Fishery Report 2023: *Dissostichus mawsoni* in Subarea 88.2

CCAMLR Secretariat

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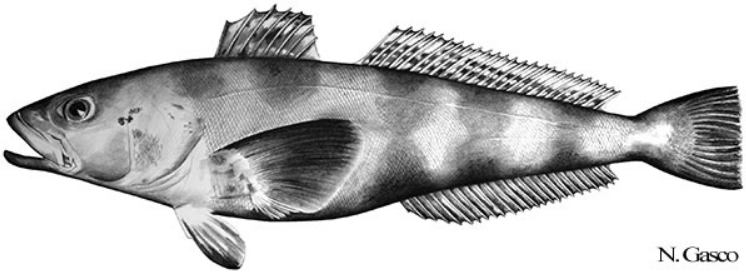
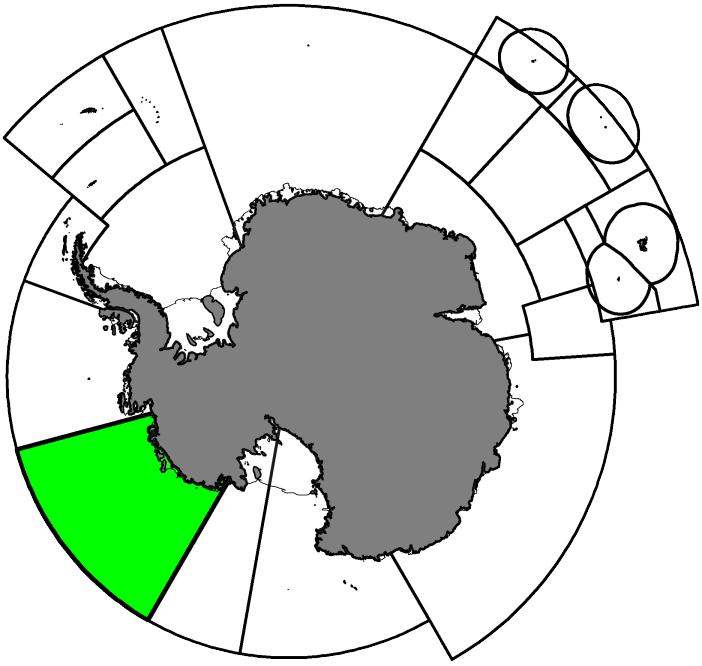


Antarctic Toothfish, *Dissostichus mawsoni* Norman, 1937.



Map of the management areas within the CAMLR Convention Area. SSRUs 882C to 882I within Subarea 88.2, are shaded in green. Throughout this report, "2023" refers to the 2022/23 CCAMLR fishing season (from 1 December 2022 to 30 November 2023). Coastlines and ice shelves: UK Polar Data Centre/BAS and Natural Earth. Projection: EPSG 6932.

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1. Introduction to the fishery

1.1. History

This report describes the exploratory longline fishery for Antarctic toothfish (*Dissostichus mawsoni*) in Small Scale Research Units (SSRUs) 882C to 882I within Subarea 88.2 in the Amundsen Sea region (Figure 1). The area spans 150°W to 105°W longitude and from the Antarctic Continent to 60°S latitude. Fishing is permitted around seamounts and ridges, the Marie Byrd Seamount, the Continental slope, and the Continental shelf areas with polynyas. SSRU 882I has had a catch limit of 0 tons since it was first defined (Conservation Measures 32-02, 41-01, 41-10).

The fishery began in 2003 on the ridge complex in SSRU 882H, and expanded to the continental slope and shelf areas beginning in 2006. The SSRUs were redefined in 2011, moving the northern extent of SSRUs 882C-G from 55°S to 70° 50'S recognising the differences between toothfish inhabiting seamounts and those inhabiting the continental slope regions.

Prior to 2017, this fishery was an exploratory fishery for *Dissostichus* spp., however, in order to better align the target species with the assessment process the target species was specified as *D. mawsoni*, with any Patagonian toothfish (*D. eleginoides*) caught counting towards the catch limit for *D. mawsoni*.

The only type of fishing gear allowed in this fishery is bottom longline gear. Three types of bottom longline gear are used; Autoline, Spanish Line, and Trotline (See the CCAMLR Gear Library for details). Although toothfish do inhabit shallow water to some degree, they are mainly a deep-water species and the fishery is restricted to fishing deeper than 550m (Conservation Measure 22-08). Most fishing occurs between 800 and 1800m depth.

The fishery has started on 1 December of each year. The duration of fishing activities in Subarea 88.2 has decreased over time, from more than two months to less than 4 weeks in recent years. Vessels tend to begin fishing in SSRU 882H, where most of the fishing has occurred, before moving south to fish in the Research Blocks (see Fig. 1). Although in recent years some vessels may gain access to the polynyas in SSRU 882F shortly after the fishery opens.

Sea ice is a major constraint on when and where fishing can occur within open areas. Significant sea ice can prevent access by vessels to many areas, especially early in the fishing season. Typically, a large sea ice bridge occurs along the continental slope and can prevent access to fishing areas in polynyas on the continental shelf and especially to Research Blocks 882_1 and 882_3.

In 2022, the Scientific Committee revised the spatial management within SSRU 882H (see section 1.4).

1.2. Conservation Measures currently in force

The limits on the exploratory fishery for *D. mawsoni* in Subarea 88.2 are defined in Conservation Measure 41-10.

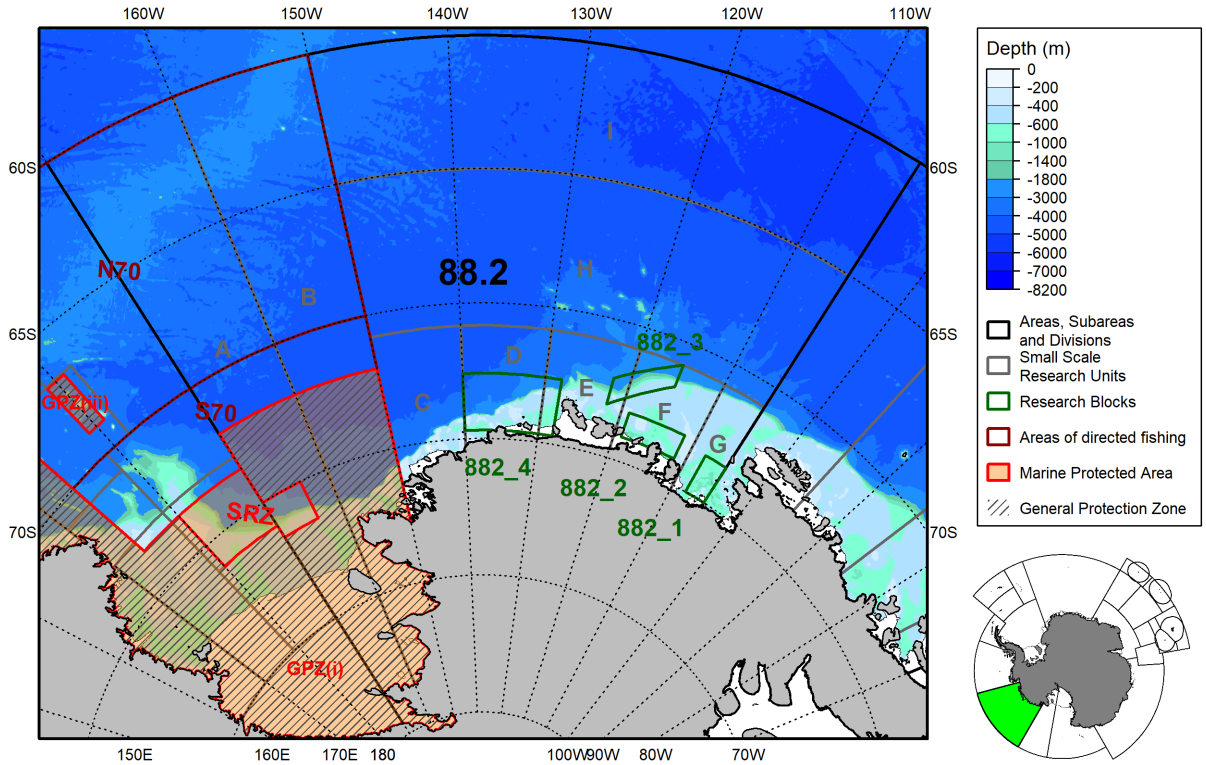

Figure 1. Location of Small Scale Research Units, Areas of directed fishing and Marine Protected Areas in Subarea 88.2. This report discusses fishing in SSRUs 882C to 882I within Subarea 88.2. The fishable depth range (600m-1800m) is highlighted in shades of green. Coastlines and ice shelves: UK Polar Data Centre/BAS and Natural Earth. Bathymetry: GEBCO. Projection: EPSG 6932 (rotated).

1.3. Active vessels

In 2023, 7 vessels participated in this fishery. For the 2024 fishing season, a total of 27 vessels notified their intention to participate in this fishery (2 from Australia; 1 from Chile; 1 from France; 1 from Japan; 1 from Namibia; 3 from New Zealand; 1 from Spain; 4 from Ukraine; 2 from Uruguay; 7 from the Republic of Korea; 1 from the Russian Federation; 3 from the United Kingdom).

1.4. Timeline of spatial management

In 2011, the Commission revised the boundaries of the SSRUs in Subarea 88.2 such that 76% of the yield was assigned to the region between 70° 50'S and 65°S (redefined as SSRU 882H) and the remaining 24% of the yield was assigned to the region south of 70° 50'S (SSRUs 882C-G) as outlined in SC-CAMLR-XXX, Annex 7, paragraph 6.127.

In 2014, the Scientific Committee agreed to a two-year research plan in SSRUs 882C-H (for the 2015 and 2016 seasons) in which the catch limit for SSRU 882H was 200 tonnes, the fishing elsewhere was restricted to four Research Blocks (see Fig. 1) and the combined catch limit for the Research Blocks was 419 tonnes with no more than 200 tonnes to be taken from any one of the Research Blocks, this overarching 419 tonne limit was removed in 2019.

In developing the research plan, the Scientific Committee noted (SC-CAMLR-XXXIII, Paragraph 3.169) that:

(i) declining recaptures by year of release in SSRU 882H indicate a loss of tagged fish from the seamounts and annual immigration of untagged fish

(ii) increasing rate of decline in recaptures by year of release, *i.e.*, recaptures of tags released in more recent years are declining at a faster rate than the declines observed in tags released in earlier years

(iii) all estimates of biomass on the seamounts from tag recaptures are biased high, with the least biased being those from fish which have been at liberty for one year

(iv) simulations indicate that the trends observed in the tag-recapture data are difficult to replicate but could be replicated with an exploitation rate on the seamounts of around 20% and an immigration and emigration of tagged fish at around 20%.

In 2022, the Scientific Committee revised the spatial management within SSRU 882H, so that structured fishing on minor seamounts would precede the Olympic fishery, and the start of fishing would be delayed by two weeks to increase the likelihood that sea-ice conditions would allow vessels to access an increased number of seamounts in this region (SC-CAMLR-41, paragraphs 3.144-3.146). The Commission agreed that five research hauls on minor seamounts should be completed in each season prior to fishing elsewhere in the SSRU (CCAMLR-41, paragraphs 4.58 and 4.59). Conservation Measure 41-10 was consequently modified to define two major seamounts areas where a vessel could fish only after it had completed five research hauls outside of these areas (see Fig. 1 in 41-10 and Fig. 2 below).

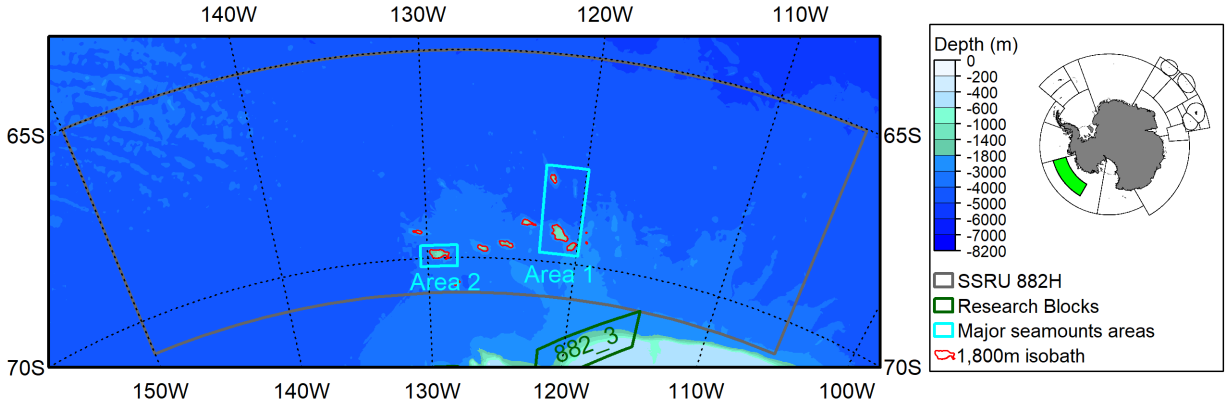

Figure 2. The SSRU 882H seamounts (delineated by the 1,800m isobath in red) and major seamounts areas. Coastlines and ice shelves: UK Polar Data Centre/BAS and Natural Earth. Bathymetry: GEBCO. Projection: EPSG 6932 (rotated).

2. Reported catch

2.1. Latest reports and limits

The catches of *D. mawsoni* from Subarea 88.2 are provided in Table 1. In this fishery, the catch of *D. mawsoni* reached a maximum of 753 tonnes in 2019. In 2023, 737 tonnes of *D. mawsoni* were caught.

The catches reported from Subarea 88.2 include catch data from particular vessels that CCAMLR has agreed should be quarantined as there is no confidence in the amount and/or the location of those catches. All ancillary data associated with these vessels (*e.g.*, by-catch, tagging, observer data) are also quarantined and not included in the data presented in this report.

Table 1. Catch (tonnes) and effort history for *Dissostichus mawsoni* in this exploratory fishery (SSRUs 882C to 882I). Source: Fine scale data and past estimates for IUU catch (-: no IUU estimate available; q: catch data currently quarantined).

Season	Number of vessels	Catch limit (tonnes)	Catch	Estimated IUU catch (tonnes)
2003	1	375	106	0
2004	2	375	362	0
2005	2	375	270	0
2006	7	487	425	15
2007	7	547	347	0
2008	4	567	416	0
2009	10	567	484	0
2010	5	575	314	0
2011	11	575	570	-
2012	5	530	412	-
2013	12	530	475 (q: 1)	-
2014	14	390	392 (q: 34)	-
2015	7	819	396 (q: 227)	-
2016	9	619	430 (q: 186)	-
2017	9	619	466 (q: 158)	-
2018	9	619	313 (q: 296)	-
2019	13	1000	753	-
2020	11	894	643	-
2021	7	804	531	-
2022	11	913	669	-
2023	7	1013	737	-

Table 2: Catch and catch limits by Research Block and in SSRU 882H in 2023 for *Dissostichus mawsoni* in Subarea 88.2. Source: Fine scale data.

Research Block	Catch limit	Catch (% of catch limit)
882_1	230	218 (94.8%)
882_2	268	116 (43.3%)
882_3	208	109 (52.4%)
882_4	185	174 (94.1%)
882H	122	102 (83.6%)

2.2. By-catch

Catch limits for by-catch species groups (*Macrourus* spp., skates and rays, and other species) are defined in Conservation Measures 41-01 and 33-03 and provided in Table 3. The total by-catch in SSRU 882H and in each of the Research Blocks is defined in Annex 41-10/A.

If the by-catch of any one species is equal to, or greater than, 1 tonne in any one haul or set, then the fishing vessel must move at least 5 nautical miles away for a period of at least five days (Conservation Measure 33-03).

Skates thought to have a high probability of survival are released at the surface in accordance with Conservation Measure 33-03.

Table 3. Reported catch and catch limits for by-catch species (*Macrourus* spp., skates and rays, and others) in this fishery (SSRUs 882C to 882I). see CM 33-03 for details. q: by-catch data currently quarantined. Source: fine-scale data.

Season	*Macrourus* spp.		Skates and rays			Other catch	
	Catch Limit (tonnes)	Reported Catch (tonnes)	Catch Limit (tonnes)	Reported Catch (tonnes)	Number Released	Catch Limit (tonnes)	Reported Catch (tonnes)
2003		18		0	0		8
2004	60	37	50	0	0	140	8
2005	60	20	50	0	0	140	3
2006	78	84	50	<1	865	100	12
2007	88	54	50	<1	0	100	13
2008	88	17	50	0	0	100	4
2009	90	58	50	<1	265	100	14
2010	92	49	50	0	0	100	15
2011	92	51	50	<1	168	100	13
2012	84	29	50	<1	0	120	11
2013	84	25 q	50	<1	0	120	8 q
2014	62	7 q	50	<1	28	120	3 q
2015	99	14 q	50	<1 q	192 q	120	6 q
2016	99	50 q	50	<1 q	861 q	120	2 q
2017	99	21 q	31	<1 q	314 q	99	2 q
2018	99	16 q	31	<1 q	104 q	99	2 q
2019	160	21	50	<1	217	160	3
2020	143	42	45	<1	571	143	5
2021	128	16	40	<1	194	128	3
2022	143	53	44	<1	1081	143	6
2023	159	24	49	<1	91	159	1

2.3. Vulnerable marine ecosystems (VMEs)

All Members are required to submit, within their general new (Conservation Measure 21-01) and exploratory (Conservation Measure 21-02) fisheries notifications requirements, information on the known and anticipated impacts of their gear on vulnerable marine ecosystems (VMEs, as shown in the CCAMLR VME taxa classification guide), including benthic communities and benthos such as seamounts, hydrothermal vents and cold-water corals. All of the VMEs in CCAMLR's VME Registry are currently afforded protection through specific area closures.

By the end of this fishing season, there were no VMEs and 17 VME Risk Areas designated in SSRUs 882C-H.

2.4. Incidental mortality of seabirds and marine mammals

The risk levels for birds in this fishery is category 1 (low) south of 65°S, category 3 (average) north of 65°S and overall is category 3 (SC-CAMLR-XXVIII, Annex 7, Table 14 and Figure 2).

Conservation Measure 25-02 applies to this fishery and in recent years has been linked to an exemption for night setting in Conservation Measure 24-02 and subject to a bird by catch limit. Offal and other discharges

are regulated under annual conservation measures (*e.g.*, Conservation Measures 41-09 and 41-10).

There have been no reports of incidental seabird mortalities in Subarea 88.2 in this fishery.

In 2020, one seal mortality was reported by a vessel in this fishery. In 2021, one Southern elephant seal mortality was reported by a vessel in this fishery.

3. Illegal, Unreported and Unregulated (IUU) fishing

Past estimates of Illegal, unreported and unregulated (IUU) catch in this fishery are shown in Table 1. Following the recognition of methodological issues regarding the estimation of IUU catch levels since 2011, evidence of IUU presence or activity has continued to be recorded but no corresponding estimates of the IUU catch for *D. mawsoni* have been provided (SC-CAMLR-XXIX, paragraph 6.5). One IUU-listed fishing vessel was observed in Subarea 88.2 in 2006 and 2010. Unmarked fishing gear, potentially from an IUU vessel, was reported in this Subarea in 2016.

4. Data collection

4.1. Data collection requirements

Extensive information about location, fishing effort, and catch is recorded by vessels and also documented by observers. The collection of biological data as part of the CCAMLR Scheme of International Scientific Observation (SISO) includes representative samples of length, weight, sex and maturity stage, as well as collection of otoliths for age determination of the target and most frequently taken by-catch species.

This fishery is managed under the umbrella of the exploratory fisheries Conservation Measure 41-01 and, as such, have an associated data collection plan (Annex 41-01/A), a research plan (Annex 41-01/B) and a tagging program (Annex 41-01/C).

4.2. Summary of available data

Following Conservation Measure 22-07, vessels participating in this fishery must report the occurrence of VME indicator organisms on hauled lines. To do so, the vessel's crew observe lines in segments (1000-hook sections or 1200m sections, whichever is the shorter) and report the number of VME indicator units (either one litre of those VME indicator organisms that can be placed in a 10-litre container, or one kilogram of those VME indicator organisms that do not fit into a 10-litre container). Depending on the number of VME indicator units landed, vessels must immediately report and potentially cease fishing in the area (termed a Risk Area) until further review of the data is completed (see Conservation Measure 22-07). Based on the portion of the line monitored, observers further identify VME indicator organisms to the lowest taxonomic level possible.

The vessel's crew report total catch of non-VME by-catch (mostly fishes) by coarse taxonomic groups given the taxonomic expertise required to discriminate similar species. Observers collect biological information on toothfish and by-catch specimens at a finer taxonomic resolution, as well as data on individual specimens such as size and maturity.

Summaries of data reported to CCAMLR for the past five years are given in Tables 4 and 5.

Table 4. Summary of VME indicator taxa by-catch, by-catch of other species and biological data reported by vessels crew and observers in each of the last five seasons. By-catch records correspond to the number of observations of total weight and count of individuals for each taxon identified. Observers may take further biological measurements on toothfish and by-catch taxa. Taxonomic identification may occur at different levels.

Data source	Data class	Variable	2019	2020	2021	2022	2023
Vessel crew	VME	line segments	4800	4276	2550	4352	3679
		VME indicator units > 5 and < 10	0	1	2	1	0
		VME indicator units > 10	0	1	0	0	0
	by-catch	taxa identified	22	23	16	19	30
		records	1269	1385	676	1024	844
Observer	VME	line segments	2790	1929	1389	1610	1315
		taxa identified	23	25	17	18	17
		weight or volume measurements	451	636	338	471	204
	toothfish	specimens examined	16097	11874	7092	11115	11271
		length measurements	16094	11870	7092	11115	11263
		weight measurements	15535	11381	7084	11085	10436
		sex identifications	16074	11870	7078	11097	11271
		maturity stage identifications	15192	11323	7060	11000	10413
		gonad weight measurements	12510	9389	6475	9651	7069
		otolith samples	5039	2850	2145	3206	2385
	by-catch	specimens examined	5213	4173	2831	2955	3295
		taxa identified	28	33	23	23	14
		length measurements	4586	4127	2397	2828	2991
		weight measurements**	4696	4161	2831	2955	3287
		standard length measurements*	863	640	613	594	593
		wingspan measurements*	18	107	2	28	0
		pelvic length measurements*	16	26	2	26	0
		snout to anus measurements*	3493	1967	1317	1668	2419
		sex identifications**	4417	2553	623	1681	2078
		maturity stage identifications**	4186	2275	554	1648	343
		gonad weight measurements**	184	76	34	848	35
		otolith samples**	199	43	239	13	73

*: Species-dependent records
**: Voluntary records

Table 5. Summary of biological data for predominant by-catch groups reported by observers (from random subsets of lines) in each of the last five seasons. Taxonomic identification may occur at different levels.

By-catch group	Variable	2019	2020	2021	2022	2023
Macrourus spp.	specimens examined	3508	1983	1326	1663	2427
	taxa identified	5	6	5	5	5
	length measurements	2890	1980	1019	1543	2124
	weight measurements**	3247	1978	1326	1663	2420
	snout to anus measurements*	3493	1967	1317	1663	2419
	sex identifications**	3143	1210	446	796	1816
	maturity stage identifications**	3106	1205	414	792	333
	gonad weight measurements**	132	38	34	334	34
	otolith samples**	191	42	239	1	45
Skates and rays	specimens examined	19	110	2	26	0
	taxa identified	4	5	1	4	0
	length measurements	17	109	2	26	0
	weight measurements**	15	109	2	26	0
	wingspan measurements*	18	107	2	26	0
	pelvic length measurements*	16	26	2	26	0
	sex identifications**	17	110	2	26	0
	maturity stage identifications**	12	40	2	24	0
	gonad weight measurements**	0	0	0	0	0
Other fish	specimens examined	1671	2038	1365	1243	867
	taxa identified	15	20	13	10	8
	length measurements	1669	2038	1363	1238	866
	weight measurements**	1419	2032	1365	1243	866
	standard length measurements*	859	638	604	594	593
	sex identifications**	1247	1233	175	838	262
	maturity stage identifications**	1068	1030	138	831	10
	gonad weight measurements**	52	38	0	514	1
	otolith samples**	8	1	0	12	28

*: Species-dependent records
**: Voluntary records

The counts of by-catch taxa reported above (Table 5) correspond to specimens that have been individually sampled by observers. These are a subset of all the specimens counted by observers and are generally identified at a more precise taxonomic level. The figures below (Figs. 3 and 4) display the distribution of the most frequently examined by-catch taxa in time and space. It is important to note that observers sample a random subset of lines and do not individually examine all taxa; as such these figures are more representative of the distribution of biological observations than the catch of these taxa or their spatial distribution. At a coarse taxonomic level, the total catch of by-catch species groups is provided in section 2.2 above.

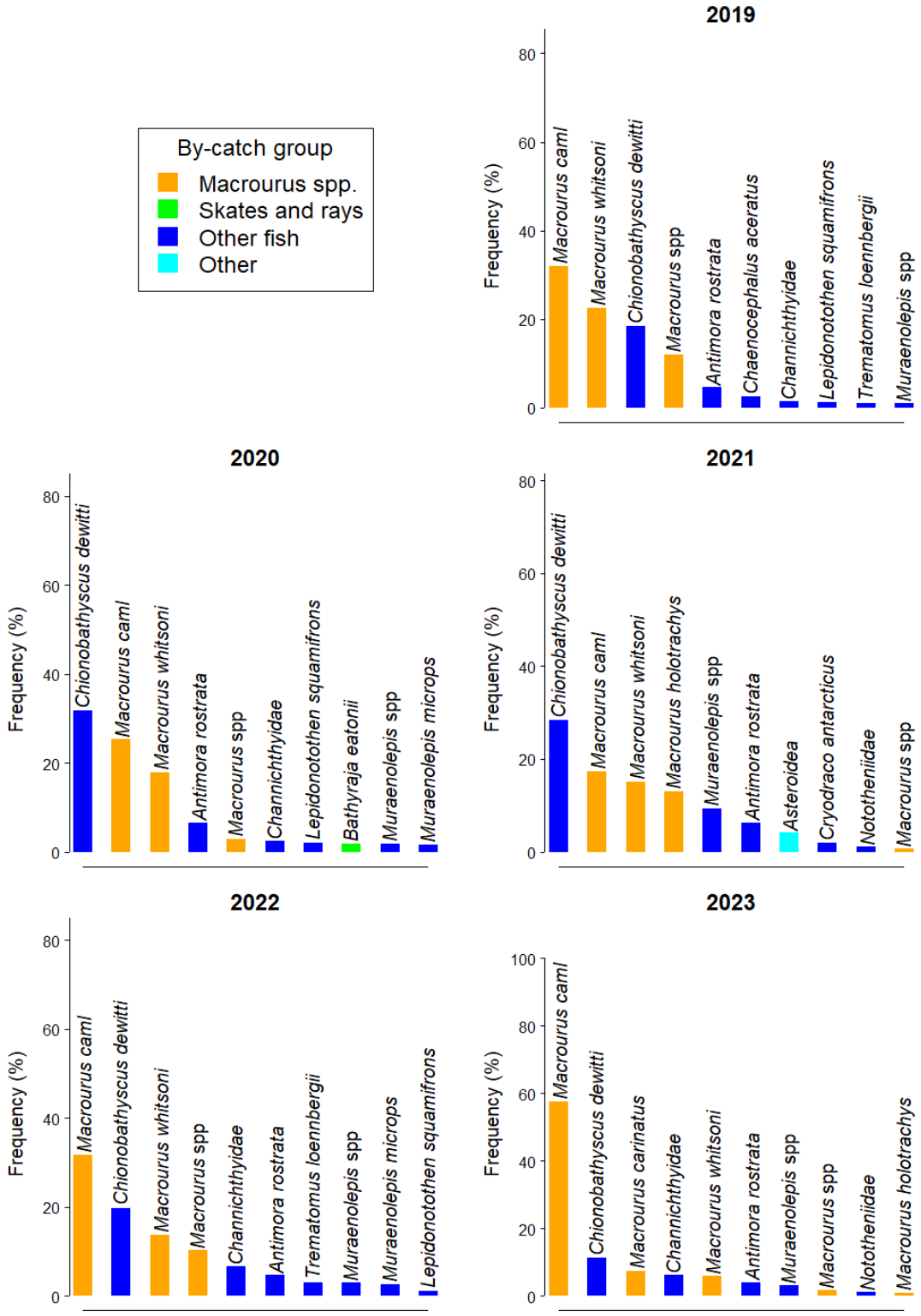

Figure 3. Relative frequencies of the most commonly examined by-catch taxa in each of the last five seasons, from the observer data (unweighted raw counts of individually examined specimens). Taxonomic identification may occur at different levels.

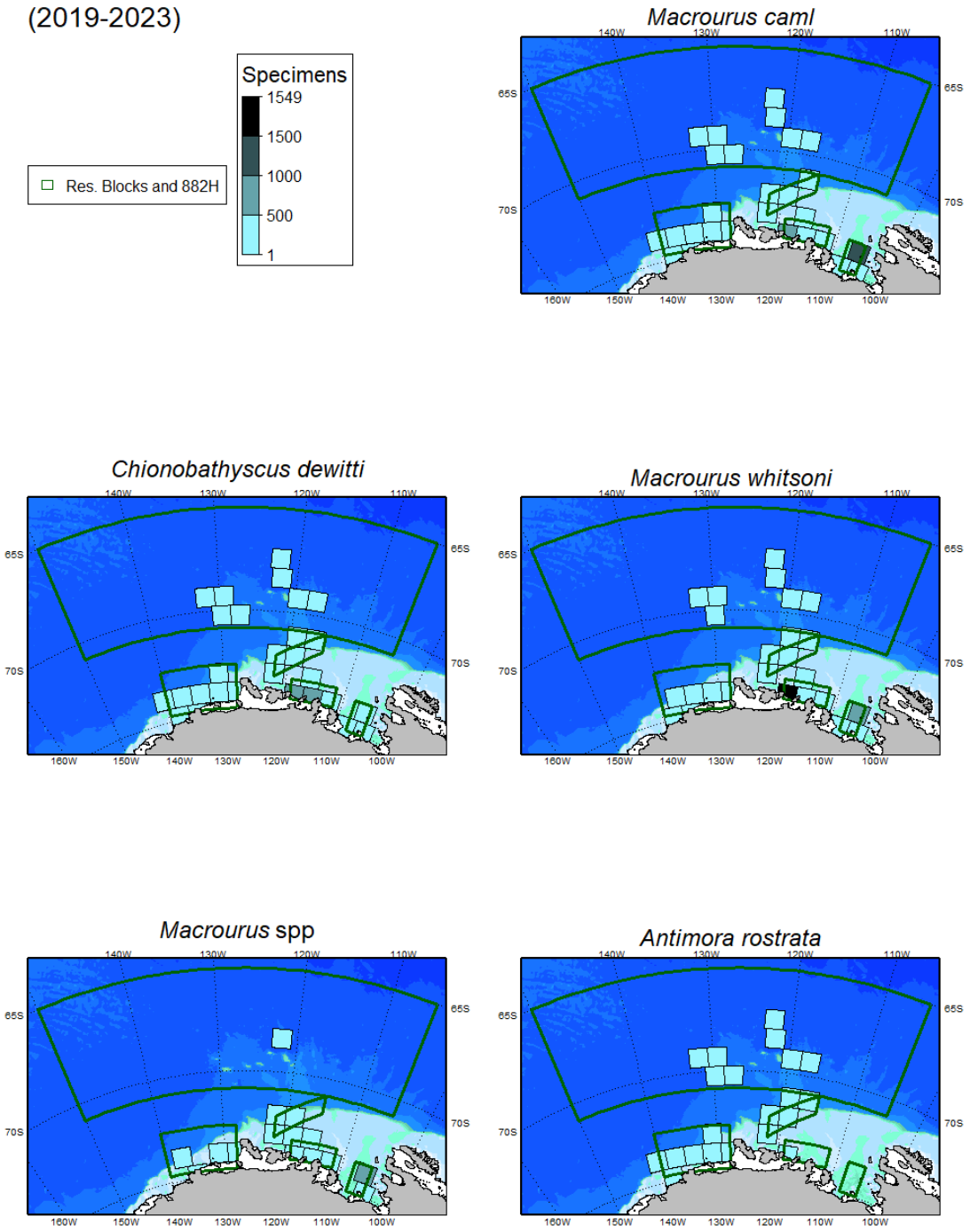

Figure 4. Spatial distribution of the most commonly examined by-catch taxa across the last five seasons, from the observer data (unweighted raw counts of individually examined specimens in each cell). The data were aggregated using equal area (100 km x 100 km) cells. Taxonomic identification may occur at different levels. Refer to Figure 1 for more details on the boundaries shown. Coastlines and ice shelves: UK Polar Data Centre/BAS and Natural Earth. Bathymetry: GEBCO. Projection: EPSG 6932 (rotated).

4.3. Length frequency distributions

The recent length frequency distributions of *D. mawsoni* caught in this fishery are shown in Figure 5. These length frequency distributions are unweighted; they have not been adjusted for factors such as the size of the catches from which they were collected. The interannual variability exhibited in the figure may reflect changes in the fished population but is also likely to reflect changes in the gear used, the number of vessels in the fishery and the spatial and temporal distributions of fishing.

The length frequency distribution of the *D. mawsoni* catch in SSRU 882H appears to be very stable with little evidence of change in length over time (Fig. 5). In the Research Blocks there is distinct bimodality and this is reflected in the overall length frequency distribution for the Subarea.

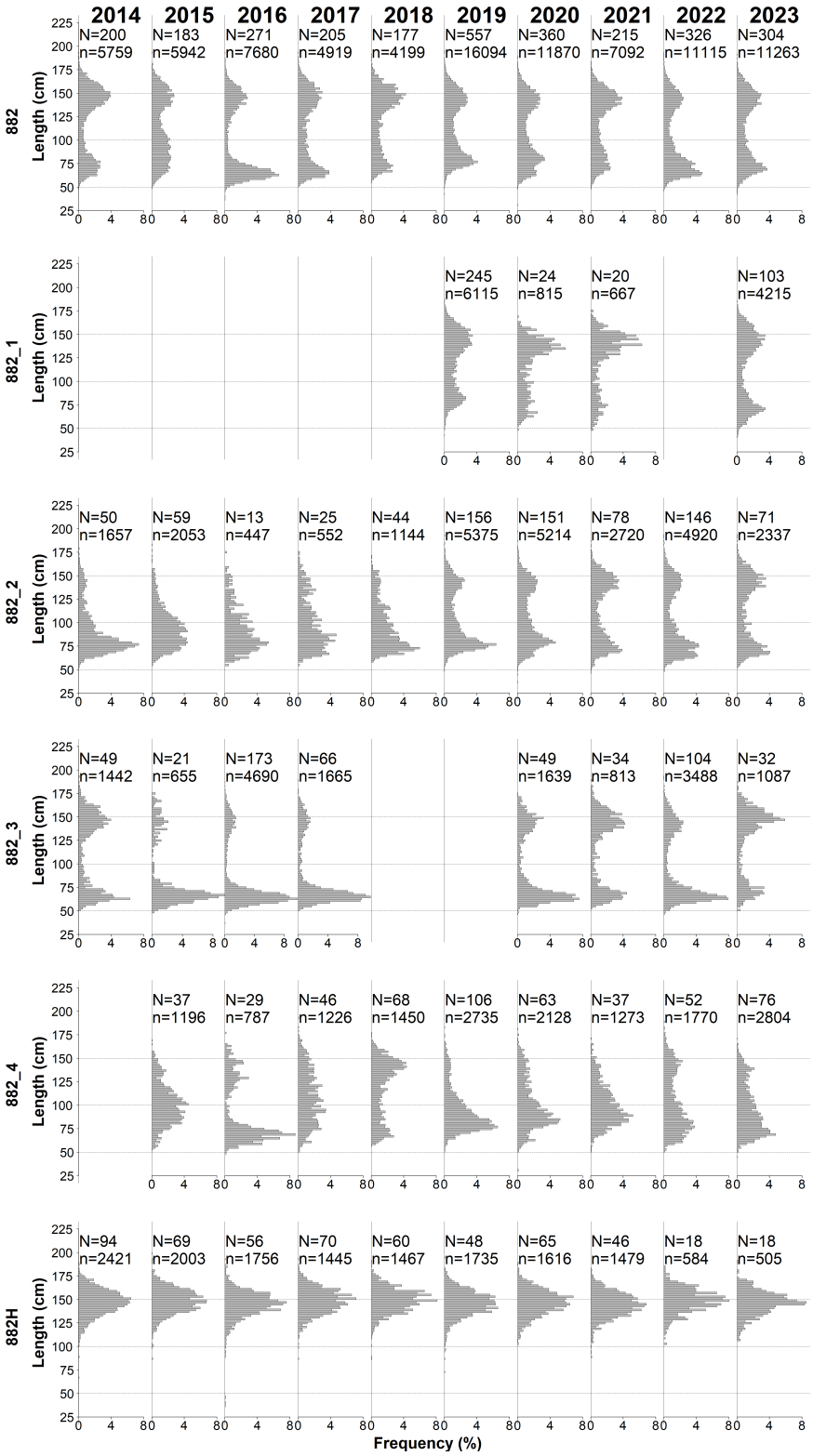

Figure 5. Annual length frequency distributions of *Dissostichus mawsoni* caught in this fishery (top panel) and its five areas. The number of hauls from which fish were measured (N) and the number of fish measured (n) in each year are indicated. Note: length frequency distributions are only shown where more than 150 fish were measured in a given season/area.

4.4. Tagging

Under Conservation Measure 41-01, each longline vessel fishing in exploratory fisheries for toothfish has been required to tag and release *D. mawsoni* and *D. eleginoides* according to the CCAMLR tagging protocol and the required tagging rate per tonne of green weight caught specified in the fishery-specific Conservation Measure. In order to ensure that there is sufficient overlap between the length distribution of those fish that are tagged by a vessel and of all the fish that are caught by that vessel, each vessel is required to achieve a minimum tag-overlap statistic of 60% (see Annex 41-01/C, footnote 3). To avoid low sample size artefacts, the requirement for a 60% tag-overlap statistic does not apply to vessels that tag at the required rate but tag less than 30 fish (Table 6).

To date in this area, 22292 *D. mawsoni* have been tagged and released (1043 have been recaptured; Table 7), and, 6 *D. eleginoides* have been tagged and released (4 have been recaptured).

Table 6. Annual tagging rate (number of fish tagged per tonne of total catch), reported by vessels operating in this exploratory fishery (SSRUs 882C to 882I). The tag-overlap statistics (CM 41-01) for *D. mawsoni* and *D. eleginoides* respectively are provided in brackets (NC: Tag-overlap statistic is Not Calculated for less than 30 fish tagged; -: no fish were tagged). In the last row, the tagging rate and tag-overlap statistic were computed using all fish tagged and all fish caught in the area.

		Fishing Season													
Flag State	Vessel name	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Argentina	Argenova XXI	1 (NC,-)													
Australia	Antarctic Chieftain						1.8 (87.6,-)								
Australia	Antarctic Discovery								3.2 (72.1,-)		3.1 (87.1,-)	3.1 (84.8,-)			3.1 (88.6,-)
Spain	Tronio	1.2 (49.5,NC)													3.2 (72.8,-)
Spain	Yanque							3.5 (87.3,-)							
United Kingdom	Argos Froyanes	1 (53.8,NC)	1 (75.4,-)	1 (65.5,NC)	1.1 (NC,-)	1.2 (75.5,-)		1.4 (88,-)		3.4 (70.3,-)		3.3 (91.5,-)			
United Kingdom	Argos Georgia	1.1 (NC,-)	1 (49.8,-)			1.2 (NC,-)		2.4 (86.5,-)				3.3 (79.3,-)	3.4 (91.7,-)		
United Kingdom	Argos Helena													3 (81.6,-)	
United Kingdom	Nordic Prince										3 (88.1,-)	3 (87.3,-)	3.5 (89.8,-)		
Republic of Korea	Blue Ocean													3.4 (85.2,-)	
Republic of Korea	Greenstar										3 (89,-)	3 (NC,-)			
Republic of Korea	Hong Jin No. 701				1.3 (NC,-)				3.2 (81,-)					3.2 (91.5,-)	3.3 (77.7,-)
Republic of Korea	Hong Jin No. 707		0.9 (72.6,-)	1.7 (61.8,-)							3.4 (NC,-)		3.2 (80.1,-)	3.5 (85.9,-)	
Republic of Korea	Jung Woo No. 3	1.1 (NC,-)	1.1 (84.4,-)												
Republic of Korea	Kingstar										3.5 (62.9,-)				3.9 (NC,-)
Republic of Korea	Kostar				1.1 (NC,-)	1 (NC,-)	3.1 (NC,-)								
Republic of Korea	Southern Ocean													3.2 (80.3,-)	3.3 (79.6,-)
Republic of Korea	Sunstar				1.1 (NC,-)	1 (64.8,-)	3.2 (77,-)	3.2 (83,-)			3.7 (NC,-)		3.9 (87.4,-)	3.2 (83.7,-)	
Norway	Argos Georgia									3.9 (77.9,-)					
Norway	Seljevaer				1.2 (NC,-)	1.1 (86.1,-)	2.9 (74,-)								
New Zealand	Antarctic Chieftain		1 (92.3,-)	1 (95.6,NC)	1.1 (85.5,-)	1 (80.2,-)									
New Zealand	Janas		1.1 (81.5,-)	1 (82.5,-)	1.1 (81.9,-)	1.4 (NC,-)		4.3 (94.1,NC)	10 (NC,-)						
New Zealand	San Aspiring		1.1 (77.2,-)									3.9 (78.9,-)			
Russian Federation	Chio Maru No. 3		1.4 (49,-)												
Russian Federation	Gold Gate		1.1 (75.6,-)												
Russian Federation	Mys Velikan									5 (NC,-)					
Russian Federation	Oladon 1							3.1 (82.7,-)							
Russian Federation	Palmer				1 (74.8,-)	1 (NC,-)		1.1 (60.6,-)							
Russian Federation	Sparta		1.2 (77.7,NC)	1.1 (61.5,NC)	1.2 (NC,-)	1 (NC,-)			3.3 (77.6,-)						
Russian Federation	Ugulan								3.3 (63.7,-)						
Russian Federation	Volk Arktiki										3.1 (92.3,-)				
Russian Federation	Yantar 31				2.2 (NC,-)	1 (NC,-)	3 (NC,-)	3.1 (77.7,-)							
Ukraine	Calipso										3.5 (78.9,-)	3.3 (83.2,-)	3.1 (93.3,-)	3.4 (88.6,-)	3.1 (82,-)
Ukraine	Koreiz										3.1 (67.6,-)	3 (64.5,-)		3 (63.3,-)	
Ukraine	Marigolds								3.5 (NC,-)	3.8 (NC,-)	4.1 (NC,-)		3.1 (84.7,-)	3.2 (76.8,-)	3 (80,-)
Ukraine	Polus 1											2.7 (NC,-)			
Ukraine	Simeiz				1.7 (NC,-)	1.2 (NC,-)					3.2 (64.3,-)	3.8 (NC,-)	3.1 (77.5,-)	3.5 (85,-)	
Uruguay	Altamar										3.1 (86.7,-)				
Uruguay	Badaro									3.2 (69.2,-)					
Uruguay	Ocean Azul													3.4 (82.9,-)	
Uruguay	Proa Pioneer								3.2 (67.6,-)	3 (63.6,-)	3.1 (81.9,-)	3 (87.5,-)			
Uruguay	Ross Star		1.1 (NC,-)												
Total		**1 (53.4,NC)**	**1.1 (85.5,NC)**	**1.1 (73.8,NC)**	**1.1 (84.9,-)**	**1.1 (76.5,-)**	**2.4 (80.5,-)**	**2.4 (92.7,NC)**	**3.2 (86.3,-)**	**3.2 (79.6,-)**	**3.1 (93.7,-)**	**3.1 (90.2,-)**	**3.2 (94.5,-)**	**3.2 (91.7,-)**	**3.1 (89.8,-)**

Table 7. Number of *D. mawsoni* tagged in recent fishing Seasons in this exploratory fishery (SSRUs 882C to 882I). The number of fish recaptured by each vessel in each Season is provided in brackets.

		Fishing Season													
Flag State	Vessel name	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Argentina	Argenova XXI	8 (0)													
Australia	Antarctic Chieftain						385 (26)								
Australia	Antarctic Discovery								476 (4)		553 (12)	463 (66)			802 (62)
Spain	Tronio	52 (4)													364 (0)
Spain	Yanque							57 (1)							
United Kingdom	Argos Froyanes	250 (38)	68 (2)	210 (49)	15 (4)	67 (3)		262 (8)		337 (11)		110 (10)			
United Kingdom	Argos Georgia	9 (1)	58 (13)			13 (5)		78 (2)				96 (4)	285 (16)		
United Kingdom	Argos Helena													406 (28)	
United Kingdom	Nordic Prince										194 (11)	429 (19)	292 (9)		
Republic of Korea	Blue Ocean													63 (4)	
Republic of Korea	Greenstar										236 (4)	12 (0)			
Republic of Korea	Hong Jin No. 701				7 (0)				545 (0)					127 (0)	106 (3)
Republic of Korea	Hong Jin No. 707		40 (3)	38 (1)							13 (0)		72 (0)	358 (2)	
Republic of Korea	Jung Woo No. 3	6 (0)	35 (0)												
Republic of Korea	Kingstar										50 (2)				26 (0)
Republic of Korea	Kostar				11 (0)	10 (0)	5 (0)								
Republic of Korea	Southern Ocean													69 (0)	97 (1)
Republic of Korea	Sunstar				8 (1)	33 (1)	76 (0)	73 (0)			26 (0)		41 (0)	45 (0)	
Norway	Argos Georgia									45 (2)					
Norway	Seljevaer				9 (1)	30 (0)	449 (20)								
New Zealand	Antarctic Chieftain		46 (1)	59 (9)	321 (42)	170 (19)									
New Zealand	Janas		30 (3)	99 (17)	62 (0)	21 (0)		323 (0)	1 (0)						
New Zealand	San Aspiring		190 (17)									46 (1)			
Russian Federation	Chio Maru No. 3		44 (2)												
Russian Federation	Gold Gate		44 (16)												
Russian Federation	Mys Velikan									2 (0)					
Russian Federation	Oladon 1							101 (0)							
Russian Federation	Palmer				55 (3)	24 (0)		44 (2)							
Russian Federation	Sparta		50 (3)	36 (10)	12 (3)	27 (0)			178 (0)						
Russian Federation	Ugulan								61 (0)						
Russian Federation	Volk Arktiki										159 (2)				
Russian Federation	Yantar 31				2 (0)	13 (0)	18 (0)	86 (0)							
Ukraine	Calipso										52 (1)	76 (0)	330 (5)	105 (1)	379 (6)
Ukraine	Koreiz										282 (18)	478 (35)		362 (13)	
Ukraine	Marigolds								13 (0)	5 (0)	13 (0)		226 (9)	461 (12)	529 (8)
Ukraine	Polus 1											21 (0)			
Ukraine	Simeiz				4 (0)	12 (0)					248 (8)	21 (2)	473 (18)	42 (4)	
Uruguay	Altamar										352 (13)				
Uruguay	Badaro									208 (9)					
Uruguay	Ocean Azul													111 (2)	
Uruguay	Proa Pioneer								216 (5)	408 (18)	184 (14)	243 (9)			
Uruguay	Ross Star		16 (0)												
Total		**325 (43)**	**621 (60)**	**442 (86)**	**506 (54)**	**420 (28)**	**933 (46)**	**1024 (13)**	**1490 (9)**	**1005 (40)**	**2362 (85)**	**1995 (146)**	**1719 (57)**	**2149 (66)**	**2303 (80)**

5. Research

5.1. Status of the science

Catch and Effort

Details of catch and effort for this fishery were updated for 2021 in WG-FSA-2022/50. The data are used to develop the catch limits using the trend analysis but data collection is also designed to provide the information necessary to inform a future integrated stock assessment.

Age composition

Little age information is currently available to develop annual age-length keys, particularly in the South. Because of this, data from years that had information were pooled to create a single age-length key for all years. Pooling information may mask changes in the age composition of the catch if length at age varies spatially or through time, further emphasizing the need for more age information. Overall, fish are smaller and younger in the South, but the data show two distinct size modes, of which, the relative magnitude depends on where fishing occurs in a given year. The youngest fish sampled in the South were four years old. The large mode of older fish in 2012 and 2013 is due to fishing that occurred in research block 882_1 in SSRU 882G (WG-FSA-2022/50).

Tag-recapture data

In the South, the required tagging rate for commercial fishing was increased from 1 fish per tonne of catch to 3 fish per tonne beginning in the 2015 season (in addition to constraining fishing to four Research Blocks). The required tagging rate for the North remained at 1 fish per tonne of catch for 2015 and 2016 but increased to 3 fish per tonne from the 2017 season (Conservation Measure 41-10). Tag recapture data are used for mark-recapture biomass estimation and also to detect movements related to stock structure.

In 2023, WG-FSA-2023/62 presented a characterisation of the fishing and tagging programme in the Amundsen Sea Region. It highlighted that there was an improvement in the numbers of recaptures of tagged toothfish within the four research blocks. However, data on recaptured fish was limited due to an uneven distribution of fishing effort on the seamounts in SSRU 882H.

Antarctic toothfish diet and genetics

In 2022, WG-FSA-2022/28 presented analyses of diet spatial variations of Antarctic toothfish. Macrouridae, *Chionobathyscus dewitti* and Mollusks were found to be dominant prey items, and diet was found to differ between slope and shelf areas, reflecting the different prey assemblages between these areas. A genetic study using microsatellite markers (WG-FSA-2022/29 Rev. 1) reported a higher genetic diversity in the Ross Sea region than other areas within Area 88.

5.2. Research plans

No research plans under Conservation Measure 24-01 targeting toothfish have been proposed for this fishery. The Scientific Committee did agree a temporary, but ongoing, research plan in 2014 to provide fishery structure on the Continental slope and shelf (SSRUs 882C-G), and to collect the necessary data for a stock assessment.

An alternative plan for structuring the fishery in the South (SSRU 882H) was needed to improve mark recapture data and to better index the biomass for the seamount complex (see WG-FSA-2021/29). In 2022,

the Scientific Committee revised the spatial management within SSRU 882H to spread fishing effort among seamounts to improve the representativeness of mark recapture data for the seamount complex rather than single seamounts (see section 1.4).

6. Stock status

6.1. Summary of current status

As a data-limited fishery, this fishery does not have such estimates.

6.2. Assessment method

Catch limits are determined annually for the research blocks and SSRU 882H using the trend analysis while data are collected to inform an integrated stock assessment (SC-CAMLR-38, Paragraphs 3.141-3.143).

6.3. Year of last assessment, year of next assessment

Catch limits for data-limited fisheries are reviewed annually.

7. Climate Change and environmental variability

The impact of Anthropogenic climate change in the short-term could be expected to be related to changes in sea ice and physical access to fishing grounds, whereas longer-term implications are likely to include changes in ecosystem productivity affecting target stocks (FAO 2018).

In anticipation of potential impacts of climate change on targeted fish stocks, the Scientific Committee indicated that changes in productivity parameters may impact assessments and management advice, and these changes may be related to long-term environmental change, shorter-term variability, or potential effects of fishing (SC-CAMLR-XXXVII paragraph 3.51, Annex 9 paragraph 2.28).

The parameters that could be evaluated for the effects of environmental variability and change would include mean recruitment, recruitment variability, mean length-at-age, mean weight-at-length, natural mortality, and maturation ogives.

Other factors that may impact assumptions underlying the assessments that could also be considered, including stock distribution (for example, for its impact on tagged fish distribution or research survey interpretation), sex ratio (indicating maturation or other sex specific changes), and the ages or lengths observed in the fishery (indicating changes in vulnerability patterns or mortality).

In 2022, the Commission recognised that climate change is already having effects in the Convention Area (CCAMLR-41, paragraph 6.3) and agreed that it needed to act urgently to prepare for, and adapt to, the effects of climate change on the marine ecosystems within the Convention Area (CCAMLR-41, paragraph 6.5). The Commission noted (CCAMLR-41, paragraph 6.4) that the Scientific Committee had incorporated climate change into its advice (SC-CAMLR-41, paragraph 7.8) and through discussions at the SC-Symposium (SC-CAMLR-41, Annex 11) had also added climate change to the work plans and terms of reference of its Working Groups (SC-CAMLR-41, paragraph 7.14). The Commission adopted (CCAMLR-41, paragraph 6.28) Resolution 36/41.

In 2023, the Scientific Committee held a workshop on Climate Change (WS-CC-2023) which made recommendations regarding monitoring and management actions CCAMLR could progress to document and track the effects of climate change in the Convention Area. The recommendations were incorporated into the workplan of the Scientific Committee. Further, the Scientific Committee recommended that summaries of evidence for changes in stock assessment parameters or processes that could be due to the effects of environmental variability or climate change be developed for all fisheries (SC-CAMLR-42, paragraph 2.149).

Additional Resources

- Fishery Summary: pdf, html
- Species Description: pdf, html
- Trend Analysis: pdf, html
- Fisheries Documents Browser