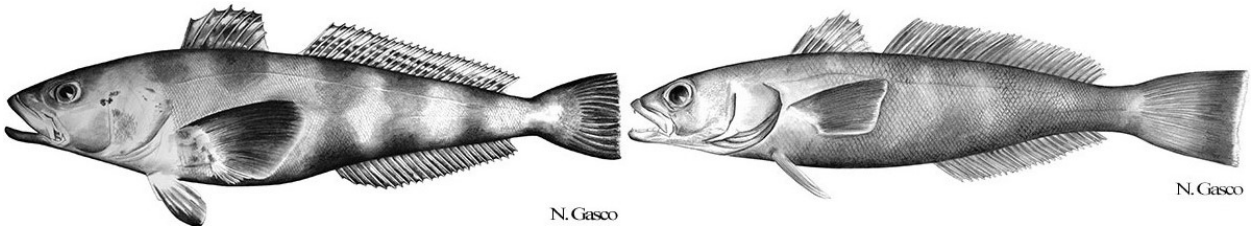
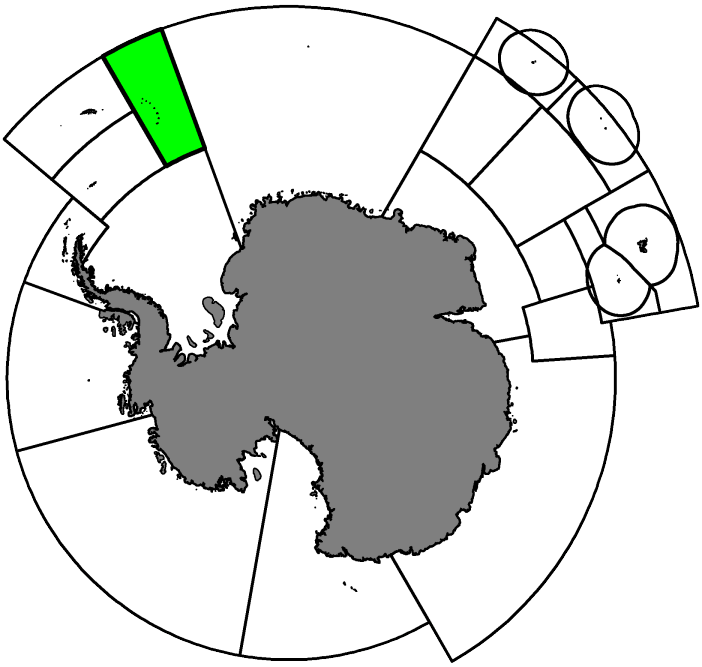
Fishery Report 2022: *Dissostichus eleginoides* and *Dissostichus mawsoni* in Subarea 48.4

CCAMLR Secretariat

12 April 2023



Antarctic toothfish, *Dissostichus mawsoni* Norman, 1937, and, Patagonian toothfish, *Dissostichus eleginoides* Smitt, 1898.



Map of the management areas within the CAMLR Convention Area. Subarea 48.4, the region discussed in this report is shaded in green. Throughout this report, "2022" refers to the 2021/22 CCAMLR fishing season (from 1 December 2021 to 30 November 2022).

Contents

1. Introduction to the fishery

1.1. History

This report describes the longline fishery for Patagonian (*Dissostichus eleginoides*) and Antarctic (*D. mawsoni*) toothfish in Subarea 48.4.

The fishery for *D. eleginoides* in Subarea 48.4 was initiated as a new fishery in 1993 following notifications from Chile and the USA (SC-CAMLR-XI, Annex 5, paragraph 6.22), and the adoption of Conservation Measure 44/XI, which set a precautionary catch limit for *D. eleginoides* of 240 tonnes for that season. Subsequently, the USA withdrew from the fishery and the Chilean longline vessel abandoned fishing after one week of poor catches (SC-CAMLR-XII, Annex 5, paragraph 6.2). In addition, a Bulgarian-flagged longliner fished in November and December 1992 and reported a catch of 39 tonnes of *D. eleginoides* (SC-CAMLR-XII, Annex 5, paragraph 6.1).

There was no further fishing activity in Subarea 48.4 until 2005 when a mark-recapture experiment was initiated.

1.2. Conservation Measures currently in force

The limits on the established fishery for *Dissostichus* spp. in Subarea 48.4 are defined in Conservation Measure 41-03.

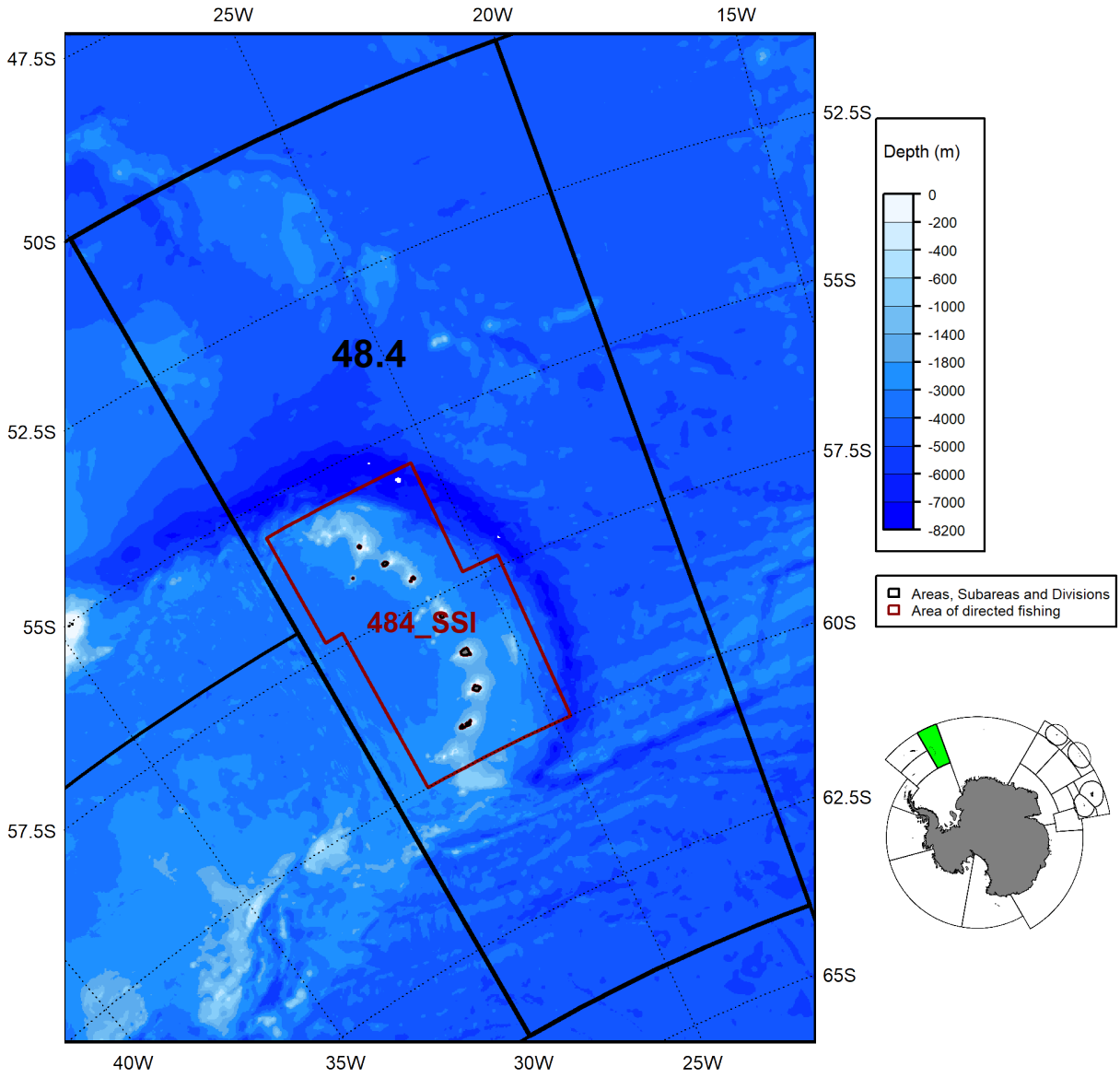


Figure 1: Location of the area of directed fishing in Subarea 48.4.

1.3. Active vessels

In 2022, 1 vessel participated in this fishery.

1.4. Timeline of spatial management

In 2008, the Commission agreed to divide Subarea 48.4 into a northern area (Subarea 48.4N) and a southern area (Subarea 48.4S) with directed longline fisheries of *D. eleginoides* in Subarea 48.4N and *Dissostichus* spp. in Subarea 48.4S with a single catch limit applied to both species.

In 2014, the management approach in this Subarea was changed and rather than using the northern and

southern areas, separate catch limits were set for each species within the directed fishing area specified in Conservation Measure 41-03 (see Fig. 1).

2. Reported catch

2.1. Latest reports and limits

Reported catches of *Dissostichus* spp. are presented in Table 1. In this fishery, the catch of *D. eleginoides* reached a maximum of 98 tonnes in 2008. In 2022, 14 tonnes of *D. eleginoides* and 32 tonnes of *D. mawsoni* were caught.

Table 1. Catch (tonnes) and effort history for *Dissostichus* spp. in this fishery. The separate catch limits for *D. eleginoides* and *D. mawsoni* from 2014 onwards are shown here separated by a semicolon (-: no IUU estimate available). Source: Fine scale data.

Season	Number of vessels	Catch limit (tonnes)	*D. eleginoides*	*D. mawsoni*	Estimated IUU catch (tonnes)
1990	1		0	0	-
1992	1		27	0	-
1993	1		12	0	-
2005	1	100	27	0	-
2006	2	100	19	0	-
2007	2	100	54	0	-
2008	2	100	98	0	-
2009	2	150	74	59	-
2010	2	116	57	56	-
2011	2	70	39	15	-
2012	2	81	55	22	-
2013	2	115	72	40	-
2014	2	44 ; 24	44	24	-
2015	2	42 ; 28	42	28	-
2016	2	47 ; 39	42	28	-
2017	2	47 ; 38	28	19	-
2018	2	26 ; 37	17	32	-
2019	2	26 ; 37	17	33	-
2020	2	27 ; 45	19	44	-
2021	2	27 ; 45	16	43	-
2022	1	23 ; 50	14	32	-

2.2. By-catch

Catch limits for by-catch species groups (*Macrourus* spp., skates and rays, and other species) are defined in Conservation Measure 41-03.

As defined in Conservation Measure 41-03, if the by-catch of skates exceeded 5% of the catch of *Dissostichus* spp. in any one haul or set, or if the catch of *Macrourus* spp. reached 150kg and exceeds 16% of the catch of *Dissostichus* spp. 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.

In addition to the mitigation measures described in Conservation Measure 41-03, skates are handled and released following 'Year-of-the-Skate' protocols to maximise their survival.

Catches of by-catch species groups (*Macrourus* spp., skates and rays, and other species) and number of skates released alive, are summarised in Table 2. The by-catch limits in Subarea 48.4 (as set out in Conservation Measure 41-03) have changed with the development of the fishery research: prior to 2009 there were no specified limits, from 2009 to 2013 there was an overall by-catch limit for macrourids and skates in area 48.4N and a move-on rule provision in Subarea 48.4S, and in 2014, with the introduction of species-specific catch limits for the two target species, whole-fishery catch limits for macrourids and skates were introduced.

Table 2. Reported catch and catch limits for by-catch species (*Macrourus* spp., skates and rays, and others) in this fishery (see Conservation Measure 41-03 for details). Source: fine-scale data.

	Macrourus spp.		Skates and rays			Other catch	
Season	Catch Limit (tonnes)	Reported Catch (tonnes)	Catch Limit (tonnes)	Reported Catch (tonnes)	Number Released	Catch Limit (tonnes)	Reported Catch (tonnes)
1990		<1		<1	0		<1
1992		0		0	0		0
1993		0		0	0		0
2005		3		0	0		<1
2006		5		1	4359		<1
2007		14		2	6515		<1
2008		16		4	8276		<1
2009		26		2	9767		1
2010		16		2	6183		1
2011		5		<1	4680		<1
2012		7		<1	5582		<1
2013		6		<1	3115		<1
2014	11	3	3.5	<1	1124		<1
2015	11.2	4	3.5	<1	624		<1
2016	13.8	3	4.3	<1	1203		<1
2017	13.6	4	4.3	<1	1549		<1
2018	10.1	5	3.2	2	1768		<1
2019	10.1	4	3.2	<1	1750		<1
2020	11.5	3	3.6	<1	2322		<1
2021	11.5	8	3.6	<1	2016		<1
2022	12	10	4	<1	3784		<1

The distribution of skates and macrourids in Subarea 48.4 has been investigated and their distributions described in WG-FSA-09/17 and WG-FSA-09/18.

Catch rates for macrourids in the north of Subarea 48.4 were high at the start of the fishery. Vessels subsequently altered their fishing techniques and areas to avoid macrourid by-catch and rates dropped (Table 2).

Macrourid catches were previously thought to be almost entirely comprised of Whitson's grenadier (*Macrourus whitsoni*). Subsequent taxonomic studies (including genetic analyses) now indicate that the Macrourid population comprises two species, including *M. whitsoni* and the recently described species *Caml* grenadier (*M. caml*) (WG-FSA-10/33; McMillan et al., 2012).

2.3. Vulnerable marine ecosystems (VMEs)

As Conservation Measure 22-06 does not apply to this subarea there are no CCAMLR VMEs or VME Risk Areas designated in Subarea 48.4. There are fishery-specific restrictions in place to mitigate the impact of the fishery on VMEs, including benthic communities and benthos such as seamount and hydrothermal vent communities and cold-water corals.

2.4. Incidental mortality of seabirds and marine mammals

In 2017 one Southern giant petrel (*Macronectes giganteus*), and in 2022 one grey-headed albatross (*Thalassarche chrysostoma*) were killed in this fishery. There have been no reported mammal mortalities reported by vessels in this fishery.

The level of risk of incidental mortality of birds in Subarea 48.4 is category 3 (medium) (SC-CAMLR-XXX, Annex 8, paragraph 8.1).

Conservation Measure 25-02 on minimisation of the incidental mortality of birds in longline fishing applies to this Subarea. Conservation Measure 41-03 also stipulates that if any vessel catches three seabirds in a season then that vessel must only set longlines at night.

3. Illegal, Unreported and Unregulated (IUU) fishing

Data on potential illegal, unreported and unregulated (IUU) fishing in this Subarea is limited to sightings from licenced vessels (including fishing vessels, expedition yachts and research ships). There has been no recorded evidence of IUU fishing activities in Subarea 48.4 since 2006.

4. Data collection

4.1. Data collection requirements

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.

4.2. Summary of available data

Both the vessel's crew and observers collect fishing effort, catch, and by-catch information.

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.

Conservation Measures 22-06 and 22-07 do not apply to this fishery.

Summaries of data reported to CCAMLR for the past five years are given in Tables 3 and 4.

Table 3. Summary of by-catch 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	2018	2019	2020	2021	2022
Vessel crew	by-catch	taxa identified	12	7	5	9	7
		records	273	225	183	242	273
Observer	toothfish	specimens examined	1346	1270	1050	910	1186
		length measurements	1346	1268	1050	910	1186
		weight measurements	1345	1265	1047	819	751
		sex identifications	1346	1270	1048	829	769
		maturity stage identifications	1342	1259	1044	825	768
		gonad weight measurements	1340	1256	1035	823	678
		otolith samples	739	758	622	465	365
	by-catch	specimens examined	833	917	517	351	621
		taxa identified	8	6	8	8	9
		length measurements	833	915	212	351	620
		weight measurements**	831	912	515	348	613
		standard length measurements*	0	0	27	0	0
		wingspan measurements*	142	95	31	63	31
		pelvic length measurements*	142	95	31	64	31
		snout to anus measurements*	474	591	424	157	387
		sex identifications**	815	917	334	347	30
		maturity stage identifications**	789	916	299	342	26
		gonad weight measurements**	246	1	0	197	0
		otolith samples**	2	0	223	0	0

*: Species-dependent records

**: Voluntary records

Table 4. 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	2018	2019	2020	2021	2022
Macrourus spp.	specimens examined	474	591	414	157	387
	taxa identified	3	2	2	3	3
	length measurements	474	590	119	157	387
	weight measurements**	474	591	412	157	387
	snout to anus measurements*	474	591	414	157	387
	sex identifications**	464	591	252	157	0
	maturity stage identifications**	462	591	232	153	0
	gonad weight measurements**	146	0	0	107	0
	otolith samples**	0	0	207	0	0
Skates and rays	specimens examined	142	95	31	64	31
	taxa identified	1	1	1	1	1
	length measurements	142	95	31	64	30
	weight measurements**	142	90	31	61	23
	wingspan measurements*	142	95	31	63	31
	pelvic length measurements*	142	95	31	64	31
	sex identifications**	135	95	31	62	30
	maturity stage identifications**	112	94	31	63	26
	gonad weight measurements**	0	1	0	19	0
Other fish	specimens examined	217	231	72	130	203
	taxa identified	4	3	5	4	5
	length measurements	217	230	62	130	203
	weight measurements**	215	231	72	130	203
	standard length measurements*	0	0	27	0	0
	sex identifications**	216	231	51	128	0
	maturity stage identifications**	215	231	36	126	0
	gonad weight measurements**	100	0	0	71	0
	otolith samples**	0	0	16	0	0

*: Species-dependent records
**: Voluntary records

The counts of by-catch taxa reported above (Table 4) 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. 2 and 3) 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.

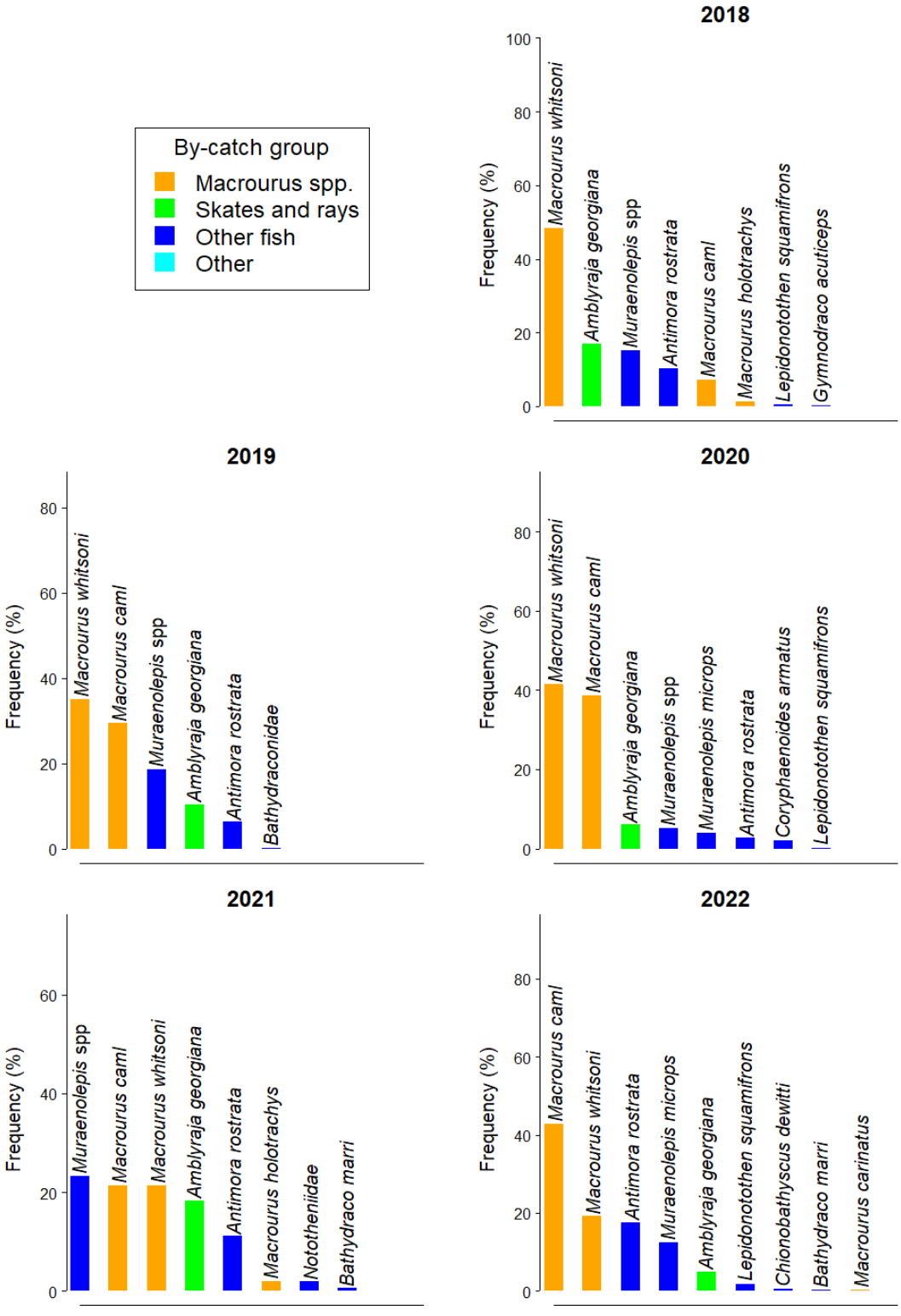


Figure 2. Relative frequencies of the most commonly examined by-catch taxa in each of the last five seasons, from the observer data (unweighted raw counts of individually examined specimens). Taxonomic identification may occur at different levels.

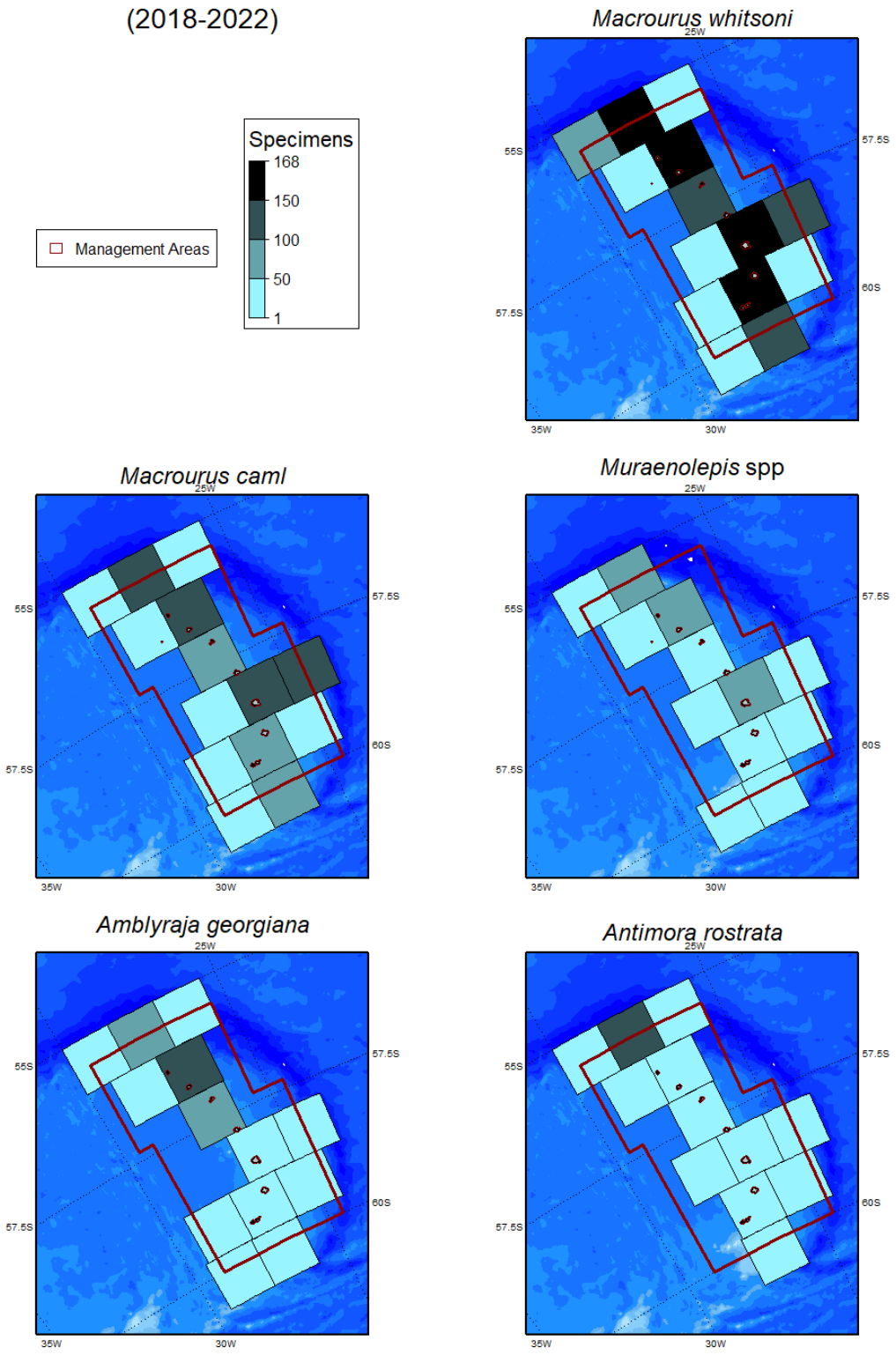


Figure 3. Spatial distribution of the most commonly examined by-catch taxa across the last five seasons, from the observer data (unweighted raw counts of individually examined specimens in each cell). The data were aggregated using equal area (100 km x 100 km) cells. Taxonomic identification may occur at different levels. Refer to Figure 1 for more details on the boundaries shown.

4.3. Length frequency distributions

The recent length frequency distributions of *D. eleginoides* and *D. mawsoni* caught in this fishery are presented in Figures 4 and 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 *D. eleginoides* caught in Subarea 48.4 shows a shifting mode from around 120 cm at the beginning of the time series to 140 cm in recent years (Figure 4). A second mode of smaller fish (75cm) is evident in 2013 and develops throughout the remainder of the time series, indicating a recruitment pulse.

The length frequency distribution of *D. mawsoni* (Figure 5) is dominated by a single strong mode around 150cm and does not show any cohort progression between years as observed in the length frequency distributions of *D. eleginoides*.

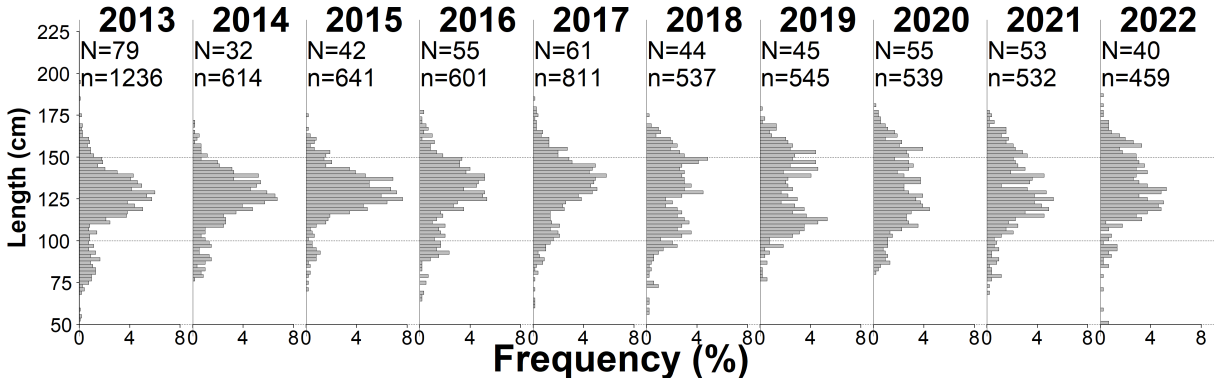


Figure 4. Annual length frequency distributions of *D. eleginoides* caught in Subarea 48.4. The number of hauls from which fish were measured (N) and the number of fish measured (n) in each year are indicated. Note: length frequency distributions are only shown where more than 150 fish were measured in a given season.

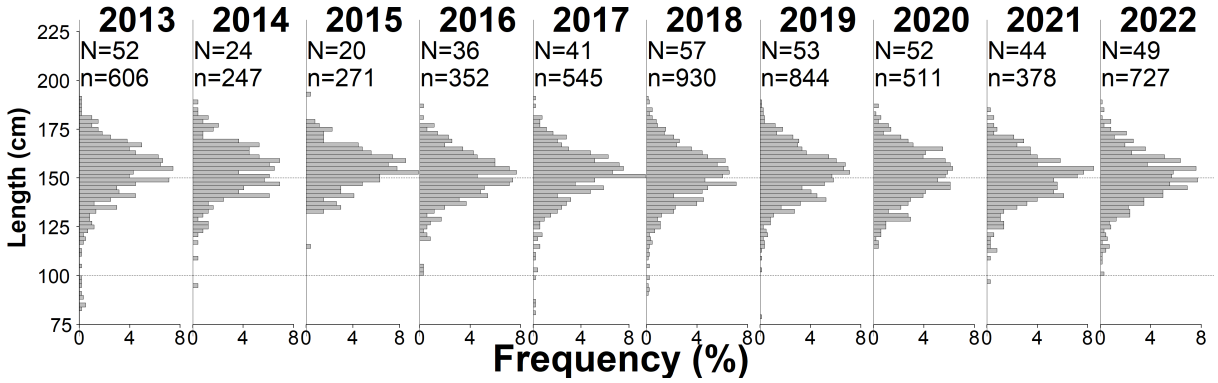


Figure 5. Annual length frequency distributions of *Dissostichus mawsoni* caught in Subarea 48.4. The number of hauls from which fish were measured (N) and the number of fish measured (n) in each year are indicated. Note: length frequency distributions are only shown where more than 150 fish were measured in a given season.

4.4. Tagging

In 2005, the UK conducted a pilot tagging program using a longline fishing vessel. Following the pilot study, the Commission agreed to continue the tagging experiment in Subarea 48.4.

Since 2012, vessels have been required to tag and release *Dissostichus* spp. at a minimum rate of 5 fish per tonne of green weight caught. All vessels which have fished in Subarea 48.4 have exceeded the minimum required tagging rate. Tagging data now underpin stock assessments for Subarea 48.4.

The tag-overlap statistic estimates the similarity between the size distributions of those fish that are tagged by a vessel and of all the fish that are caught by that vessel. In exploratory fisheries since 2015, each vessel releasing more than 30 tagged fish of each species of *Dissostichus* is required to achieve a minimum tag-overlap statistic of 60% (Annex 41-01/C). Vessels fishing in Subarea 48.4 have exceeded this requirement.

To date in this area, 2790 *D. mawsoni* have been tagged and released (181 have been recaptured, 164 of which were released in this area; Table 5), and, 4226 *D. eleginoides* have been tagged and released (567 have been recaptured, 535 of which were released in this area; Table 6).

One tagged *D. eleginoides* has also moved into Subarea 48.4 from Subarea 48.3 (WG-FSA-14/29 Rev. 1; WG-FSA-17/06). One *D. mawsoni* tagged in Subarea 48.4 was reported recaptured in Subarea 88.2 after three years at liberty. During the survey in the south of Subarea 48.4, 85 *D. mawsoni* were tagged and none recaptured.

WG-FSA-09/17, WG-FSA-09/18 and WG-FSA-16/40 Rev. 1 provided a comprehensive analysis of the catch distribution of the two *Dissostichus* species in Subarea 48.4.

Table 5. Number of *Dissostichus mawsoni* tagged and recaptured in the area for each fishing season.

		Recaptured													
Season	Tagged	2009	2010	2011	2012	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
2006	10														
2007	1														
2009	193	2	15	3	2										**22**
2010	202		6	4		1									**11**
2011	83				1		1								**2**
2012	147														
2013	179					1		1	1	2					**5**
2014	191						13	1	1	1					**16**
2015	584							12	5	1	1				**19**
2016	149							8	5	2	1	1			**17**
2017	104									3	3		1		**7**
2018	161									3	1	1	1		**6**
2019	168										2	6	3		**11**
2020	229												16	3	**19**
2021	224												12	15	**27**
2022	165													2	**2**
Total	**2790**														**164**

Table 6. Number of *Dissostichus eleginoides* tagged and recaptured in the area for each fishing season.

		Recaptured																
Season	Tagged	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
2005	42		2	2		1				1								**6**
2006	134	2	8	5	2	1	1	2			2	1						**24**
2007	291		13	12	1	4	5	4	2	1			2	2				**46**
2008	504			8	11	7	11	10	4	3	6	6	2	3	2	1		**74**
2009	558			3	16	12	11	8	2	5	3	3		1	4	1		**69**
2010	418				2	12	2	12	4	1	4	2	2	2	3		1	**47**
2011	222							2	3		4	2	1	1	1		1	**15**
2012	302							7	3	2	2	2	5	3	1		1	**26**
2013	470								23	19	15	7	1	4	3	2	4	**78**
2014	223									20	12	9	1	2	2	1	2	**49**
2015	226										11	12	7	4	1	5	2	**42**
2016	225											5	1	4	3	9	5	**27**
2017	159											1	1	1	2	5	1	**11**
2018	87													1	3	2		**6**
2019	91														3	3	1	**7**
2020	102															3		**3**
2021	97																5	**5**
2022	75																	
Total	**4226**																	**535**

5. Research

A precautionary approach has been applied in treating the Subarea 48.4 *D. mawsoni* as a separate stock. Based on the biological characteristics of the catches in Subarea 48.4, and the surrounding regions, the *D. mawsoni* around the southern South Sandwich Islands are now hypothesised as being part of a much larger stock that extends south into Subarea 48.2, 48.6 and possibly 48.5 (WG-FSA-2019/27).

According to the Stock Assessment of *D. eleginoides* in this fishery, observed recruitment is characterised by a large pulse from the early 2000s, followed by low background levels of recruitment. The stock hypothesis currently used in the assessment assumes a single stock unit for this subarea. The characteristics of the growth and maturity do not provide evidence for localised spawning activity.

The UK conducted a multi-year (2017-2019) effort-limited research program to the south of the directed fishery area in Subarea 48.4 examining the linkages between *D. mawsoni* in Subarea 48.2 and the adjacent area of Subarea 48.4. The results provided evidence linking *D. mawsoni* with the Antarctic continental shelf and a potential spawning region in Subarea 48.2 (WG-FSA-2021/22). The movements of tagged fish indicated potential connections with the Lazarev Sea (Subarea 48.6) as well as the southern South Sandwich Islands (WG-FSA-2021/22).

6. Stock status

6.1. Summary of current status

A CASAL based assessment of *D. eleginoides* indicated that the stock was at 65% of B0 in 2021 (see Stock Assessment Report).

The five-year (2018-2022) average biomass of *D. mawsoni* in this Subarea, estimated from mark-recapture data was 1110 tonnes (see Stock Assessment Report).

6.2. Assessment method

The stock of *D. eleginoides* in this Subarea is assessed using a combined-sex, single-area integrated CASAL stock assessment (see Stock Assessment Report).

The stock of *D. mawsoni* in this Subarea is assessed using a tag-recapture based population assessment (see Stock Assessment Report).

6.4. Year of last assessment, year of next assessment

Assessments are reviewed biennially, the last assessments were in 2021.

7. Climate Change and environmental variability

In 2018, a summary of the potential impacts of climate change on Southern Ocean fisheries (FAO 2018) highlighted the following key points:

The Antarctic region is characterized by complex interaction of natural climate variability and anthropogenic climate change that produce high levels of variability in both physical and biological systems, including impacts on key fishery taxa such as Antarctic krill. 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. There are no resident human populations or fishery-dependent livelihoods in the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) Area, therefore climate change will have limited direct implications for regional food security. However, as an "under-exploited" fishery, there is potential for krill to play a role in global food security in the longer term. The institutional and management approach taken by CCAMLR, including the ecosystem-based approach, the establishment of large marine protected areas, and scientific monitoring programmes, provides measures of resilience to climate change.

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 also welcomed (CCAMLR-41, paragraph 6.8) the Scientific Committee's agreement to hold a workshop on climate change in the first half of 2023 (SC-CAMLR-41, paragraph 7.10) and encouraged the inclusion of a range of scientific experts as well as policy makers to foster integration of the best available science into management actions. The Commission adopted (CCAMLR-41, paragraph 6.28) Resolution 36/41.

References

McMillan, P., T. Iwamoto, A. Stewart and P.J. Smith. 2012. A new species of grenadier, genus *Macrourus* (Teleostei, Gadiformes, Macrouridae) from the southern hemisphere and a revision of the genus. Zootaxa, 3165: 1-24.

Additional Resources

- Fishery Summary: pdf, html
- Stock Assessment Report: pdf
- Species Description for Patagonian Toothfish: pdf, html
- Species Description for Antarctic Toothfish: pdf, html
- Fisheries Documents Browser