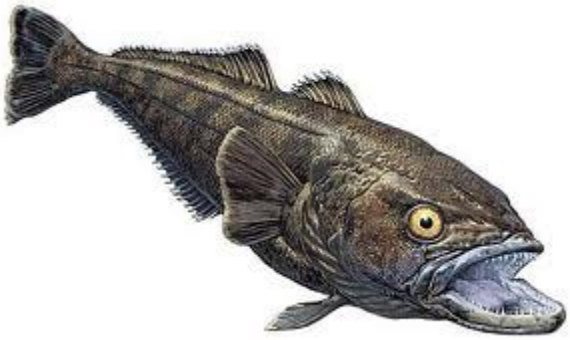
STATUS REPORT

Dissostichus eleginoides

Common Name: Patagonian toothfish

FAO-ASFIS Code: TOP



2023

Updated November, 2023

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1. Description of the fishery

1.1 Description of fishing vessels and fishing gear

Fishing for Patagonian toothfish in the SEAFO Convention Area (CA) started around 2002. Based on the SEAFO database (as of August 31, 2023), Japan is the main fishing country that operated almost continuously for 19 years (2003-2020 and 2022), while Republic of Korea, EU(Spain) and South Africa operated for 4, 8 and 2 years, respectively. Since SEAFO established, eight vessels (from four countries) operated in the SEAFO CA. Table 1 shows the list of Patagonian toothfish bottom longline vessels and their specifications (2006-2023). The Spanish longline system has been used by EU-Spain, and Republic of Korea, while the trotline by Japan, and South Africa (Figure: 1).

Table 1: List of Patagonian toothfish bottom longline vessels and their specifications (2006-Aug 31, 2023)

target species	Year	ves_Name	ves_Flag	ves_Callsign	ves_IMO	ves_Gear_Type	ves_Length	ves_Tonnage
TOP	2006	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2007	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2008	INSUNG NO1	KOR	DTBD3	7913220	LL	58.33	911
TOP	2009	JUNGWOO NO2	KOR	DTBQ4	8509961	LL	58	911
TOP	2009	JUNGWOO NO3	KOR	DTBV7	8421078	LL	48	494
TOP	2009	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2010	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2010	VIKING BAY	ESP	EAWJ	9221516	LL	43.5	692
TOP	2011	KORYO MARU 11	RSA	ZR7955	8603896	LL	10.4	336
TOP	2011	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2012	KORYO MARU 11	RSA	ZR7955	8603896	LL	10.4	336
TOP	2012	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2013	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2014	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2015	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2016	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2017	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2018	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2019	SHINSEI MARU NO3	JPN	JAAL	8520094	LL	47.2	495
TOP	2020	SHINSEI MARU NO8	JPN	7KFU	9891799	LL	57.85	1062
TOP	2020	TRONIO	ESP	ECJF	9361603	LL	55	569.26
TOP	2021	TRONIO	ESP	ECJF	9361603	LL	55	569.26
TOP	2022	SHINSEI MARU NO8	JPN	7KFU	9891799	LL	57.85	1062
TOP	2022	TRONIO	ESP	ECJF	9361603	LL	55	569.26
TOP	2023	TRONIO	ESP	ECJF	9361603	LL	55	569.26

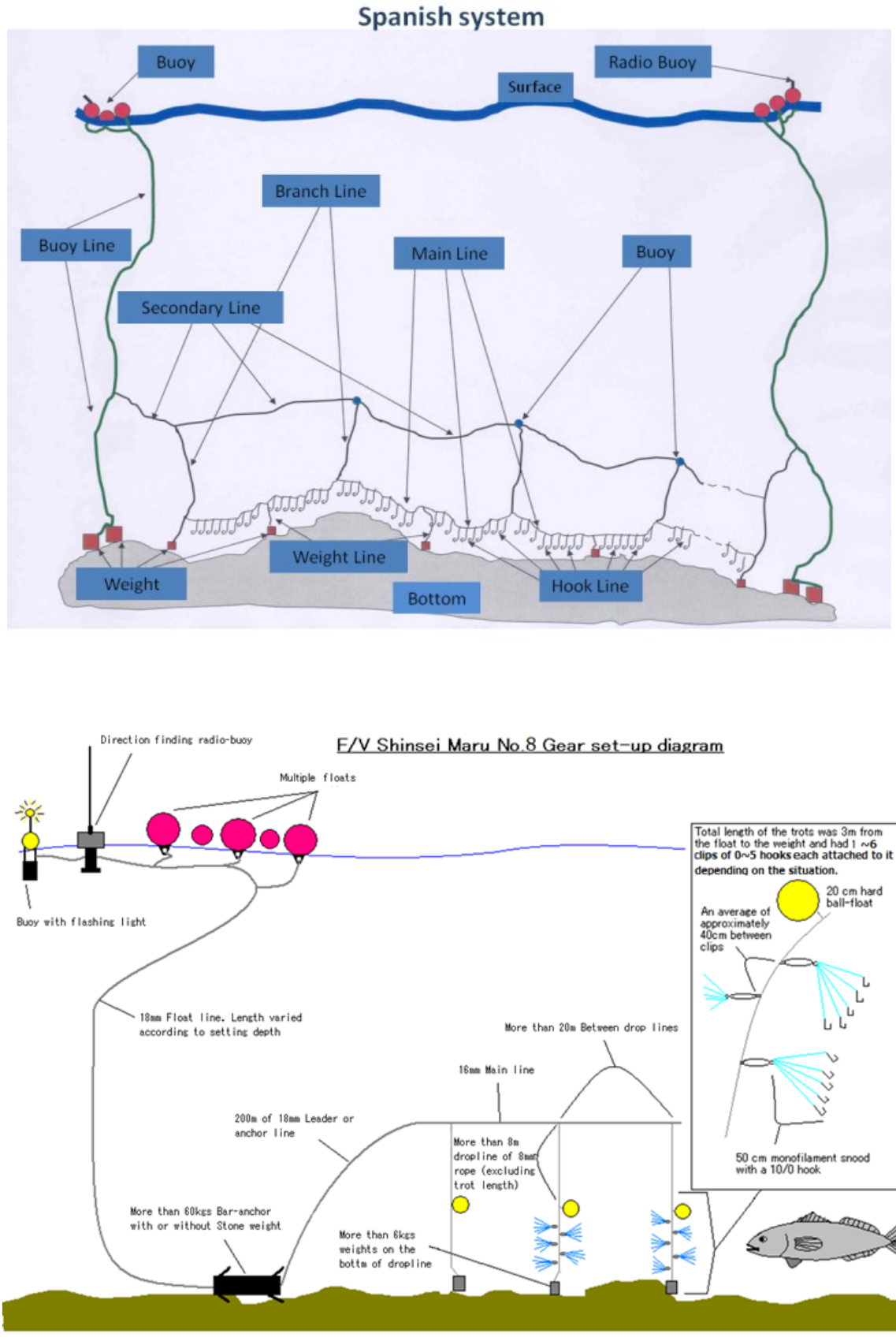

Figure 1: Fishing gears used to fish *D. eleginoides*: Spanish longline system (top) and the trotline (bottom).

1.2 Spatial and temporal distribution of fishing

In SEAFO CA, the fishery has been conducted in Sub-Area D, being concentrated over seamounts in Division D1 (Meteor), at Discovery seamount (central part of Sub-Area D) and at seamounts located in the western part of Sub-Area D (West) shown as below.

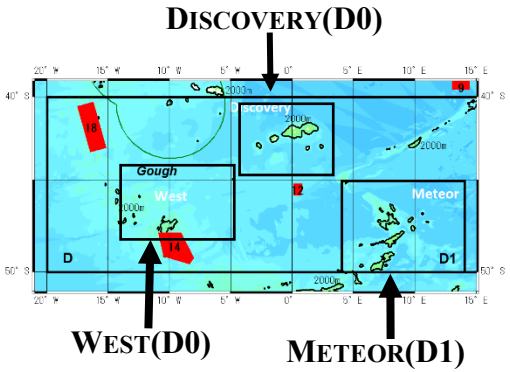

Fig. 2 shows the spatial and temporal distribution of fishing using distribution maps of annul catch by set (2009-Aug.,2023) (15 years). 7 historically highest catches were recorded in 2022-2023 (3.0~6.7 tons/set). The overall average catch (1,993 sets) is 0.69 ton/set, while 1.49 ton/set (2022-2023) which is 2.2 times higher.

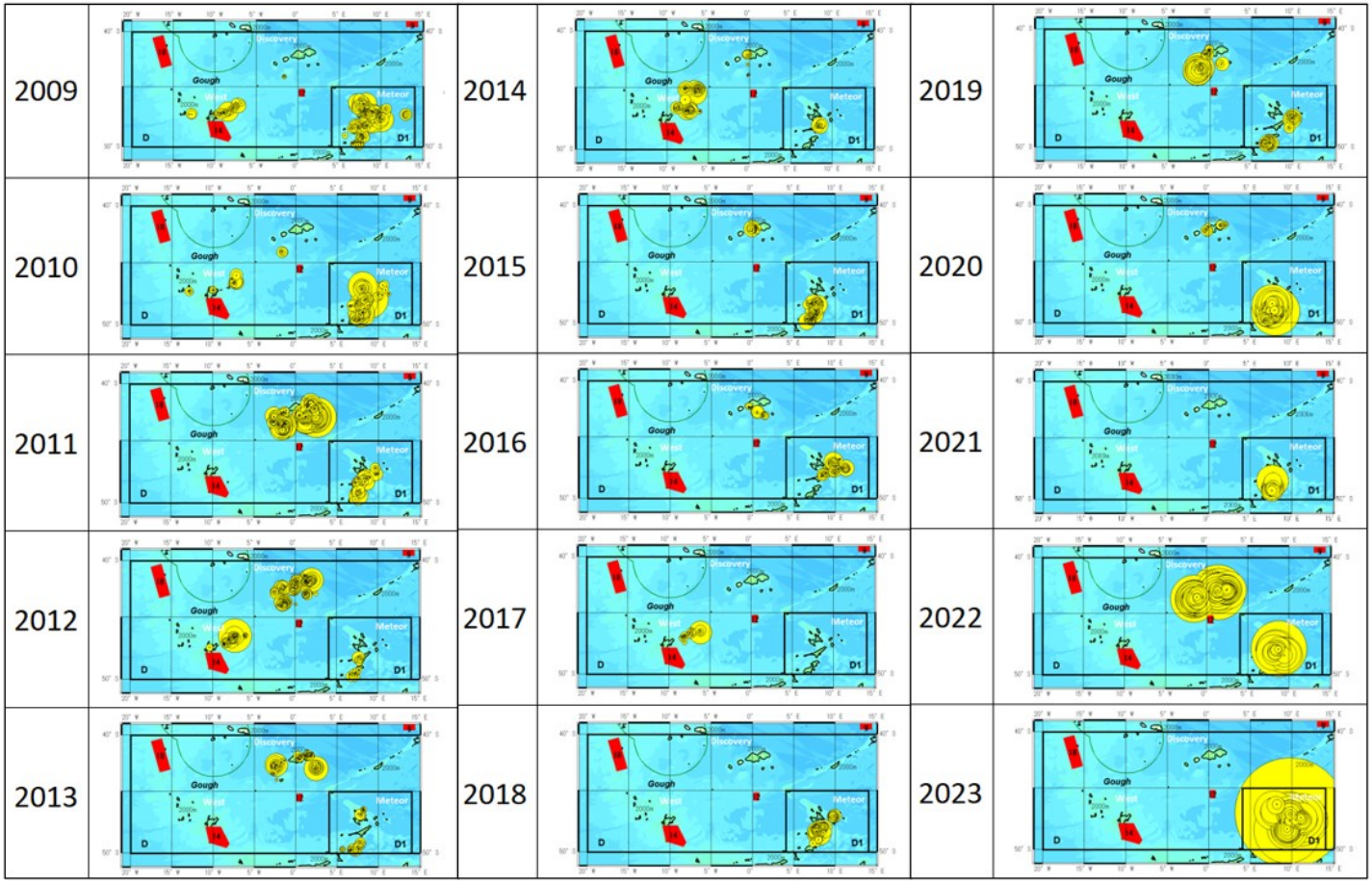

Figure 2: Annual catch distribution by set (Patagonian toothfish) (2009-2023) (SEAFO database) (created by Marine Explorer ver 4.9.33) (Bottom contour data: NOAA ETOPO1)

Legend ● Catch: 2 tons/set Red-polygons: closed areas

Table 2 shows the summary of fishing efforts (number of sets and hooks) by year and area (2009-2023). More fishing efforts have been almost continuously in place in Meteor and Discovery areas and less and discontinuously in the West area.

Table 2: Summary of fishing efforts (number of sets and hooks) by year and area (2009-2023)
(2023 is preliminary as of Aug 31, 2023)
(Data source: SEAFO Secretariat)

Area	D1 (Meteor)		Discovery		West		Total	
year	# of set	# of hooks (million)	# of set	# of hooks (million)	# of set	# of hooks (million)	# of set	# of hooks (million)
2006	147	(na)					147	(na)
2007	31	(na)	101	(na)	94	(na)	226	(na)
2008	52	(na)			68	(na)	120	(na)
2009	233	1.37	3	0.02	49	0.25	285	1.64
2010	118	0.55	5	0.04	27	0.17	150	0.76
2011	54	0.19	207	0.82	1	0.00	262	1.02
2012	25	0.12	207	0.92	68	0.26	300	1.29
2013	57	0.26	108	0.43		0.00	165	0.70
2014	13	0.05	64	0.26	100	0.40	177	0.71
2015	127	0.56	24	0.10			151	0.66
2016	67	0.27	22	0.09			89	0.36
2017					34	0.14	34	0.14
2018	100	0.46					100	0.46
2019	75	0.21	48	0.23			123	0.44
2020	56	0.49	24	0.11			80	0.60
2021	15	0.18	2	0.01			17	0.19
2022	21	0.17	75	0.36			96	0.53
2023	74	0.57					74	0.57
Average (operation year)	74	0.39	68	0.28	55	0.17	144	0.67

Blank: no fishing operations and (na): Data are not available

1.3 Reported retained catches and discards

Table 3 presents data on Patagonian toothfish catches and discards (2002-Aug 31, 2023) listed by country and the management area from which catches were taken. Annual catches varied between 12t (2017) and 393t (2003). A small amount (< 1 ton) of Atlantic toothfish (*Dissostichus mawsoni*) were caught in 2014 by Japan.

In the last three years with complete data (2020-2022) retained catches were 63, 16 and133 tons respectively and the annual weight of discarded specimens was less than 1 t in 2020-2021 and 4 t in 2022. Discards were mainly due to parasite infection of fish. Retained and discarded bycatch from the Patagonian toothfish fishery by species are available in the Secretariat. It is noted that the two most dominant bycatch species (in terms of weight) are rattail (GRV) and deep-sea cod (ANT).

Table 3: Catches (tonnes) (Retained & Discarded) of Patagonian toothfish (*Dissostichus eleginoide)*, (TOP) exploited by EU (Spain), Japan, Republic of Korea and Republic of South Africa (2002- Aug 31,2023) *(Quoted from Landing Tables for 2023, DOC/SC/03/2023)*

Flag State	Spain					Japan				Rep of Korea				South Africa				BOLIVIA (IUU)	
Fishing method	Longlines					Longlines				Longlines				Longlines				Longlines	
Management Area	D	D0		D1		D0		D1		D0		D1		D0		D1		Unknown	
Year	Retain	Retain	Discard	Retain	Discard	Retain	Discard	Retain	Discard	Retain	Discard	Retain	Discard	Retain	Discard	Retain	Discard	Retain	TOTAL
2002	18					N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**18**
2003	101					47	0	N/F	N/F	245	0	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**393**
2004	6					124	0	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**130**
2005	N/F	N/F	N/F	N/F	N/F	158	0	N/F	N/F	10	0	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**168**
2006	11					155	0	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**166**
2007	N/F	N/F	N/F	N/F	N/F	166	0	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**166**
2008	N/F	N/F	N/F	N/F	N/F	122	0	N/F	N/F	76	0	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**198**
2009	N/F	N/F	N/F	N/F	N/F	N/F	N/F	74	0	16	0	46	0	N/F	N/F	N/F	N/F	N/F	**136**
2010	26	12	0	14	0	N/F	N/F	54	2	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**108**
2011	N/F	N/F	N/F	N/F	N/F	159	6	N/F	N/F	N/F	N/F	N/F	N/F	15	0	28	0	N/F	**208**
2012	N/F	N/F	N/F	N/F	N/F	86	3	N/F	N/F	N/F	N/F	N/F	N/F	24	0	12	0	N/F	**125**
2013	N/F	N/F	N/F	N/F	N/F	41	2	19	1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**63**
2014	N/F	N/F	N/F	N/F	N/F	47	<1	6	<1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**53**
2015	N/F	N/F	N/F	N/F	N/F	52	<1	7	<1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**59**
2016	N/F	N/F	N/F	N/F	N/F	7	<1	53	<1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	101	**161**
2017	N/F	N/F	N/F	N/F	N/F	12	<1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**12**
2018	N/F	N/F	N/F	N/F	N/F	N/F	N/F	57	<1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**57**
2019	N/F	N/F	N/F	N/F	N/F	26	1	37	<1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**64**
2020	N/F	N/F	N/F	58	0	5	<1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**63**
2021	N/F	N/F	N/F	16	0	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**16**
2022	N/F	N/F	N/F	32	0	101	4	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**137**
2023*	N/F	N/F	N/F	113	0			N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F	**113**
TOTAL	**162**	**12**	**0**	**233**	**0**	**1308**	**16**	**307**	**3**	**347**	**0**	**46**	**0**	**39**	**0**	**40**	**0**	**101**	**2396**

* Provisional (Data received up to 31 August). N/F = No Fishing. Blank fields = No data available

1.4 IUU

IUU fishing activity in the SEAFO CA has been reported to the Secretariat in 2012 and 2015-2016. In 2015-2016 it was reported that one IUU vessel (Bolivia) caught 101 tonnes of Patagonian toothfish.

2. Stock distribution and identity

Patagonian toothfish is a southern circumpolar, eurybathic species (70-1,600m), associated with shelves of the sub-Antarctic islands usually north of 55ºS. Young stages are pelagic (North, 2002). The species occurs in the Kerguelen-Heard Ridge, islands of the Scotia Arc and the northern part of the Antarctic Peninsula (Hureau, 1985; DeWitt et al., 1990). This species is also known from the southern coast of Chile northward to Peru and the coast of Argentina, especially in the Patagonian area (DeWitt, 1990), and also present in Discovery and Meteor seamounts in the SE Atlantic (Figure 3) and El Cano Ridge in the South Indian Ocean (López-Abellán and Gonzalez, 1999, López-Abellán, 2005).

In SEAFO CA the stock structure of the species is unknown. The CCAMLR Scientific Committee in 2009 noted that in most years since 2003, the main species caught in CCAMLR

sub-area 48.6 (adjacent to and directly south of SEAFO Division D) is *D. eleginoides*. The distribution of the species appears to be driven by the sub-Antarctic front which extends into the SEAFO CA.

There were two tags recaptures between SEAFO CA and CCAMLR CA, which suggests connectivity between two waters. For details, see Section 3.8 Tagging and migration, page 12).

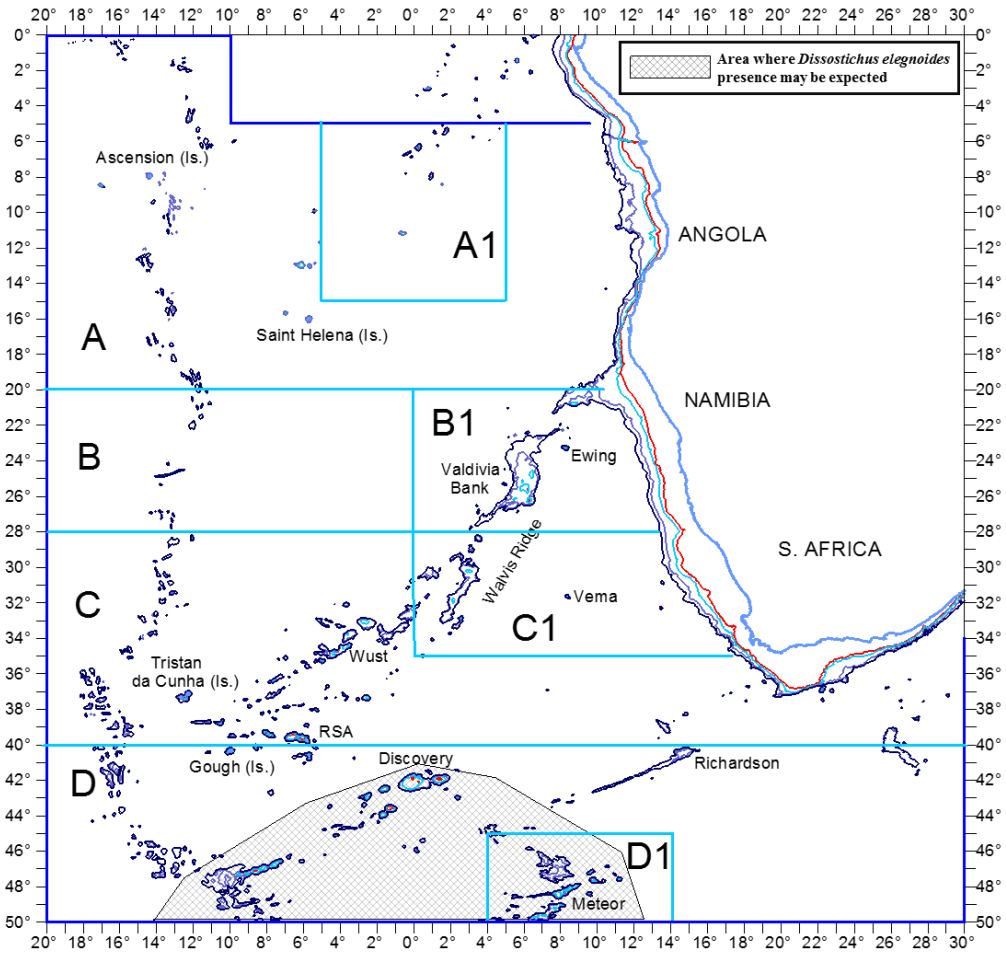

Figure 3: Species geographical distribution in the SEAFO CA
(just above the CCAMLR sub-area 48.6)
(Source: Species profile on the SEAFO website).

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3. Data available for assessments, life history parameters and other population information

3.1 Samplings

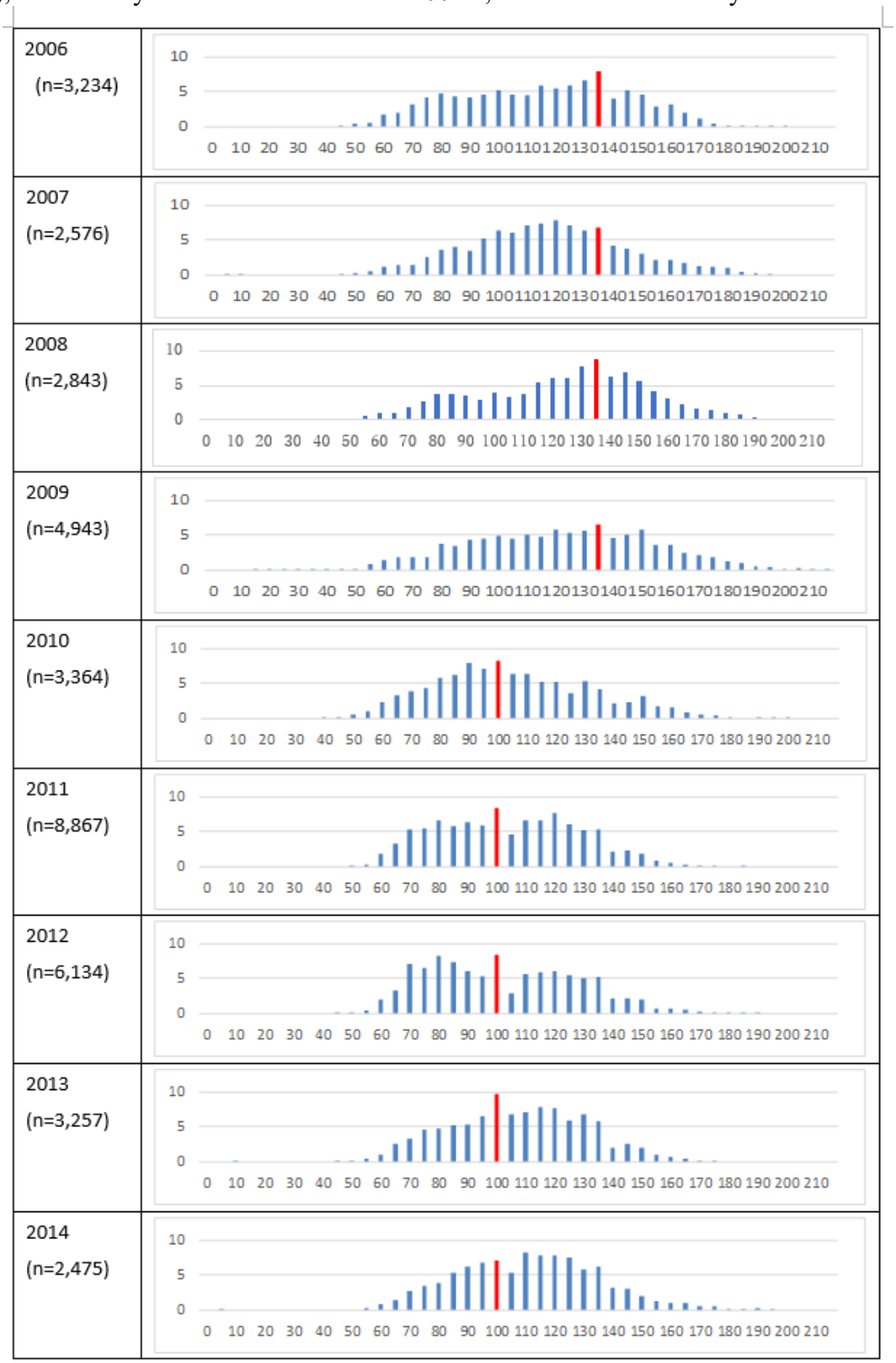
The number of fishing sets sampled for Patagonian toothfish from 2006 onwards indicates a good sampling level in line with the SEAFO guidelines for data collection (Table 4). On average, samplings were conducted in 92% of the total sets and 23 specimens were measured per sampled fishing set, which is considered acceptable given the length range of the exploited population and satisfies with the SEAFO sampling protocol (n=20). Annex A shows number of various biological samples collected for Patagonian toothfish, i.e., fork length, weight, sex, otolith, gonad weight and maturity stage. Information of all biological samples of Patagonian toothfish and bycatch species exploited by Patagonian toothfish bottom longline fisheries are available in the Secretariat's database.

Table 4: Annual biological sampling efforts for Patagonian toothfish (2006- Aug 31, 2023) (SEAFO database)

year	Total no. of sets	No.of set with samples	% of sets including samplings	Ave. no. of fish sample/set	Total no. of fish sampled
2006	147	146	99	22	3,235
2007	226	222	98	12	2,577
2008	120	120	100	24	2,843
2009	285	275	96	18	4,943
2010	150	125	83	27	3,364
2011	262	263	100	33	8,667
2012	300	298	99	21	6,134
2013	165	164	99	20	3,258
2014	177	163	92	15	2,475
2015	151	149	99	17	2,568
2016	89	88	99	18	1,551
2017	34	11	32	44	481
2018	100	92	92	21	1,955
2019	123	112	91	19	2,142
2020	80	77	96	30	2,297
2021	17	15	88	35	525
2022	96	94	98	23	2,196
2023	74	74	100	20	1,491
Average	144	138	92	23	2,928

3.2 Length data and frequency distribution

Figure 4 shows the annual total length (%) frequency distributions of Patagonian toothfish catch (samples) in the SEAFO CA (2006-Aug 31, 2023). Distribution patterns and modes vary widely from year to year. Around 135cm is the most common mode in the early years (2006-2009), followed by smaller modes down to 100cm, which are indicated by red bars.



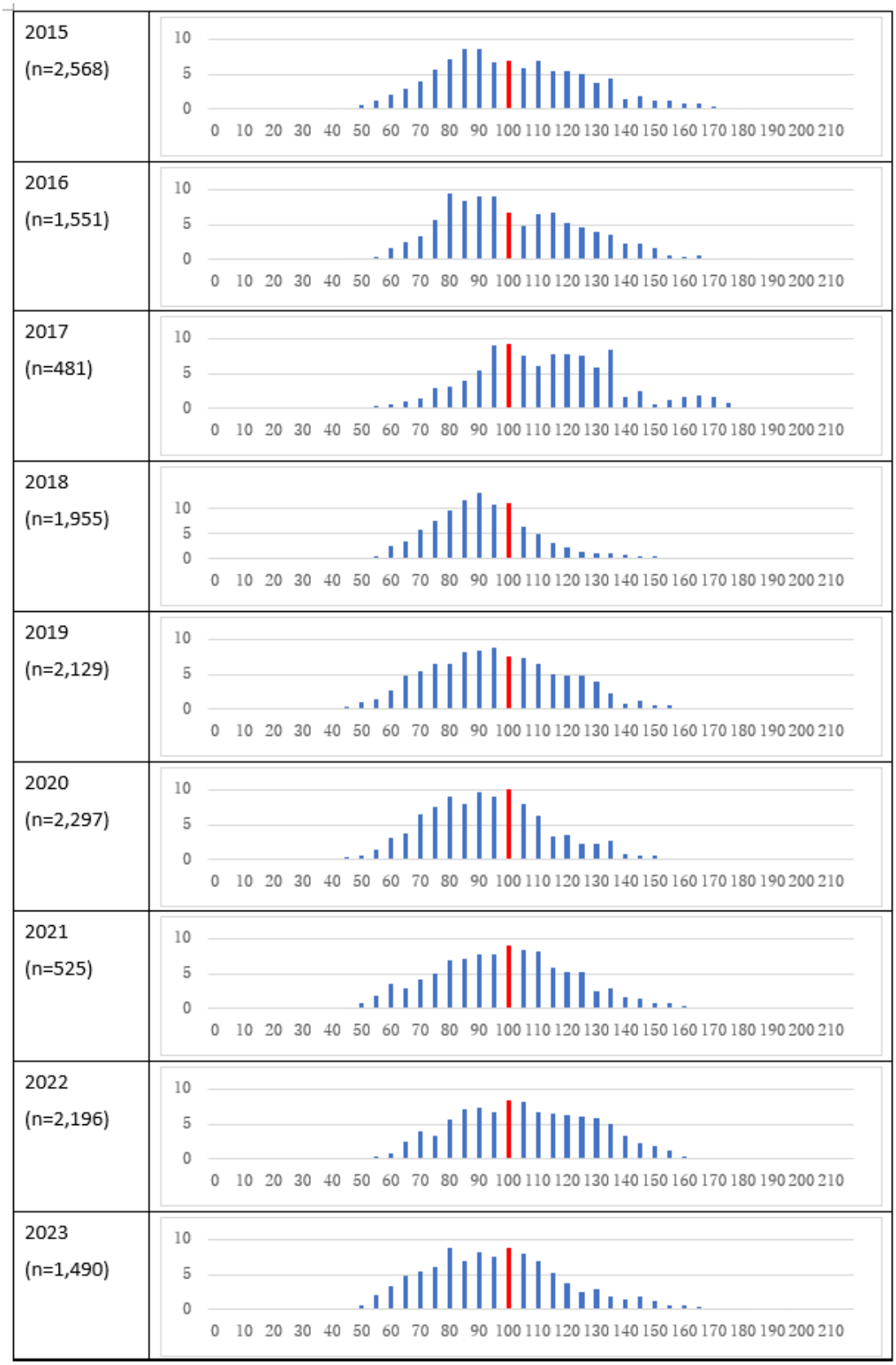


Figure 4: Annual size (total length) % frequency distributions of *D. eleginoides* in Sub-Area D (2006-Aug 31, 2023) by 5cm size class.
Note: Around 135cm is the most common mode in the early years (2006-2009), followed by smaller modes down to 100cm, which are indicated by red bars.

3.3 Length-weight relationships

Figure 5 shows the length-weight relationships by sex based on observer data from the Japanese fleet in 2012. Both are similar, but females have higher variance according to spawning conditions.

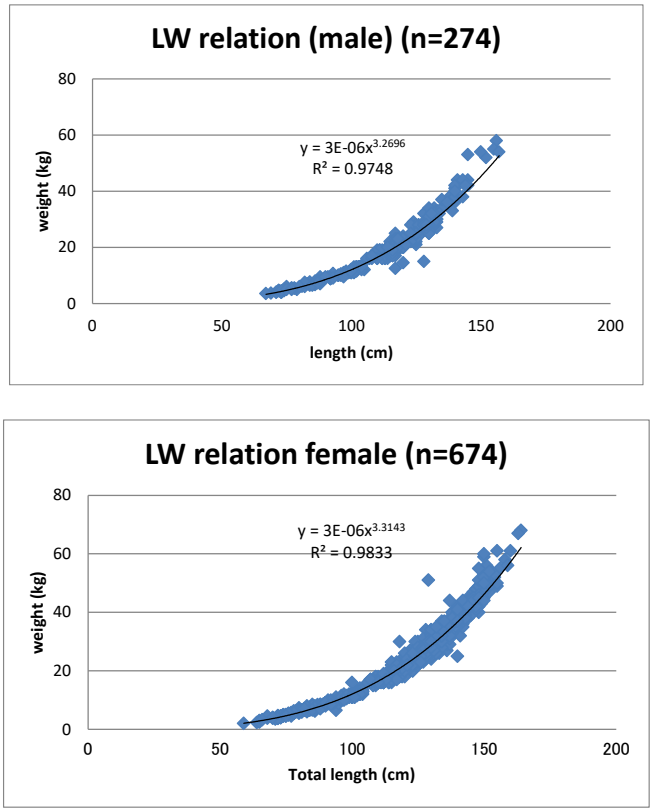


Figure 5: Total length-weight relationships by sex based on the Japanese exploratory fishing in 2012

3.4 Age data and growth parameters

There is no available information for this species in SEAFO CA.

3.5 Reproductive parameters

There is no available information for this species in SEAFO CA.

3.6 Natural mortality

There is no available information for this species in SEAFO CA.

3.7 Feeding and trophic relationships (including species interaction)

There is no available information for this species in SEAFO CA.

3.8 Tagging and migration

Table 5 shows the information on tag releases and recaptures in SEAFO and CCAMLR CA, indicating movements between two areas. This implies that the stock is likely to be the same between SEAFO and CCAMLR (area 48.6 adjacent to SEAFO CA and up to Kerguelen adjacent to SIOFA CA).

Table 5 Summary of tag releases and recaptures for Patagonian toothfish in SEAFO and CCAMLR CA.

CA	Release				Recapture			
	#	year	Area	Vessel	#	Year	Area	Vessel
SEAFO	11	2006	Sub area D	Viking Bay	1		CCAMLR CA	
	14	2010		(Spain)				
	117	2023		Tronio (Spain)				
CCAMLR					1	2017	Sub area D (SEAFO CA)	
		2013	Sub area 48.6		1	2020	Meteor (D1) (SEAFO CA)	Tronio (Sapin)
		2017	Kerguelen 58.5.1		1	2022	Discovery (D0) (SEAFO CA)	Shinsei No 8 (Japan)

(Note 1) Blank: no information available.

(Note 2) A total of 142 TOP has been tagged and released in the SEAFO CA (2006~2023).

4. Stock assessment and status

At the 9th meeting of the Scientific Committee in 2014 (SC9 (2014)), preliminary stock assessment attempts were made using Y/R analysis, length cohort analysis and ASPIC (production model). However, there was no consensus on the results because the time series were too short and the r2 (correlation coefficient) of the standardized CPUE was too low (r2 < 30%). However, SC9 (2014) suggested that all results provided the perception that the current harvest rate (F) was below Fmsy in 2014 (SC9, 2014 report).

As no agreed stock assessment results are available, two basic information (trends of catch and nominal CPUE) are provided as reference in Figure 6 and 7, respectively. The trend of the total catch has been decreasing since 2003 in general except a few years (Figure 6). The trend of annual average nominal CPUE (2009-2023) (Figure 7) shows the high level (235 kg/1,000 hooks) in the last 2 years (2022-2023), while the low level (2009-2021) (116 kg/1,000 hooks) in the previous years (2002~2021), which is about 2 times difference.

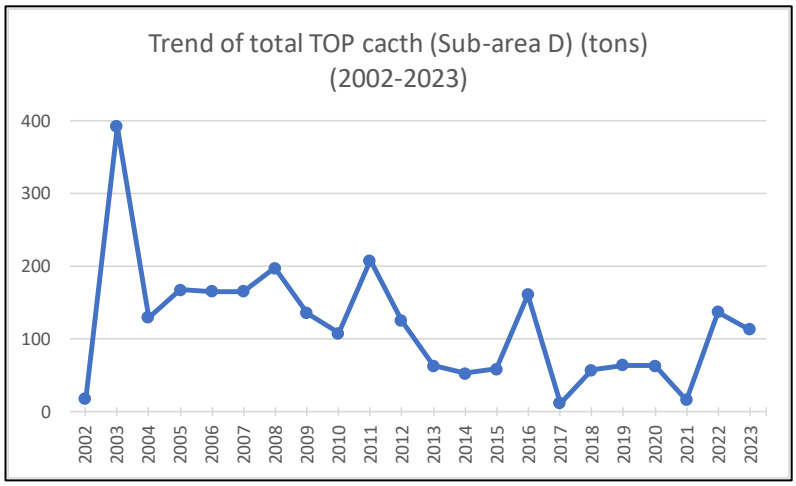


Figure 6: Trend of total catch of Patagonian toothfish (sub-area D)

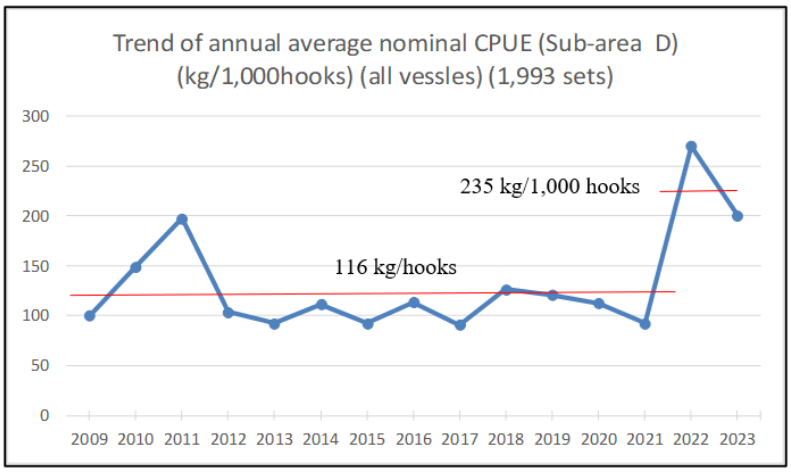


Figure 7: Trend of annual average nominal CPUE (2009-2023) in Sub area D
Note: (average) 116kg/1,000hooks (2009-2021) and 235 kg/1,000hooks (2022-2023).

5. Incidental catch

In this section, incidental catch (VME species, seabird, mammals and turtles) is reported.

5.1 Invertebrate bycatch (VME taxa)

Table 6 shows VME indicator species annual bycatch (16 coral and 3 sponge species) exploited by Patagonia toothfish bottom longline fishery (kg) (2010-Aug 31, 2023) (3 areas). Figure 8 shows their geographic locations.

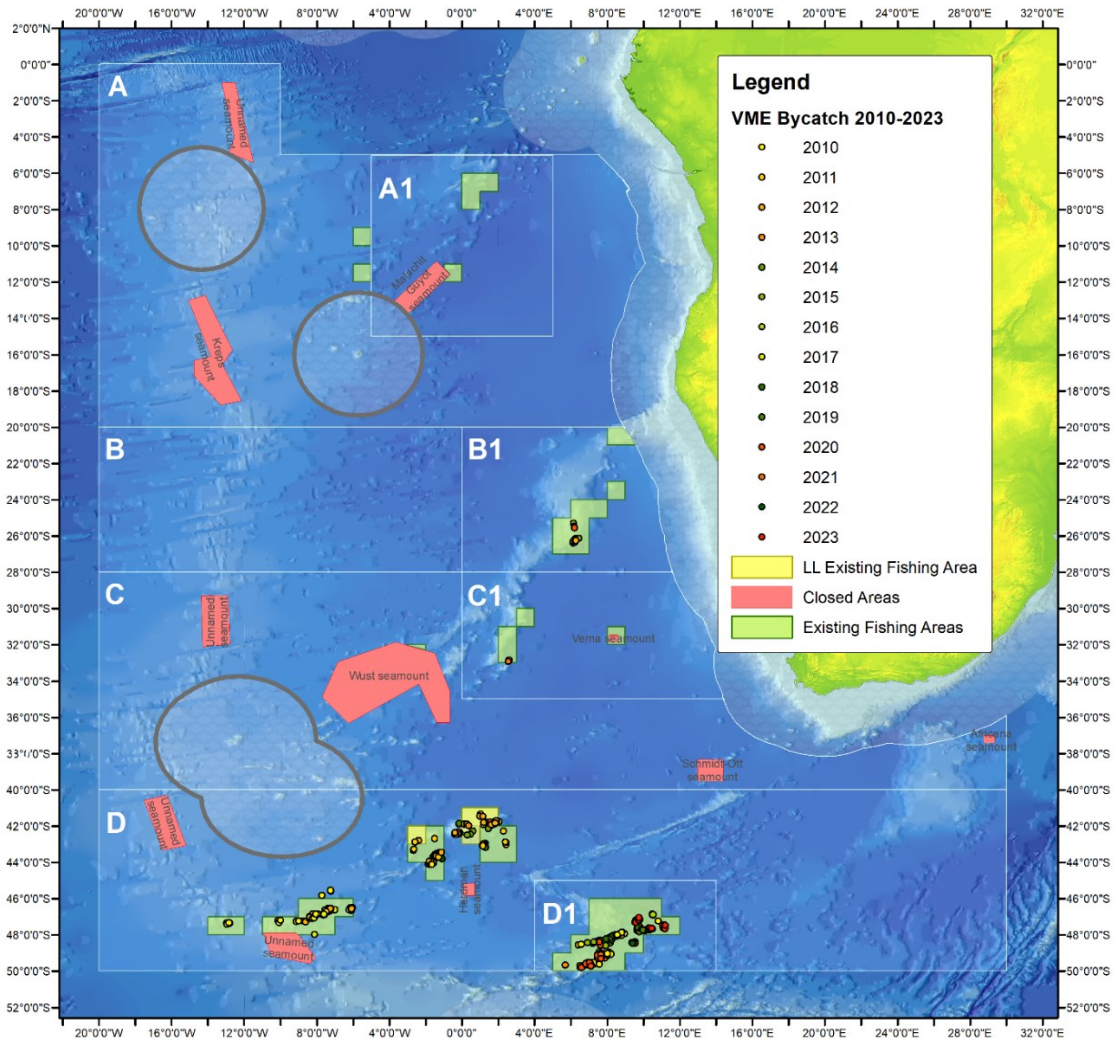


Figure 8: Locations for incidental bycatch of VME indicator species exploited by Patagonia toothfish bottom longline fishery (kg) (2010- Aug 31, 2023). (Note) To now, there are no records on VME indicators species weights > encounter threshold values.

Table 6: Annual total bycatch wights (kg) of VME indicator species in the Patagonia toothfish bottom longline fisheries by area (2010-Aug 31, 2023) (NF: No fishing operations and yellow markers: bycatch weight and blank for no bycatch)

type		Corlas (16)																Sponges (3)		
FAO code		GGW	CSS	ATX	OEQ	OWP	AXT	AZN	HXY	AQZ	CWD	AJZ	ZOT	NTW	KQL	HQZ	BZN	PFR	SPO	DMO
English name		Gorgonians	Hard corals madrepores nei	Sea anemones	Basket Star	Basket and brittle stars	Hydrocorals	Hydrocorals	Glass Sponges	Black corals and thorny corals	Feather stars and sea lilies	Soft corals	Zoanthids	Sea pens	Branched bamboo coral	Hydrozoans	Erect bryozoans	Sponges	Sponges	Spomges
Scieitific name		Gorgoniidae	Scleractinia	Actiniaria	Euryalida	Ophiuroidea	Stylasteridae	Anthoathecatae	Hexactinellida	Antipatharia	Crinoidea	Alcyonacea	Zoanthidea	Pennatulacea	Acanella spp	Hydrozoa	Bryozoans	Porifera	Spongidae	Demospongiae
D0 (West)	2010	33.24	1.76	0.10		1.09	0.10			3.86	0.91	0.16	0.14	0.02		0.06		4.89		
	2011																			
	2012	10.42								0.20										
	2013(NF)																			
	2014																			
	2015(NF)																			
	2016(NF)																			
	2017	1.41	6.91		1.14			0.59		0.10		0.06	1.12	0.02				0.52		
	2018(NF)																			
	2019(NF)																			
	2020(NF)																			
	2021(NF)																			
	2022(NF)																			
	2023(NF)																			
	Average	15.02	4.33	0.10	1.14	1.09	0.10	0.59		1.39	0.91	0.11	0.63	0.02		0.06		2.71		
D0 (Discovery)	2010	0.65	0.29	0.01		0.16							0.05	0.93				13.13		
	2011	3.81	15.40	0.40																
	2012	19.86	17.60	1.66										0.02					1.20	
	2013	1.12																		
	2014	2.34	2.80	0.20		0.10														
	2015					0.00												0.40		
	2016	0.01	0.68																	
	2017(NF)																			
	2018(NF)																			
	2019	0.02	3.20				0.10		0.64	0.01		0.02	0.08	0.01						
	2020	0.00													0.18		0.12			
	2021(NF)																			
	2022	1.03	1.82	0.00			0.02							0.20						
	2023(NF)																			
	Average	3.20	5.97	0.45		0.09	0.06		0.64	0.01		0.02	0.07	0.29	0.18		0.12	6.76	1.20	
D1 (Meteor)	2010	13.60	0.10	0.90		2.00				0.50	0.10	1.00	0.10	0.30		0.30		11.70		
	2011																			
	2012																			
	2013	0.70		1.20																
	2014	2.60	0.30																	
	2015	0.35				4.90	1.00													
	2016	9.54	3.88			0.60	0.12											0.84		
	2017(NF)																			
	2018	0.60	2.76		1.04		0.94	1.46		0.04							0.08			0.02
	2019	6.93	0.08		0.02							0.06	0.02	0.22						
	2020	17.79		14.82			4.49			0.57		0.54								0.67
	2021	4.21	0.37	0.54								0.07								0.32
	2022	4.64	1.12															1.85		
	2023	16.41	1.03		3.39		1.80		0.98	0.04				0.01						
	Average	7.03	1.21	4.36	1.48	2.50	1.67	1.46	0.98	0.29	0.10	0.42	0.06	0.18		0.30	0.08	4.80		0.33
	over all average	6.58	3.54	1.98	1.40	1.27	1.07	1.03	0.81	0.66	0.50	0.27	0.25	0.19	0.18	0.18	0.10	4.76	1.20	0.33

5.2 Incidental mortality (seabirds, mammals and turtles)

In the SEAFO CA, five sea birds were caught incidentally in Sub-area D (2014 and 2016) as shown in Table 7.

Table 7: Summary of sea bird bycatch in SEAFO CA.

FAO ASFIS code	DIM	DIX	MAI	PUG
English name	Black-browed Albatross	Wandering Albatross	Southern giant Petrel	Great Shearwater
Scientific name	*Thalassarche melanophris*	*Diomedea exulan*	*Macronectes giganteus*	*Puffinus gravis*
2014	1			2
2016		1	1	

5.3 Bycatch mitigation methods (Sea birds)

No offal dumping during hauling, deployment of bird scaring devices (Tori lines) and bottle test are mandated to mitigate seabird bycatch.

6. Lost and abandoned gear

Figure 9 shows locations the lost gears (2019-Aug 31, 2023) based on the observer data.

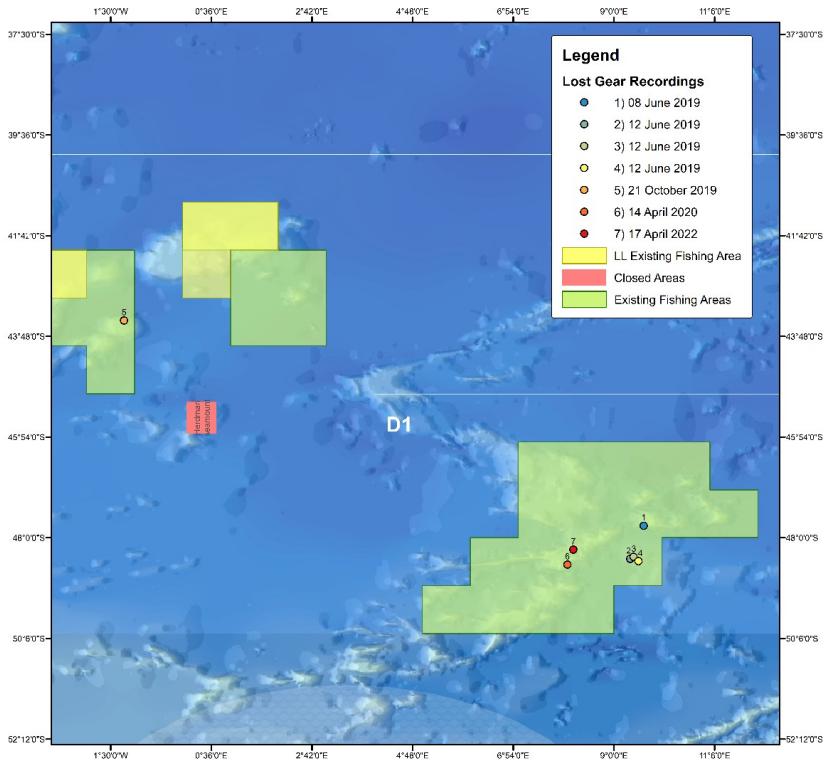


Figure 9: Locations of the lost gears in the Patagonia toothfish bottom longline fishery based on observer data (2019- Aug 31, 2023)

7. Current conservation measures and management advice

In 2015, the Commission adopted Harvest Control Rule (HCR) to decide TAC if agreed stock assessment is not available. This HCR had been applied in NAFO (Greenland halibut during 2011-2017), which uses average of slopes of CPUE in recent 5 years (Box 1).

$$TAC_{y+1} = \begin{cases} TAC_y \times (1 + \lambda_u \times slope) & if \quad slope \geq 0 \\ TAC_y \times (1 + \lambda_d \times slope) & if \quad slope < 0 \end{cases}$$

Slope: average slope of the Biomass Indicator (CPUE, Survey) in recent 5 years

- λ_u :TAC control coefficient if slope > 0 (Stock seems to be growing) : λ_u=1
- λ_d :TAC control coefficient if slope < 0 (Stock seems to be decreasing) : λ_d=2
- TAC generated by the HCR is constrained to ± 5% of the TAC in the preceding year.

Box 1: HCR for Patagonian toothfish adopted by the Commission in 2015

In the HCR, standardized CPUE is preferable to apply. Although SC estimated standardized CPUE using generalised linear models (GLM) five times in the past (2014, 2015, 2016-twice and 2018), all results indicated that correlation coefficients (goodness of fitness) were too low (r2 < 30%) to provide the plausible standardized CPUE for the HCR and SC did not agree to use standardized CPUE for HCR.

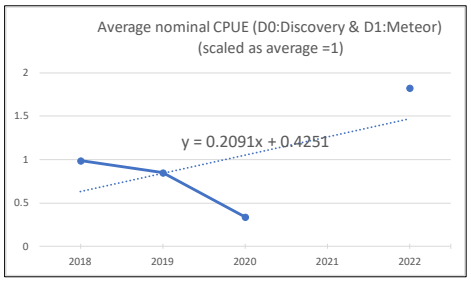
Then SC12 (2016) agreed to apply nominal CPUE for the HCR. As nominal Japanese CPUE in the Meteor and Discovery seamounts areas are available almost every year, SC12 (2016) agreed to use the slope of average of two nominal CPUE and applied in 2016 and afterwards.

Using this method, TAC for 2022-2023 is computed as 261t for Sub-Area D in SC (2021). Then SC (2021) recommends TAC for Sub-Area D of 261t and a zero TAC for the remainder of the SEAFO CA for the years 2022 and 2023, which was agreed by the Commission meeting in 2021.

The last Commission meeting (2022) requested SC19 (2023) to assess whether the current TAC (261 tonnes) could be carried over to 2024. In this regard, the virtual TAC (2024) was calculated using HCR and resulted in 274 tonnes (Box 2).

The stock is considered to be safe and sustainable if the current TAC (261 tons) is extended to 2024 from 3 points of view: (a) recent catches are at the low level (Figure 6), (b) CPUE (2022-2023) shows the increase trend (Figure 7) and the virtual TAC (2024) (274 tons) is higher than the current TAC (261 tons).

Box 2: Virtual TOP TAC (2024) based on HCR



Average slope (Discovery and Meteor)= +0.2091
Apply HCR ➔ Virtual TAC (2024) =**316 tons**

Difference (%) from the current TAC (2022-2023)= +21.1% > +5 %
Apply the 5% constraint rule

➔ the virtual TAC (2024) = 261 tons x **105%**= **274 tons**

1

Table 8 shows relevant Conservation Measures.

Table 8: Conservation Measures.

Conservation Measure 04/06	On the Conservation of Sharks Caught in Association with Fisheries Managed by SEAFO
Conservation Measure 14/09	To Reduce Sea Turtle Mortality in SEAFO Fishing Operations.
Conservation Measure 25/12	On Reducing Incidental Bycatch of Seabirds in the SEAFO Convention Area
Conservation Measure 30/15	On the Management of Vulnerable Deep Water Habitats and Ecosystems in the SEAFO Convention Area
Conservation Measure TAC-01 (2023)	On Total Allowable Catches and related conditions for Patagonian Toothfish, Deep-Sea Red Crab, Alfonsino, Orange Roughy and Pelagic Armourhead for 2024 in the SEAFO Convention Area.

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Annex A: Sample sizes of Patagonian toothfish biological data by year
(2006-Aug 31, 2022)

year	Total length(cm)	Weight (kg)	Sex	Maturity Stage	Gonad Weight (g)	Scale and/or Otolith
2006	3,235					
2007	2,577					
2008	2,843					
2009	4,943	2,175				
2010	3,364	490	482	432		
2011	8,667	1,592				
2012	6,134	1,870				
2013	3,258					
2014	2,475	2,475	2,468	2,467	2,467	800
2015	2,568	2,568	2,567	2,568	2,567	736
2016	1,551	1,551	1,531	1,530	1,529	749
2017	481	472	472	472	472	141
2018	1,955	1,955	1,952	1,935	1,955	479
2019	2,129	2,120	2,096	2,112	2,112	551
2020	2,297	2,268	2,268	2,268	2,233	659
2021	525	525	525	522	292	150
2022	2,196	2,196	2,175	2,175	2,175	576
2023	1,490	1,491	1,491	1,490	1,291	248
Total	52,688	23,748	18,027	17,971	17,093	5,089