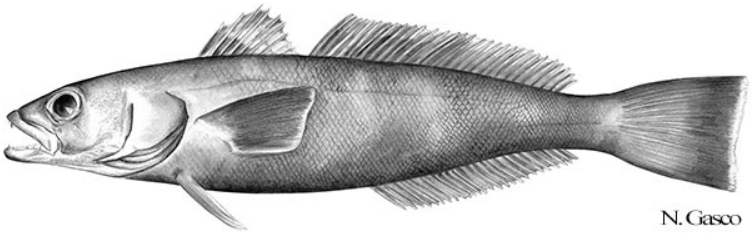
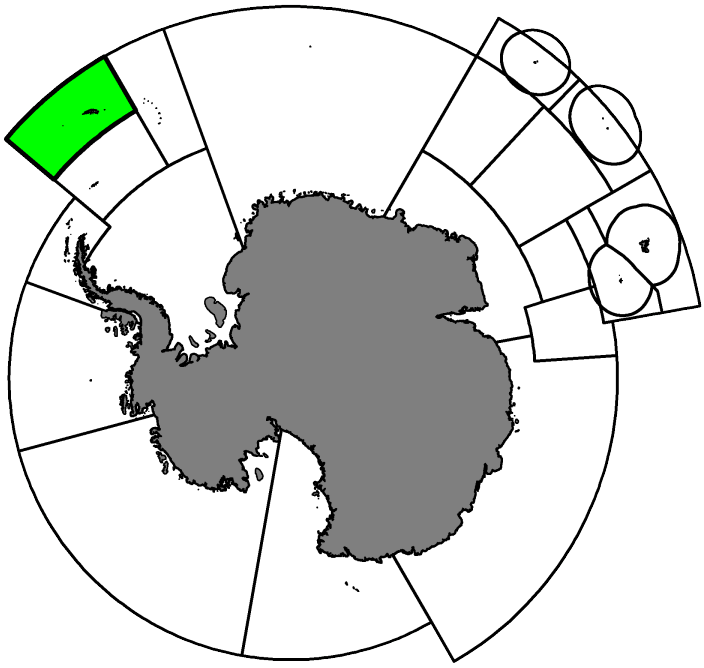
Fishery Report 2021: *Dissostichus eleginoides* in Subarea 48.3

CCAMLR Secretariat

27 May 2022



Patagonian Toothfish, *Dissostichus eleginoides* Smitt, 1898.



Map of the management areas within the CAMLR Convention Area. Subarea 48.3, the region discussed in this report is shaded in green. Throughout this report, "2021" refers to the 2020/21 CCAMLR fishing season (from 1 December 2020 to 30 November 2021).

Contents

1. Introduction to the fishery

1.1. History

The fishery for Patagonian toothfish (*Dissostichus eleginoides*) in Subarea 48.3 began in the 1980s and expanded rapidly during the early 1990s, when considerable illegal, unreported and unregulated (IUU) catches were also taken (Table 1). The initial fishery also caused high rates of incidental bird mortality, with relatively large numbers of albatrosses and petrels attracted to the baited hooks and being caught and drowned. In response to these issues, CCAMLR introduced strict regulations designed to reduce bird by-catch. These regulations, including seasonal closures, streamer lines, line-weighting regimes and night-setting requirements, greatly reduced bird by-catch in this fishery. The fishery uses demersal longlines in which lines of baited hooks are deployed on the sea floor at depths down to 2,250 m.

1.2. Conservation Measures currently in force

The limits on the fishery for *D. eleginoides* in Subarea 48.3 for the 2020 and 2021 seasons are defined in Conservation Measure 41-02.

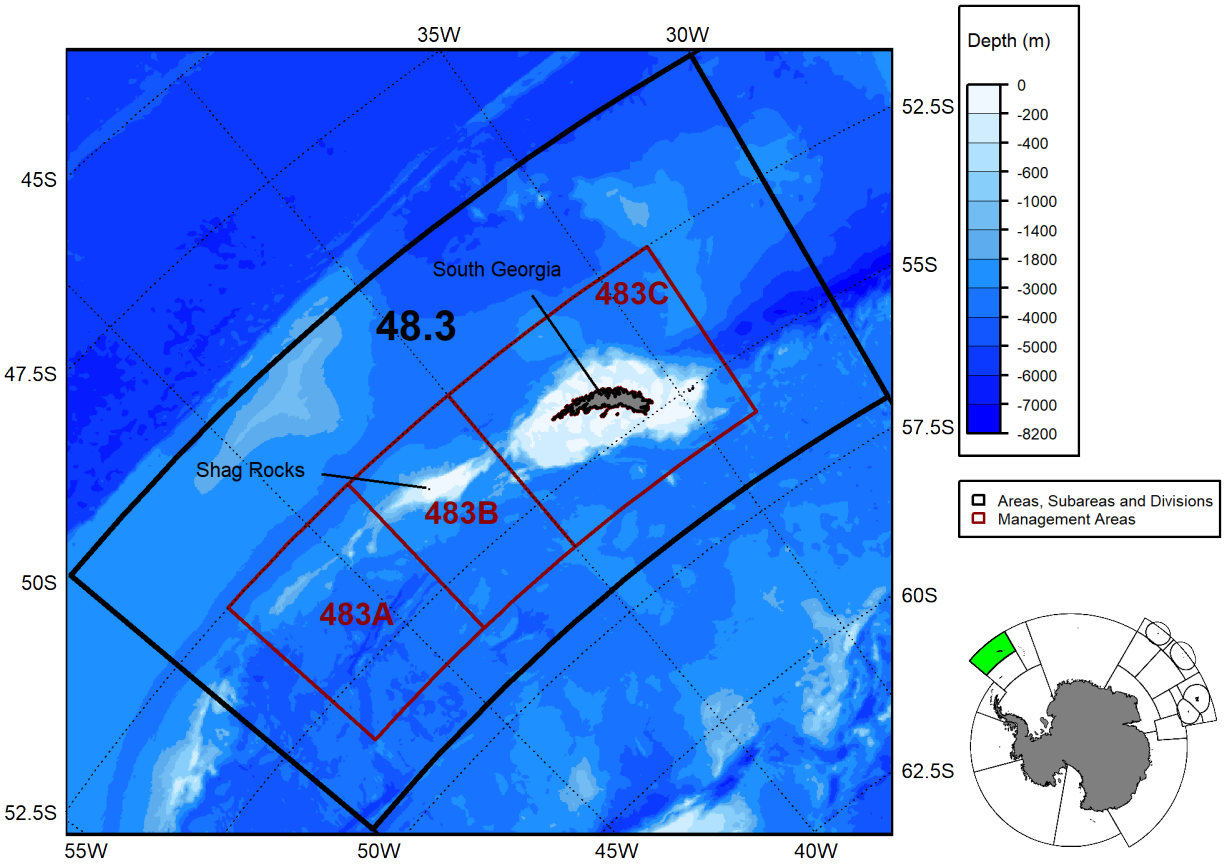


Figure 1: Location of the Management Areas in Subarea 48.3.

1.3. Active vessels

In 2021, 5 vessels participated in this fishery.

1.4. Timeline of spatial management

In 1998, the fishery was restricted to the winter months (1 May to 31 August) to minimise interactions with foraging birds during their breeding season. Since 2010, CCAMLR has applied a gradual extension to the season, accompanied by a number of seabird bycatch limits in those extension periods, the season is now from 16 April to 14 September as set out in Conservation Measure 41-02.

In 2004, CCAMLR agreed to subdivide Subarea 48.3 into three Management Areas (A, B and C; Fig. 1) defined in Conservation Measure 41-02, Annex 41-02/A.

2. Reported catch

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 7491 tonnes in 2003. In 2021, 1813 tonnes of *D. eleginoides* were caught.

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

Season	Number of vessels	Catch limit (tonnes)	Catch	Estimated IUU catch (tonnes)
1980	1		64	-
1981	1		7	-
1984	1		3	-
1986	1		7	-
1987	1		130	-
1988	4		581	-
1989	3		3580	-
1990	2		5023	-
1991	1		270	-
1992	19	3500	3975	3066
1993	19	3350	4028	4019
1994	4	1300	639	4780
1995	13	2800	3082	1674
1996	13	4000	3297	0
1997	10	5000	3724	0
1998	9	3300	2848	146
1999	12	3500	3660	667
2000	16	5310	5067	1015
2001	16	4500	3916	196
2002	17	5820	5453	3
2003	19	7810	7491	0
2004	16	4420	4456	0
2005	9	3050	3032	23
2006	11	3556	3549	0
2007	10	3554	3539	0
2008	12	3920	3862	0
2009	11	3920	3382	0
2010	9	3000	2518	0
2011	6	3000	1732	0
2012	7	2600	1836	0
2013	7	2600	2094	0
2014	7	2400	2180	0
2015	6	2400	2195	0
2016	6	2750	2196	0
2017	6	2750	2195	0
2018	6	2600	1950	0
2019	6	2600	2124	0
2020	5	2327	1884	0
2021	5	2327	1813	0

2.2. By-catch

Annual catch limits for by-catch species groups are defined in Conservation Measures 41-02 and 33-01. If the by-catch of skates or macrourids exceeds 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.

Catches of by-catch species groups (*Macrourus* spp., skates and rays, and other species), their respective catch limits and number of skates released alive are summarised in Table 2.

Table 2. Reported catch and catch limits for by-catch species (*Macrourus* spp., skates and rays, and others) in this fishery (see Conservation Measure 41-02 for details). 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)
1985	0	0	0	4	0	0	<1
1986	0	<1	0	9	0	0	<1
1987	0	<1	0	3	0	0	152
1988	0	<1	0	<1	0	0	<1
1989	0	<1	0	11	0	0	<1
1990	0	<1	0	<1	0	0	<1
1991	0	1	0	4	0	0	<1
1992	0	<1	0	2	0	0	<1
1993	0	2	0	<1	0	0	<1
1994	0	<1	0	12	0	0	<1
1995	0	12	0	90	0	0	11
1996	0	32	0	54	0	0	<1
1997	0	33	0	43	0	0	4
1998	0	21	0	13	0	0	2
1999	0	21	0	19	0	0	<1
2000	0	18	0	12	0	0	5
2001	0	21	0	27	0	0	3
2002	0	50	0	25	0	0	12
2003	0	74	0	37	0	0	19
2004	221	30	221	6	0	-	4
2005	152	121	152	8	0	-	20
2006	177	136	177	7	21056	-	37
2007	177	129	177	4	9265	-	27
2008	196	161	196	12	19558	-	36
2009	196	110	196	22	23709	-	34
2010	150	70	150	7	15810	-	16
2011	150	74	150	4	12832	-	9
2012	130	54	130	2	13503	-	9
2013	130	59	130	2	14005	-	11
2014	120	61	120	3	12969	-	15
2015	120	56	120	2	10937	-	10
2016	138	64	138	2	14960	-	15
2017	138	54	138	3	12916	-	16
2018	130	107	130	4	21235	-	29
2019	130	107	130	3	23817	-	41
2020	116	87	116	3	23610	-	47
2021	116	97	116	3	26113	-	56

A preliminary assessment of skate populations in Subarea 48.3 using a surplus production model implemented in a Bayesian framework was presented in 2007 (WG-SAM-07/11), at which time it was considered that there were insufficient data to inform the assessment. Nevertheless, these preliminary results suggested that the by-catch limit in Subarea 48.3 for rajids would be considered sustainable.

A skate tagging program has been under way since 2006 in Subarea 48.3 and a preliminary assessment of skates in Subarea 48.3 using tagging data was presented in 2014 (WG-FSA-14/48). This assessment indicated a stable biomass. Using the same skate tagging programme, a stock status and population assessment of the Antarctic starry skate (*Amblyraja georgiana*) in Subarea 48.3 was presented in 2018 (WG-FSA-18/27). These results indicated that the longline fishery for toothfish does not appear to have resulted in a decline in the population of *A. georgiana* and at present has low by-catch rates of exploitation.

Recent genetic analysis of skates (*Amblyraja* spp.) (WG-FSA-18/73) suggests that skates caught as by-catch from CCAMLR subareas 48.3 and 48.4 that were identified as *A. georgiana*, *A. georgiana* sp. anon and *A. taaf* do not represent distinct, reproductively isolated species. Rather, these different morphological forms of Amblyraja appear to be interbreeding members from two geographically differentiated stocks, one occurring around South Georgia and the other around the South Sandwich Islands (Subarea 48.4).

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 48.3. There are fishery-specific restrictions in place to mitigate the impact of the fishery on VMEs, including benthic communities and benthos such as seamounts, hydrothermal vents and cold-water corals.

2.4. Incidental mortality of seabirds and marine mammals

A summary of seabird mortality in the longline fishery in Subarea 48.3 in recent years is shown in Table 3. The three most common species injured or killed in the fishery since 2005 were southern giant petrel (*Macronectes giganteus*), white-chinned petrel (*Procellaria aequinoctialis*) and black-browed albatross (*Thalassarche melanophris*).

The requirements of Conservation Measure 25-02 'Minimisation of the incidental mortality of birds in the course of longline fishing or longline fishing research in the Convention Area' apply to this fishery in addition to the seasonal closure and the night-setting requirements described in Conservation Measure 41-02.

The risk level in this fishery in Subarea 48.3 is category 5 (high) (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 in each fishing season.

Season	*Macronectes giganteus*	*Procellaria aequinoctialis*	*Thalassarche melanophris*	Other
1992				4
1995	122	597	39	176
1996	5	102	297	291
1997	13	198	253	122
1998		37	8	6
1999	1	42	62	5
2000	1		1	
2001				1
2003		2	1	1
2004				1
2005				1
2009			1	1
2010				2
2011		1		
2012	1		1	
2013		1		1
2014		77		
2015		1		
2016		30		
2017		19		1
2018	1	22	1	1
2019	1			
2020		1		

A summary of mammal mortalities associated with longline fishing in Subarea 48.3 is given in Table 4.

Table 4. Number of reported mammals killed in this fishery in each fishing season.

Season	*Arctocephalus gazella*	*Hydrurga leptonyx*	*Leptonychotes weddellii*	*Mirounga leonina*	*Otariidae, Phocidae*	*Physeter macrocephalus*
1995				1		
1996		1	1			
1997					3	
1998					1	
2004					1	
2007				2		
2009	1				1	
2012						1
2014				1		

3. Illegal, Unreported and Unregulated (IUU) fishing

There has been no reported evidence of IUU fishing activities in Subarea 48.3 since 2006 (Table 1).

4. Data collection

4.1. Data collection requirements

The collection of biological data is conducted in accordance to Conservation Measure 23-05. 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 5 and 6.

Table 5. 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	2017	2018	2019	2020	2021
Vessel crew	by-catch	taxa identified	12	23	11	8	11
		records	3847	4288	4676	4215	4070
Observer	toothfish	specimens examined	30810	35977	36943	31022	32516
		length measurements	30805	35976	36925	30984	32492
		weigth measurements	9150	16179	20900	13245	14846
		sex identifications	8702	16217	19300	14442	14778
		maturity stage identifications	8644	16119	12599	10354	14764
		gonad weight measurements	8553	15742	12014	10240	9709
		otolith samples	3106	4387	3923	3210	3677
	by-catch	specimens examined	5168	7363	7525	6067	8011
		taxa identified	14	21	16	12	11
		length measurements	3891	6076	6388	3783	8010
		weigth measurements**	5103	7112	7201	6057	7998
		standard length measurements*	0	0	784	688	827
		wingspan measurements*	169	447	292	300	348
		pelvic length measurements*	169	447	293	300	348
		snout to anus measurements*	3141	4592	4740	3725	5237
		sex identifications**	860	5199	5732	4379	6306
		maturity stage identifications**	847	4701	4824	3477	6273
		gonad weight measurements**	20	1821	2314	41	3214
		otolith samples**	0	2	1	677	195

*: Species-dependent records
**: Voluntary records

Table 6. 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	2017	2018	2019	2020	2021
Macrourus spp.	specimens examined	3140	4455	4767	3725	5238
	taxa identified	4	5	4	4	5
	length measurements	1889	3204	3662	1443	5238
	weigth measurements**	3090	4349	4603	3725	5230
	snout to anus measurements*	3129	4439	4732	3725	5235
	sex identifications**	597	3134	3869	2806	5088
	maturity stage identifications**	591	3070	3401	2164	5081
	gonad weight measurements**	0	1110	1603	0	2409
	otolith samples**	0	0	1	533	194
Skates and rays	specimens examined	171	448	297	301	348
	taxa identified	3	5	5	2	2
	length measurements	170	446	274	300	348
	weigth measurements**	168	411	288	296	345
	wingspan measurements*	169	447	292	300	348
	pelvic length measurements*	169	447	293	300	348
	sex identifications**	169	442	291	300	347
	maturity stage identifications**	162	123	288	298	326
	gonad weight measurements**	19	0	1	41	1
Other fish	specimens examined	1831	2421	2461	2040	2425
	taxa identified	3	4	7	5	4
	length measurements	1831	2405	2452	2039	2424
	weigth measurements**	1819	2324	2310	2035	2423
	standard length measurements*	0	0	782	688	827
	sex identifications**	94	1592	1572	1272	871
	maturity stage identifications**	94	1507	1135	1015	866
	gonad weight measurements**	1	711	710	0	804
	otolith samples**	0	2	0	144	0

*: Species-dependent records
**: Voluntary records

4.3. Length frequency distributions

Recent length frequency distributions for catches of *D. eleginoides* in Subarea 48.3 are shown in Figure 2. 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.

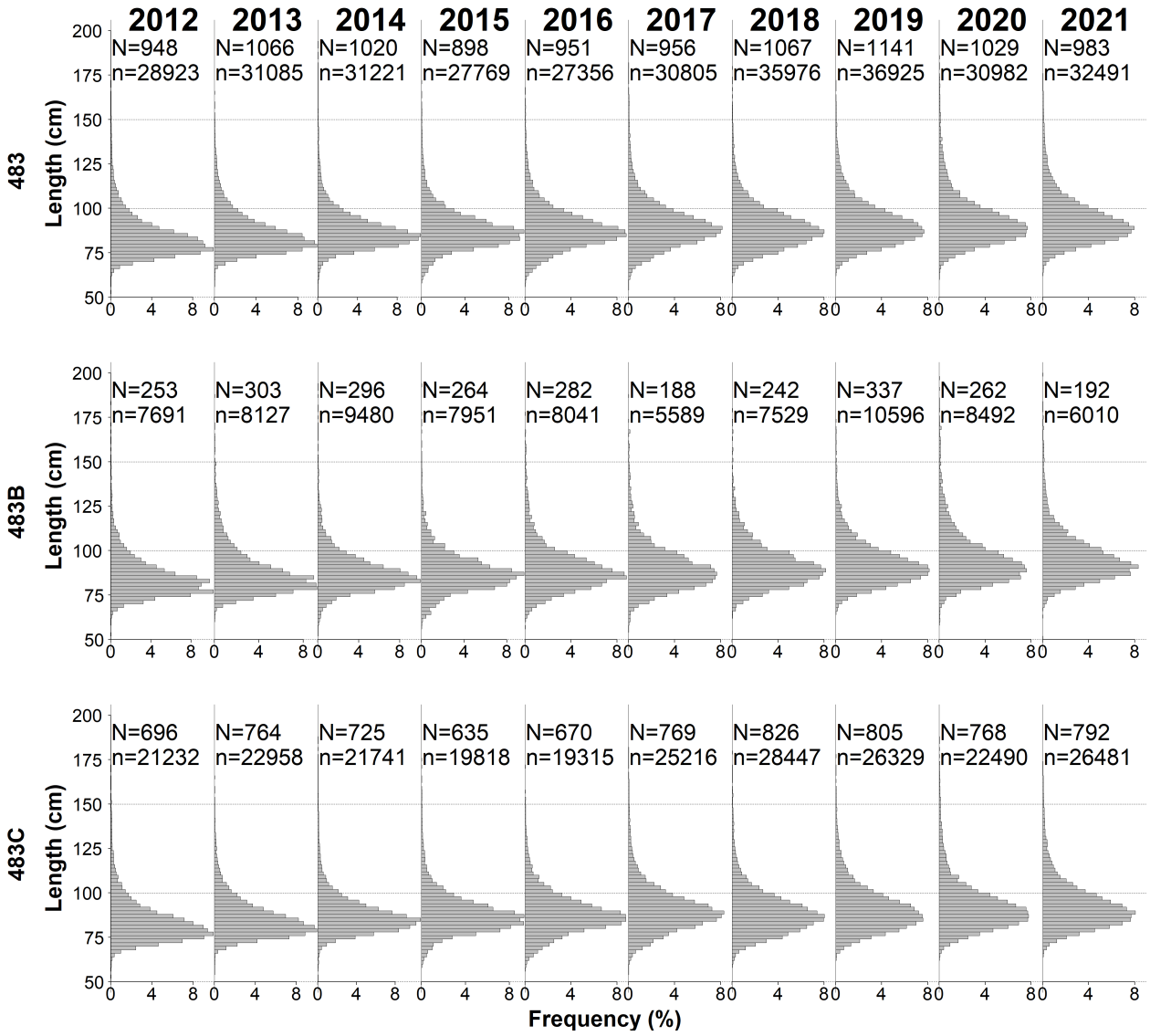


Figure 2. Annual length frequency distributions of *D. eleginoides* caught in Subarea 48.3. The number of hauls from which fish were measured (N) and the number of fish measured (n) in each year are indicated. Letters to the left of the panel (B and C) refer to the management areas shown in Figure 1. Note: length frequency distributions are only shown where more than 150 fish were measured in a given season/area.

4.3. Tagging

Tagging of *D. eleginoides* is conducted at a rate of 1.3 fish per tonne in this fishery; a total of 64002 *D. eleginoides* have been tagged and released and 11674 have been recaptured, 10829 of which were released in this area (Table 7).

Table 7. Number of *Dissostichus eleginoides* tagged and recaptured in the area for each fishing Season.

		Recaptured																		
Season	Tagged	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
2004	3218	19	70	82	66	64	45	35	25	16	4	16	9	9	6	6	2	3	1	**478**
2005	3949		23	194	155	148	121	86	45	24	39	26	17	19	25	11	10	5	7	**955**
2006	4889			31	223	194	144	132	71	51	52	43	20	13	22	16	12	12	6	**1042**
2007	4782				41	238	170	139	82	64	56	51	36	21	30	17	16	14	15	**990**
2008	4632					61	230	150	107	81	79	69	48	49	43	35	38	14	16	**1020**
2009	3506						19	138	71	67	66	60	52	32	40	22	29	16	21	**633**
2010	2966							12	72	62	48	55	39	40	32	19	17	17	13	**426**
2011	2909								18	98	89	81	64	59	48	32	42	25	32	**588**
2012	3027									19	118	98	79	72	53	37	33	36	19	**564**
2013	3356										17	126	89	93	90	53	63	37	32	**600**
2014	3563											34	126	129	106	72	70	48	39	**624**
2015	3718												15	170	143	98	119	83	69	**697**
2016	3515													35	193	111	107	110	80	**636**
2017	3486														41	169	140	127	81	**558**
2018	3381															27	154	119	98	**398**
2019	3328																27	183	154	**364**
2020	2915																	43	186	**229**
2021	2862																		27	**27**
Total	**64002**																			**10829**

5. Research

All toothfish vessels in Subarea 48.3 carry a SISO observer who collects data on toothfish and common by-catch, including conversion factors, length frequencies, weights and maturity. Toothfish otoliths are collected by observers for an ageing program that provides length-at-age data for stock assessments. Observers also record whale occurrence at the vessel during hauling; data which is then used to model depredation rates which are included in the stock assessment. Observers work with vessels to tag toothfish and skates and collate recapture data.

Dissostichus eleginoides in Subarea 48.3 are genetically distinct from those found on the Patagonian shelf (FAO Area 41). The stock, occurring within Management Areas A, B and C, is genetically separate from fish taken in the extreme north and west of Subarea 48.3 and the assessments consider only the stock within Management Areas A, B and C (see Stock Assessment Report).

In January-February 2019, the UK undertook a random stratified groundfish survey of South Georgia and Shag Rocks (WG-FSA-2019/20). The survey used the same trawl gear and survey design as previous UK surveys in Subarea 48.3 (WG-FSA-15/26, WG-FSA-17/44). The 2019 survey covered the whole shelf area, covering depths of 100-350m. The primary aim of the survey was to estimate stocks of mackerel icefish (*Champsocephalus gunnari*) but juvenile *D. eleginoides* were also captured. Numbers and lengths of *D. eleginoides* provide an index of recruitment for stock assessments. *Dissostichus eleginoides* were caught in 28 of the 73 hauls in the 2019 survey and were, as in previous surveys, present in greatest numbers around the eastern and western ends of the Shag Rocks shelf. Toothfish ranged in length from 18 to 117 cm, with evidence of a 1+ cohort with a mode at 18-26 cm.

In May 2021, the UK undertook a groundfish survey of CCAMLR Subarea 48.3 on the *FV Robin M Lee* (WG-FSA-2021/12). Seventy-seven random trawls were completed covering depths of 105 to 354 m, including 20 at Shag Rocks, 27 in the NW, 14 in the SW, 6 in the SE and 10 in the NE. The primary aim of the survey was to estimate stocks of mackerel icefish (*Champsocephalus gunnari*) but almost 500kg of juvenile *D. eleginoides* were also captured. Catches were dominated by fish of 40-50 cm in length, but with some smaller fish were also caught.

6. Stock status

6.1. Summary of current status

Assessment of the Patagonian toothfish (*D. eleginoides*) in Subarea 48.3 indicates that the current status of the stock is at 47% of B0 (see Stock Assessment Report).

6.2. Assessment method

The stock of *D. eleginoides* in Subarea 48.3 was assessed using an age-structured, two-fleet, CASAL integrated stock assessment model (see Stock Assessment Report).

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

A recent summary of the potential impacts of climate change on Southern Ocean fisheries (FAO 2018) highlights 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.

Additional Resources

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