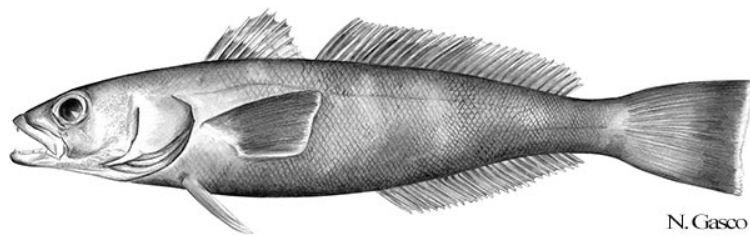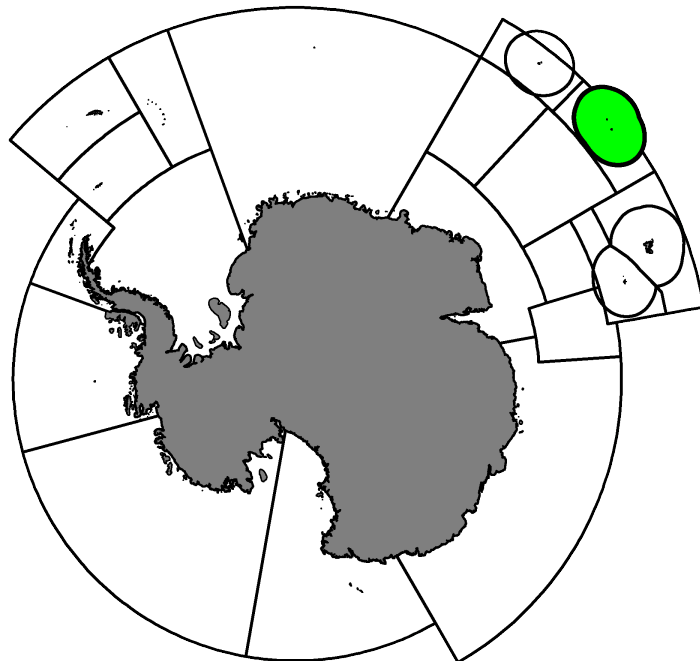# Fishery Report 2022: *Dissostichus eleginoides* at Crozet Island French EEZ (Subarea 58.6)

CCAMLR Secretariat

16 May 2023

Patagonian Toothfish, *Dissostichus eleginoides* Smitt, 1898.

Map of the management areas within the CAMLR Convention Area. 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 licensed longline fishery for Patagonian toothfish (*Dissostichus eleginoides*) in the French exclusive economic zone (EEZ) established in 1978 around the Crozet Island, which includes a portion of Subarea 58.6 and extends into FAO Area 51 (north of 45°S), outside the CAMLR Convention Area.

Trawl fishing was conducted by Japanese vessels prior to 1979 and by French vessels from 1983 to 1996 and in 2000. It has since been discontinued. A joint survey between France and Japan first conducted longline fishing in Subarea 58.6 in 1997, and this method has been used in the fishery since then.

The fishery is open year-round, but most fishing effort takes place in February and March when the fishery in the French EEZ at the Kerguelen Islands (Division 58.5.1) is closed. Fishing effort in this area concentrates on the Crozet shelf slope and on the eastern part of the del Cano Rise. The fishery is also charactrised by a high level of catch depredation (Tixier et al., 2010) by killer whales (*Orcinus orca*).

1.2. Conservation Measures currently in force

Within the French EEZs, catch limits for target species, as well as vessel licensing, are allocated by France (TAAF). A six-year management was adopted in July 2019 with the overall objective of ensuring conditions for a sustainable and optimal exploitation of Patagonian toothfish. It also sets catch limits for a period of 3 years. The 2020-2022 seasonal catch limit was set at 800 tonnes, and the 2023-2025 seasonal catch limit was set at 930 tonnes.

In the EEZ of Crozet Island, various national conservation and fisheries enforcement measures are applicable, such as:

- Annual catch limit set triennially since September 2019
- Demersal longlines and pots are the only authorized fishing gears
- Fishing season extends from 1 September to 31 August of the following year, which differs from the CCAMLR fishing season
- A maximum of two vessels fishing simultaneously per 0.5° latitude x 1° longitude rectangle
- Fishing is prohibited within the strict protection areas of the Marine Reserve which include areas not exceeding 500m in depth
- Move-on rule to limit catches of *D. eleginoides* of 60cm and less
- Cut-off procedure and move-on rules for skates to reduce fishing mortality
- Mitigation measures to reduce bird mortality
- Move-on rule on VME
- One French scientific observer on board each licensed vessel
- Mandatory vessel logbooks
- A single catch landings site at Réunion Island
- Mandatory port inspection

The limits in force and the advice of WG-FSA-2021 to the Scientific Committee for the 2022 season were:

(i) The Working Group agreed that the catch limit set by France of 800 tonnes in 2022, which accounts for depredation, was consistent with the CCAMLR decision rules for the model runs presented,

(ii) No new information was available on the state of fish stocks in Subarea 58.6 outside areas of national jurisdiction. The Working Group therefore recommended that the prohibition of directed fishing for *D. eleginoides*, described in Conservation Measure 32-02, remain in force in 2022.
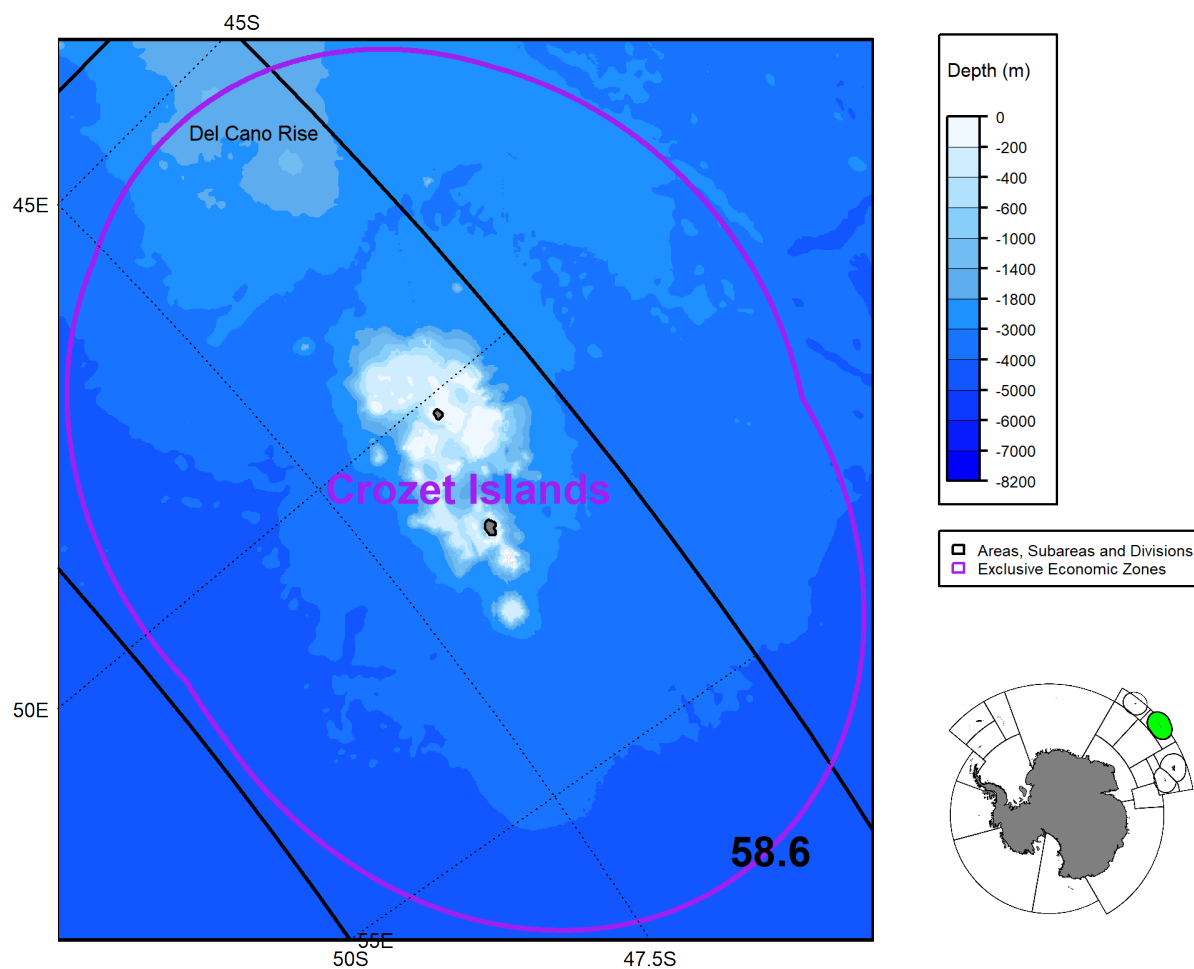
Figure 1: Map of the region discussed in this report.

1.3. Active vessels

In 2022, 7 vessels participated in this fishery.

2. Reported catch

Since the CCAMLR fishing season (1 December to 30 November of the following year, UTC time) and the TAAF fishing season (1 September to 31 August of the following year) do not match, data pooled at the annual scale and shown in this document may not match data reported by TAAF. This distinction is particularly relevant if readers wish to compare annual catch in the Convention Area to annual catch limits as set by TAAF.

2.1. Latest reports and limits

Reported catches of *Dissostichus eleginoides* are shown in Table 1. In this fishery, the catch of *D. eleginoides* reached a maximum of 1296 tonnes in 2002. In 2022, 699 tonnes of *D. eleginoides* were caught.

Table 1. Catch and effort history for *Dissostichus eleginoides* in this fishery (within Subarea 58.6). Source: Fine scale data and past estimates for IUU catch (-: no fishing, or no IUU estimate available).

Season	Longline Catch (tonnes)	Trawl Catch (tonnes)	Pot Catch (tonnes)	Total Catch (tonnes)	Number of vessels	Estimated IUU catch (tonnes)
1987	-	-	-	488	1	-
1988	-	21	-	21	1	-
1989	-	-	-	-	-	-
1990	-	-	-	-	-	-
1991	-	-	-	-	-	-
1992	-	-	-	-	-	-
1993	-	-	-	-	-	-
1994	-	56	-	56	1	-
1995	-	114	-	114	1	-
1996	-	3	-	3	1	-
1997	76	-	-	76	1	-
1998	12	0	-	12	1	-
1999	29	109	-	138	4	-
2000	989	-	-	989	5	1430
2001	1054	-	-	1054	6	685
2002	1296	-	-	1296	7	720
2003	532	-	-	532	6	302
2004	534	-	-	534	7	380
2005	596	-	-	596	7	12
2006	1051	-	-	1051	8	55
2007	421	-	-	421	7	0
2008	823	-	-	823	7	224
2009	886	-	-	886	8	0
2010	663	-	-	663	7	0
2011	703	-	-	703	7	0
2012	673	-	-	673	7	-
2013	840	-	-	840	7	-
2014	778	-	-	778	7	-
2015	864	-	-	864	7	-
2016	1054	-	-	1054	8	-
2017	1143	-	-	1143	8	-
2018	1116	-	-	1116	7	-
2019	825	-	-	825	7	-
2020	818	-	-	818	7	-
2021	832	-	2	833	7	-
2022	699	-	-	699	7	-

2.2. By-catch

Primary by-catch species from the longline fishery at Crozet Islands are the ridge-scaled grenadier (*Macrourus carinatus*), rajid skates (*Amblyraja taaf*) and blue antimora (*Antimora rostrata*). The latter species is fully discarded, while the others are partly or totally retained.

Avoidance of high level by-catch areas has been promoted with the implementations of move on rules, and the cut-off protocol is in force following CCAMLR recommendations.

The by-catch in the French EEZ at Crozet Islands consists predominantly of *Macrourus* spp. (Table 2).

Table 2. Reported catch for by-catch species (*Macrourus* spp., skates and *Antimora rostrata*) in this longline fishery (within Subarea 58.6). Source: fine-scale data.

Season	*Macrourus* spp. Reported Catch (tonnes)	Skates Reported Catch (tonnes)	Number Released	*Antimora rostrata* Reported Catch (tonnes)
1997	10	<1	0	<1
1998	2	<1	0	<1
1999	<1	3	0	<1
2000	96	31	0	11
2001	98	6	0	<1
2002	195	35	0	11
2003	148	92	0	19
2004	117	73	0	56
2005	132	93	0	67
2006	147	120	0	52
2007	119	85	2118	43
2008	135	46	11397	64
2009	193	46	17730	79
2010	113	56	6836	78
2011	93	29	2484	23
2012	96	75	2448	21
2013	64	29	273	17
2014	92	53	9684	36
2015	108	17	22575	75
2016	120	33	28395	142
2017	111	23	26718	58
2018	88	20	33859	133
2019	78	13	21800	43
2020	59	2	10465	18
2021	51	5	21942	14
2022	60	9	30681	26

2.3. Vulnerable marine ecosystems (VMEs)

All Members are required to submit, within their general fisheries notifications requirements, information on the known and anticipated impacts of their gear on vulnerable marine ecosystems (VMEs), 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.

In this fishery, fishery observers follow protocols to collect information about benthos taxa, including VME taxa.

There are no VMEs or VME Risk Areas designated in Subarea 58.6.

2.4. Incidental mortality of seabirds and marine mammals

A summary of recent bird mortalities by longline fisheries in the French EEZ at Crozet Islands is shown in Table 3. The three most common species injured or killed in the fishery were northern giant petrel (*Macronectes halli*), white-chinned petrel (*Procellaria aequinoctialis*) and grey petrel (*P. cinerea*). Night setting requirements have been highly effective in removing the previously high levels of albatross mortality.

The level of risk of incidental mortality of birds in the French EEZ at Crozet Islands in Subarea 58.6 is considered to be high (category 5) (SC-CAMLR-XXX, Annex 8, paragraph 8.1).

Table 3. Number of reported birds caught (killed or with injuries likely to substantially reduce long-term survival) in this fishery (within Subarea 58.6) in each fishing season.

Season	*Macronectes halli*	*Procellaria aequinoctialis*	*Procellaria cinerea*
2007	1		
2008		32	
2009	3	19	1
2010		27	
2011	1	7	
2012		17	
2013		13	
2014		6	
2015		11	
2016		6	
2017		5	
2018		4	
2019		5	
2020			1
2021		1	
2022		2	

The requirements of Conservation Measure 25-02 'Minimisation of the incidental mortality of seabirds in the course of longline fishing or longline fishing research in the Convention Area' apply to this fishery. France applies these CCAMLR mitigation measures.

Additional measures are also applied (WG-IMAF-11/10 Rev. 1), including:

(i) changes to the bird exclusion device to ensure it is effective in all weather conditions,

(ii) closure of fishing areas and quota allocation reduction to vessels that have high by-catch rates,

(iii) education and training is strengthened by regular meetings between TAAF and fishing masters of vessels with high by-catch.

In 2022, WG-IMAF-2022/P01 (Dasnon *et al.*, 2022) reported on the effects of by-catch mitigation measures on the demography of white-chinned petrels (*Procellaria aequinoctialis*) at Possession Island (Crozet Islands).

This population declined by 40% from 1983 to 2004 because of by-catch in longline and trawl fisheries, and reduced breeding success resulting from predation by rats. Both modelled population growth rate and observed breeding densities increased after the mid-2000s, which could be explained by the improvement in survival following implementation of by-catch mitigation measures, in breeding success following local control of rats, and changes in climatic conditions on foraging grounds.

There was no incidental mortality of marine mammals in this fishery in 2022.

3. Illegal, Unreported and Unregulated (IUU) fishing

Illegal, unreported and unregulated (IUU) fishing was first detected in Subarea 58.6 in 1996 and peaked the following year at an estimated 11,760 tonnes.

IUU fishing activities were not detected in Subarea 58.6 in the Crozet Islands EEZ during 2006 and 2007, however, IUU activities were detected in Subarea 58.6 outside the Crozet Islands EEZ during the winter of 2006. IUU activity in the Crozet Islands EEZ cannot be discounted during 2006 or 2007 due to nearby IUU activity in those years. There was a single IUU vessel sighting in 2008 and two IUU-listed vessels were observed during 2012. A further IUU fishing vessel was sighted during 2013. During the 2014 fishing season, both old and recent IUU fishing gear was recovered on four occasions, however, there were no observations of IUU-listed vessels in this Subarea. No IUU fishing activities were detected during 2015 or 2017, however, IUU fishing gear was found during 2016.

Following the recognition of methodological issues in its assessment, no estimates of IUU catch of *Dissostichus* spp. have been provided since 2011 (SC-CAMLR-XXIX, paragraph 6.5).

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 by-catch 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, and report toothfish length measurements to CCAMLR.

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

Table 4. Summary of by-catch and biological data reported by vessels crew and observers in each of the last five seasons in this longline fishery (within Subarea 58.6). By-catch records correspond to the number of observations of total weight and count of individuals for each taxon identified. Taxonomic identification may occur at different levels. *N.B.* Data prior to 2021 was collected but not reported (reporting of weight, sex, maturity, gonad weight and otolith samples started in September 2021).

Data source	Data class	Variable	2018	2019	2020	2021	2022
Vessel crew	by-catch	taxa identified	5	5	4	5	7
		records	3069	2078	1190	1963	1785
Observer	toothfish	specimens examined	28685	25994	19534	27768	13689
		length measurements	28685	25994	19534	27768	13689
		weight measurements	0	0	0	282	755
		sex identifications	0	0	0	4867	8864
		maturity stage identifications	0	0	0	4867	8860
		gonad weight measurements	0	0	0	0	0
		otolith samples	0	0	0	272	673

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. *N.B.* Data prior to 2021 was collected but not reported (reporting started in September 2021).

By-catch group	Variable	2018	2019	2020	2021	2022
Macrourus spp.	specimens examined	0	0	0	231	489
	taxa identified	0	0	0	1	3
	length measurements	0	0	0	231	489
	weight measurements**	0	0	0	0	11
	snout to anus measurements*	0	0	0	231	261
	sex identifications**	0	0	0	0	81
	maturity stage identifications**	0	0	0	0	53
	gonad weight measurements**	0	0	0	0	0
	otolith samples**	0	0	0	0	11
Skates and rays	specimens examined	0	0	0	254	1017
	taxa identified	0	0	0	1	1
	length measurements	0	0	0	254	1017
	weight measurements**	0	0	0	37	124
	wingspan measurements*	0	0	0	68	325
	pelvic length measurements*	0	0	0	0	75
	sex identifications**	0	0	0	254	1001
	maturity stage identifications**	0	0	0	49	673
	gonad weight measurements**	0	0	0	0	0
Other fish	specimens examined	0	0	0	182	292
	taxa identified	0	0	0	2	3
	length measurements	0	0	0	182	292
	weight measurements**	0	0	0	2	4
	standard length measurements*	0	0	0	0	0
	sex identifications**	0	0	0	2	2
	maturity stage identifications**	0	0	0	2	0
	gonad weight measurements**	0	0	0	0	0
	otolith samples**	0	0	0	0	4

*: 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. 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.
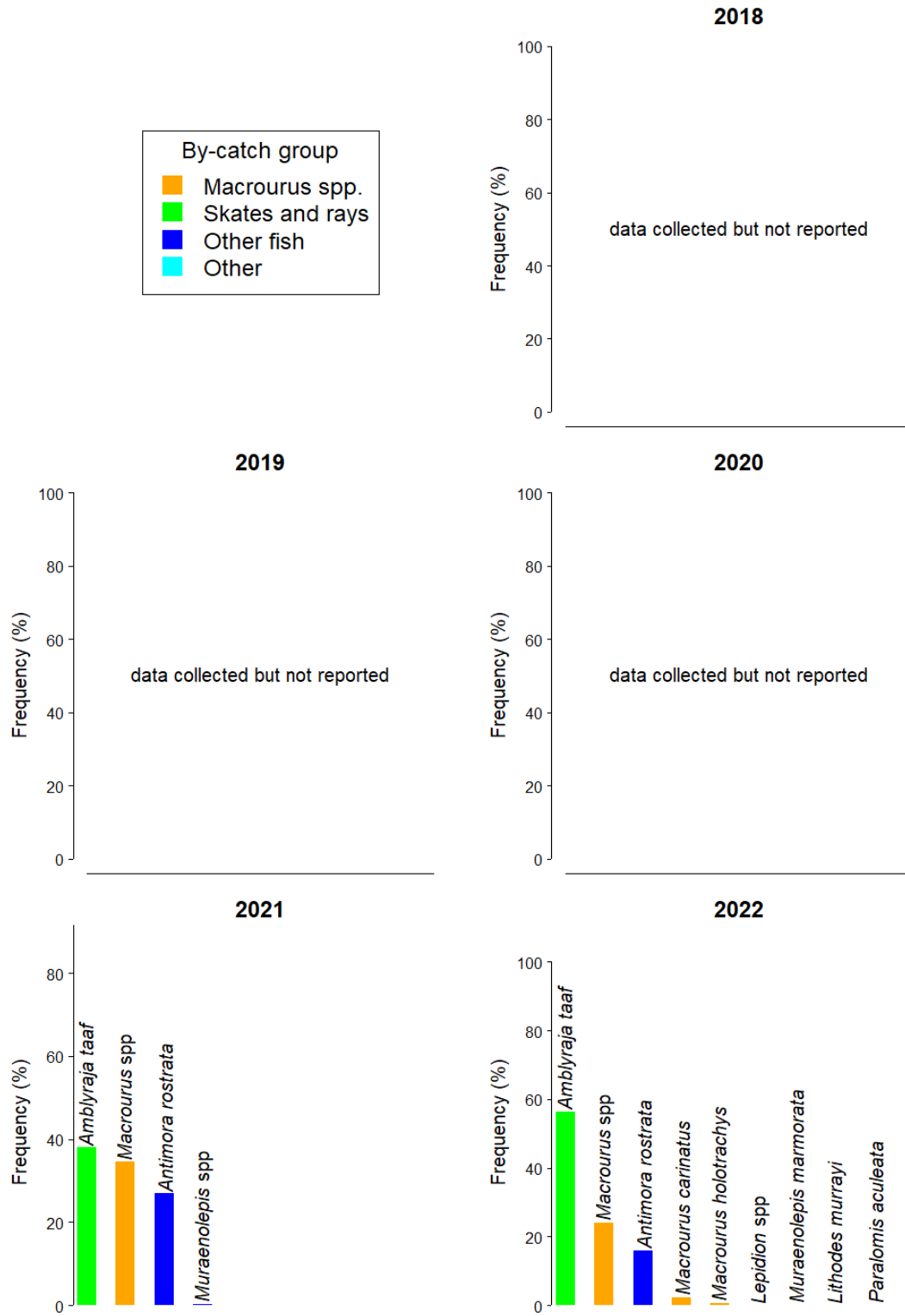
Figure 2. Relative frequencies of the most commonly examined by-catch taxa in each of the last five seasons, from the observer data (unweighted raw counts of individually examined specimens). Taxonomic identification may occur at different levels. *N.B.* Data prior to 2021 was collected but not reported (reporting started in September 2021).
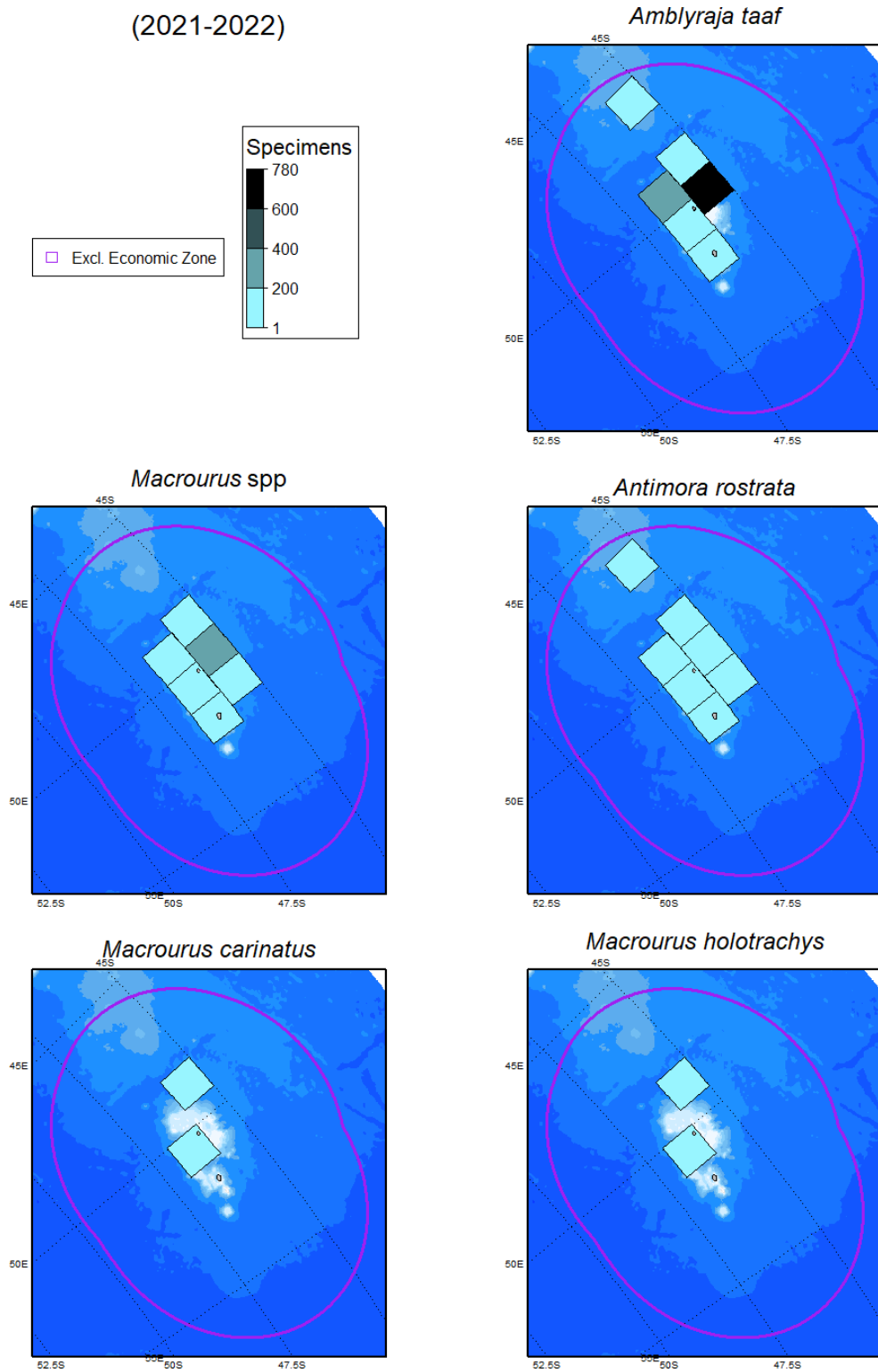
Figure 3. Spatial distribution of the most commonly examined by-catch taxa across the last five seasons, from the observer data (unweighted raw counts of individually examined specimens in each cell). The data were aggregated using equal area (100 km x 100 km) cells. Taxonomic identification may occur at different levels. Refer to Figure 1 for more details on the boundaries shown. *N.B.* Data prior to 2021 was collected but not reported (reporting started in September 2021).

4.3. Length frequency distributions

The recent length frequency distributions of *D. eleginoides* caught in this fishery are shown in Figure 4. The majority of *D. eleginoides* caught by longline range from 30 to 150cm in length, with a single strong mode for all seasons at approximately 70cm. 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.
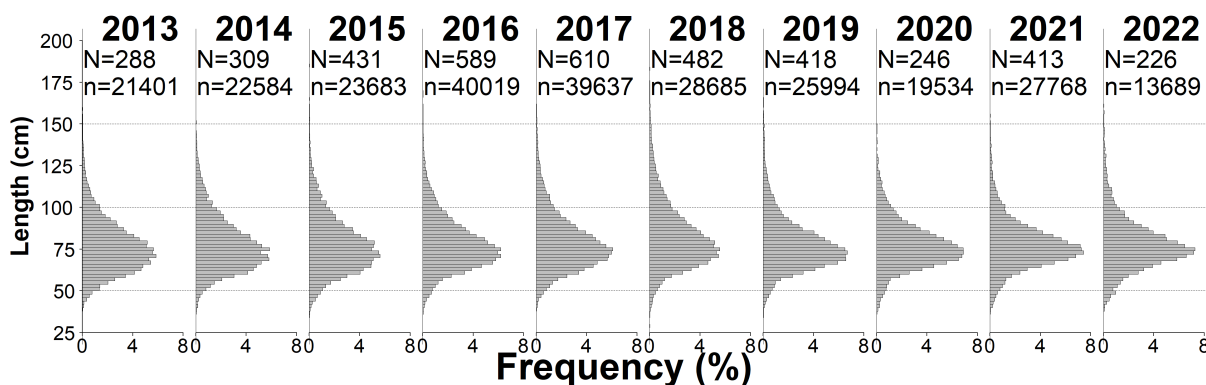

Figure 4. Annual length frequency distributions of *D. eleginoides* caught by longline in this fishery (within Subarea 58.6). The number of hauls from which fish were measured (N) and the number of fish measured (n) in each year are indicated. Note: length frequency distributions are only shown where more than 150 fish were measured in a given season.

4.4. Tagging

Within the French EEZ, vessels are required to tag and release toothfish at a rate of 1 fish per tonne of green weight caught throughout the season.

To date in this area, 14406 *D. eleginoides* have been tagged and released (1239 have been recaptured, 962 of which were released in this area; Table 6).

Table 6. Number of *Dissostichus eleginoides* tagged and recaptured in the area (within Subarea 58.6) for each fishing Season.

Season	Tagged	Recaptured																	Total
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
2005	90																		
2006	1154				1		2	2		1	2								**8**
2007	518	2	4	4	1	1			3			1	1						**17**
2008	547		3	14	4	6	1	8		1	1	1							**39**
2009	679			7	18	10	7	10	5	6	5	4	4	1	1				**78**
2010	629					5	9	2	3	4	3	3	3	1	1				**34**
2011	726					4	8		6	3	2			1					**24**
2012	691						1	20	16	8	5	2	1	1	3				**57**
2013	852							8	18	23	16	9	6	2	3	2	1		**88**
2014	839								4	26	21	10	4	10	1	3	2		**81**
2015	921									5	31	23	11	11	6	3	1		**91**
2016	1167										13	37	28	26	3	12	5		**124**
2017	1220											12	34	16	13	16	4		**95**
2018	1158												15	28	11	22	10	1	**87**
2019	854													10	16	12	11	1	**50**
2020	838														2	34	13		**49**
2021	887															8	22	3	**33**
2022	636																6	1	**7**
Total	**14406**																		**962**

One fish which was tagged in Subarea 58.6 was recaptured in Subarea 58.7 and another in the Southern Indian Ocean Fisheries Agreement (SIOFA) zone. Again, tagged fish from the Kerguelen Plateau (34 from Division 58.5.1 - Kerguelen and 53 from Division 58.5.2 - Heard Island) have been recovered in the Crozet EEZ. Despite these long-distance movements of sub-adult/adult fish, the proportion of exchange between stocks is still unknown and only one fish from Crozet Island has been recovered eastward on the Kerguelen Plateau.

5. Research

An analysis presented in WG-FSA-14/10 estimated that the depredation of *D. eleginoides* by killer whales and sperm whales (*Physeter macrocephalus*) over the period 2003 to 2013 was 2,568 tonnes; this implies a depredation rate of 28% of all fish caught for this decade.

A pot trial cruise was conducted in February 2010 (WG-FSA-10/10) to try and find solutions to the depredation problem (and to reduce bird mortality). However, while whale depredation and bird by-catch is eliminated using pot gear, the catch rates of the target species were reduced and the by-catch of king crabs (*Lithodes murrayi* and *Paralomis aculeata*) was considerable.

In 2019, catch removals due to killer and sperm whale interactions across subantarctic fisheries were estimated (WG-FSA-2019/33). These estimates are routinely updated as part of the stock assessment (WG-FSA-2021/45).

In 2022, WG-FSA-2022/19 presented an analysis of skate handling practices and condition assessment methods in the longline toothfish fisheries operating in the southern Indian Ocean. Results provided clear guidelines for crew members operating on longline vessels to maximise the survival of released skates. WG-FSA-2022/20 presented a preliminary study on the use of the vertebrae centrum in the age determination of skates (*Amblyraja taaf* in Crozet, and, *Bathyraja eatonii* and *B. irrasa* in Kerguelen waters).

6. Stock status

6.1. Summary of current status

According to the 2021 assessment (WG-FSA-2021/45), SSB0 is estimated at 55,740 tonnes (49,220 - 60,500). The estimate of the current SSB status of the stock is 65.2% (61.4%-68.5%).

6.2. Assessment method

The stock in this fishery is assessed using a fully integrated single-sex CASAL model (WG-FSA-2021/45).

6.3. Year of last assessment, year of next assessment

Assessments are reviewed biennially, the last assessment was 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.

Additional Resources

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

References

Dasnon, A., Delord, K., Chaigne, A., Barbraud, C., 2022. Fisheries bycatch mitigation measures as an efficient tool for the conservation of seabird populations. J. Appl. Ecol. 59, 1674-1685. https://doi.org/10.1111/1365-2664.14189

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Tixier, P., et al., Assessing the impact of toothed whale depredation on socio-ecosystems and fishery management in wide-ranging subantarctic fisheries, Rev. Fish Biol. Fish., vol. 30, p. 203-217, 2020, doi: 10.1007/s11160-020-09597-w