collecting opportunistic data from fishing vessels in remote locations for monitoring ecosystems, and provided valuable ecological insights of the mid-trophic levels of the Southern Ocean.

Acoustic data collected during the 2023/24 season will increase the dataset available from the Ross Sea and will help improve our understanding of the Southern Ocean ecosystem. **Protocols for collecting the acoustic data are the same as in recent seasons**, and are given in the following document for both ES70 and ES80 echosounders. We have attached a short checklist of the important points to remember as well as the more detailed instructions.

ES-70 Settings

There are several key settings, which should not be changed and these should be checked periodically. You can save these settings as 'NIWA'. To load the saved settings, either select 'NIWA' settings when starting up ES70, or if echosounder is already running, go to User settings, select 'NIWA' as Saved Settings and then click on 'Activate Selected Settings'



Data storage

The best way of storing the data is on a removable USB hard drive ('black box') which is plugged into the ES7/ES80 computer. These are cheap, simple to install, and can be removed at the end of the trip to transfer the data to NIWA.

Data file-path

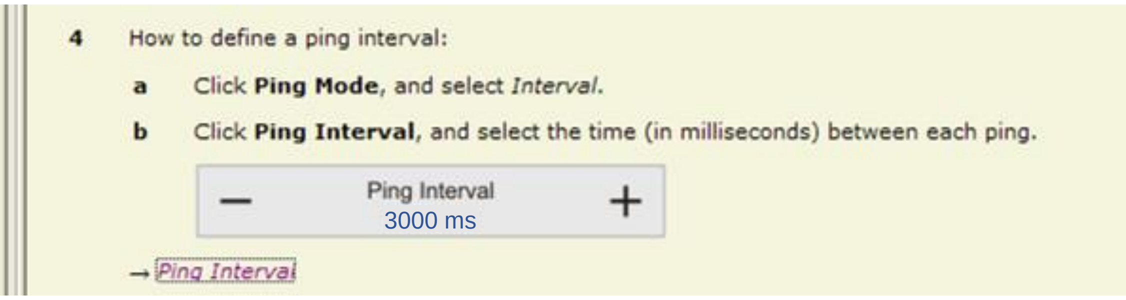
In the **Operation** menu click on **Record**, then **File Output** to bring up the dialog box. In the **Directory** field, use **Browse** to select the folder you have created for data storage (on the USB hard drive where installed). In the **Raw Data** field, set the **file name prefix** to the vessel code (**e.g., JAN, ANC**), set the **range to 1800 m** and set **Max file size** to **100 MB**. Do not check **Save raw data** box unless you want to start recording. In the **Processed Data** field do not check **Save EK500**.

ES-70 settings

Required settings are listed below, along with more detailed instructions on how to make these settings in an ES70.

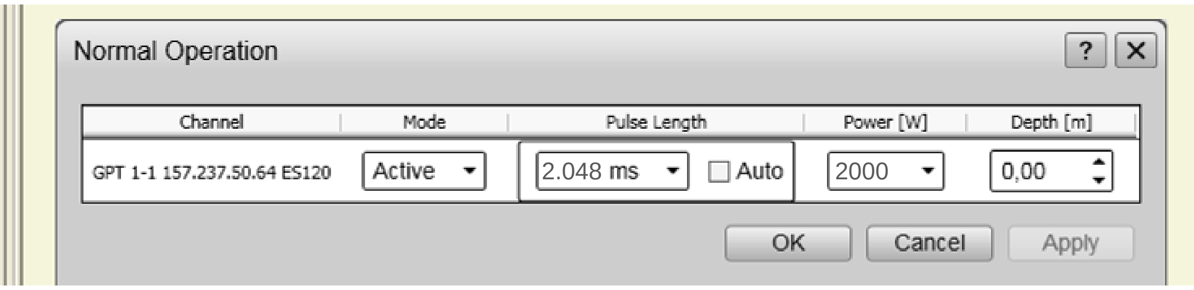
a) Transmit interval = 3 s

In **Operation** menu, click **ping mode** and select **Interval**. Click **Ping Interval** and set the time between each ping to **3000 ms** (= 3 seconds).



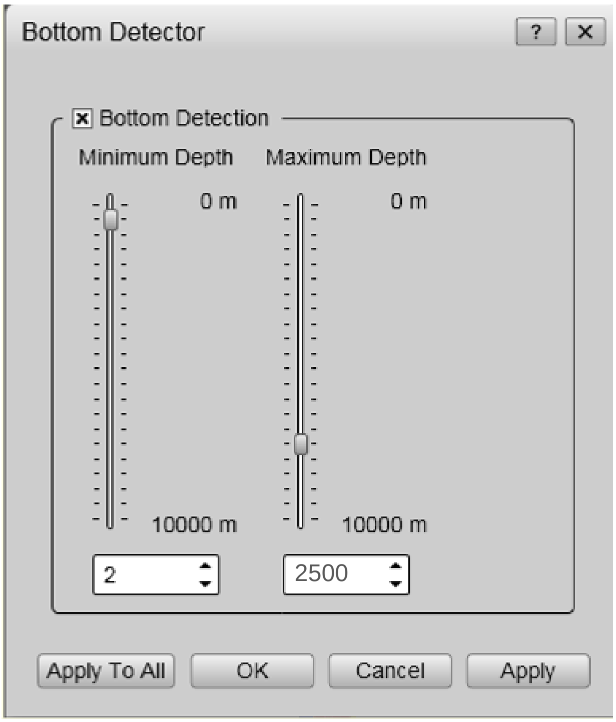
b) Pulse length = 2.048 ms and transmit power = 2000 W

In **Operation** menu, click **Normal** to open dialog box. Make sure Mode = **Active**, and set **Power** to **2000 W**, and **Pulse Length** to **2.048 ms**. **Make sure that the Auto box next to the pulse length is not checked.**



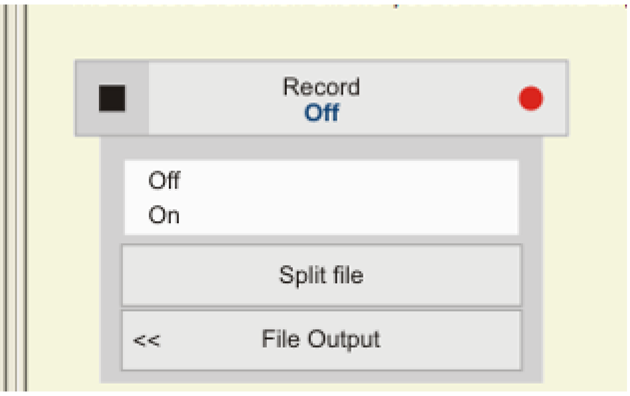
c) Bottom detection limits

In **Active** menu, click **Bottom Detector** to open dialog box. Set **Minimum Depth** to **2 m** and **Maximum Depth** to **2500 m**.



Recording data

In the **Operation** menu, select **On** to start recording and **Off** to stop recording. The current status will be indicated. We would like you to **record acoustic data continuously from port to port**. All **other echosounders should be off**.



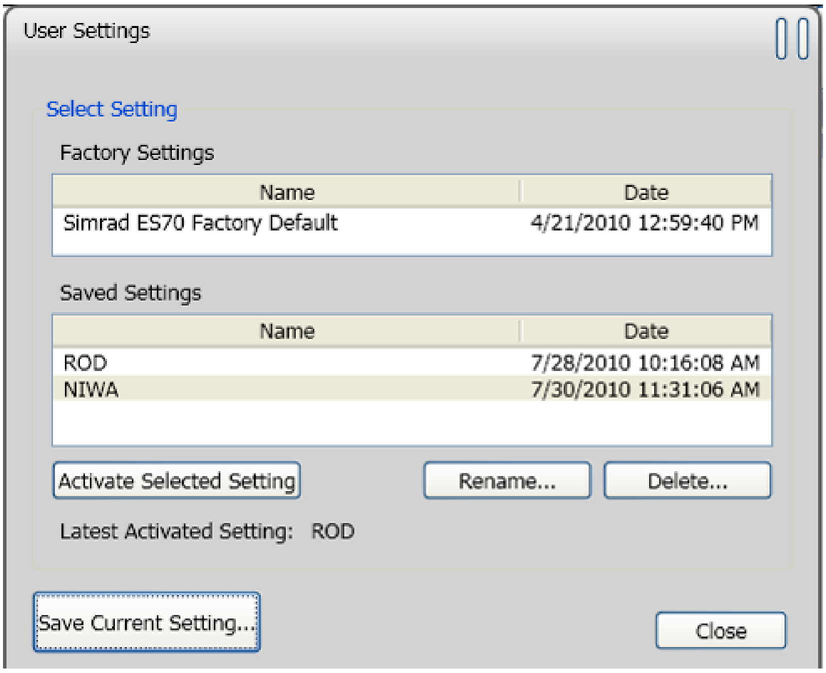
12.1 Checking data

To check that data has been recorded, use Windows Explorer or similar to view the folder where data are being stored. There should be a list of files with names like "JAN-D20040906-T225016.raw". The first part of the name is the user specified vessel code (e.g., JAN), the second part the date (Dyyymmdd), and the third part the GMT time (Thhmmss).

If the ES70 is running, hold down the windows key and push **E** on the keyboard to open Windows Explorer.

ES-80 Settings

There are several key settings, which should not be changed and these should be checked periodically. You can save these settings as 'NIWA'. To load the saved settings, either select 'NIWA' settings when starting up ES80, or if echosounder is already running, go to User settings, select 'NIWA' as Saved Settings and then click on 'Activate Selected Settings'

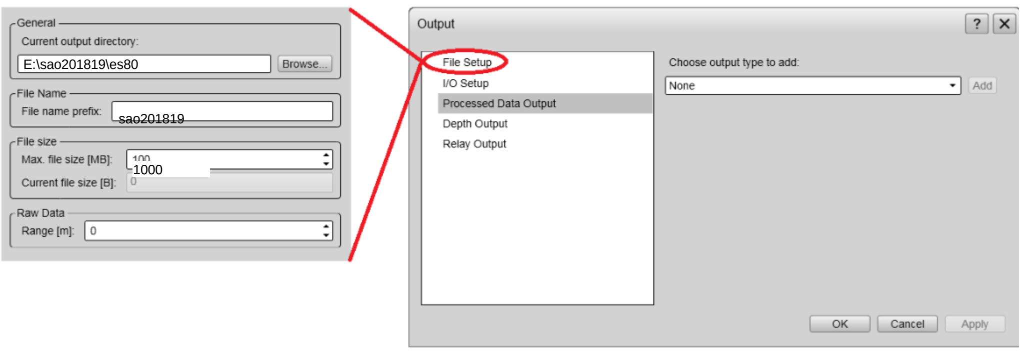


Data storage

The best way of storing the data is on a removable USB hard drive ('black box') which is plugged into the ES-80 computer. These are cheap, simple to install, and can be removed at the end of the trip to transfer the data to NIWA. **Because ES80 echosounders produce a LOT more data volume you will need a large capacity hard drive e.g., 4TB.**

Data file-path

In the **Setup** menu click on **Output**, then **File Setup** to bring up the dialog box. In the **Directory** field, use **Browse** to select the folder for data storage (on the USB hard drive – e.g., \sao201819\es80). In the **Raw Data** field, set the **file name prefix** to the voyage code (e.g., sao201819), set the **range** to 1800 m and set **Max file size** to 1000 MB. Ensure that **only raw data are recorded**, do not record processed data. There are separate recording buttons for raw and processed data.



1800

If the ES80 computer crashes for any reason, you may need to reset the data file-path to point the directory on the USB drive.

Key Echosounder settings

Required settings are listed below, along with more detailed instructions on how to make these settings in an ES80.

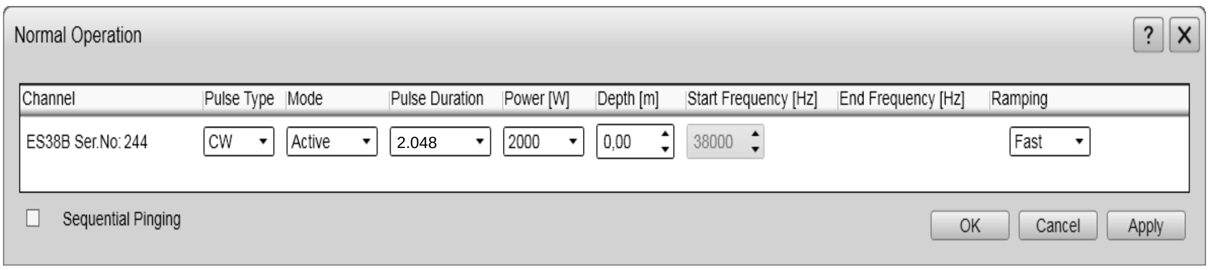
a) Transmit interval = 3 s

In **Operation** menu, click **ping mode** and select **Interval**. Click **Ping Interval** and set the time between each ping to **3000 ms** (= 3 seconds).

If you keep getting ping interval warnings you can change this to 4000 ms (= 4 seconds)

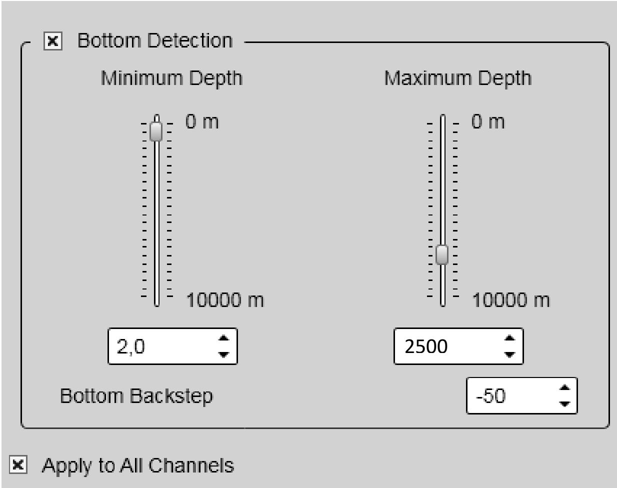
b) Pulse length = 2.048 ms and transmit power = 2000 W. Pulse Type = CW

In **Operation** menu, click **Normal Operation** to open dialog box. Make sure Mode = **Active**, and set **Power** to **2000 W**, and **Pulse Length** to **2.048 ms**. The transmit power is extremely important, as we have found problems with data collected at maximum power (4000 W). It should be set to **Pulse Type CW.** In vessels equipped with wideband transceivers (WBT) select **Pulse Type CW** and start frequency **38000** (Hz).



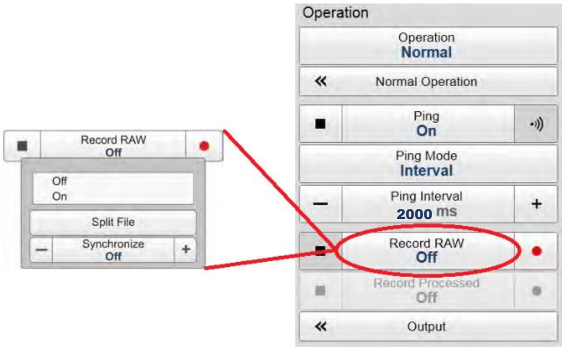
c) Bottom detection limits

In **Active** menu, click **Bottom Detection** to open dialog box. Set **Minimum Depth** to **2 m** and **Maximum Depth** to **2500 m**.



3. Recording data

In the **Operation** menu, select **Record RAW** then **On** or **Off** to start or stop recording. The current status will be indicated. We would like you to record acoustic data continuously from port to port. All other echosounders should be off.



Record only raw data. The Record Processed option should not be used – and should be greyed out in the Operation Menu. In the Record RAW menu, **Synchronize should be Off.**

4. Checking data

To check that data has been recorded, use Windows Explorer or similar to view the folder where data are being stored. There should be a list of files with names like "sao201819-D20180813-T225016.raw". The first part of the name is the user specified voyage code (e.g., sao201819), the second part the date (Dyyyymmdd), and the third part the GMT time (Thhmmss).

The vessel position (latitude and longitude) should be shown in the header and should be changing as you move. If the GPS connection is lost for any reason, you may have to re-boot the computer (not just the ES80 software).

12.1.1 Checklist for recording acoustic data in the Ross Sea

Installation

- USB hard drive installed and appropriate data storage path set in ES-70/ES-80 (If ES-80 then you need a hard drive with at least 4TB of storage)
- Save raw data not just history files

Settings

- Transmit (ping) interval is fixed (e.g. 3 s, not maximum)
- Transmit power 2000 W
- Pulse length 2.048 ms
- Correct Latitude/Longitude appears on echosounder screen
- Recording is ON

Other Equipment

- All other acoustic equipment is switched off

Documentation

- Record acoustic data continuously from port to port and not just in the Ross Sea
- Start new acoustic file for each new set or when steaming to a new destination. Stop recording at end of set or steam, then restart new file
- Check that data has been saved by checking folder where data are stored

If you encounter any issues please contact:

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or if unreachable contact:

Richard O'Driscoll (NIWA)
Richard.odriscoll@niwa.co.nz