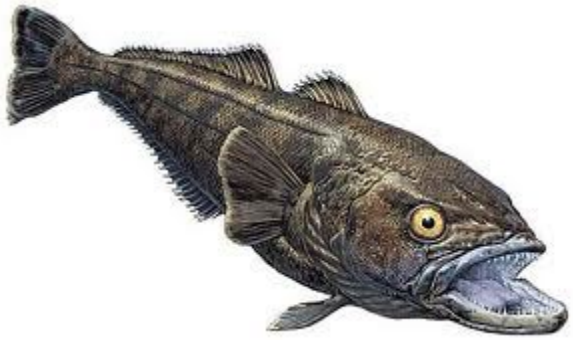
STATUS REPORT

Dissostichus eleginoides

Common Name: Patagonian toothfish

FAO-ASFIS Code: TOP



2018

Updated 22 November, 2018

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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 CA started around 2002. The main fishing countries working in the area include vessels from Japan, the Republic of Korea, Spain and South Africa. Historically a maximum of three vessels per year fished in the SEAFO CA. The Spanish longline system and the Trotline (Fig. 1) are the fishing gears commonly used.

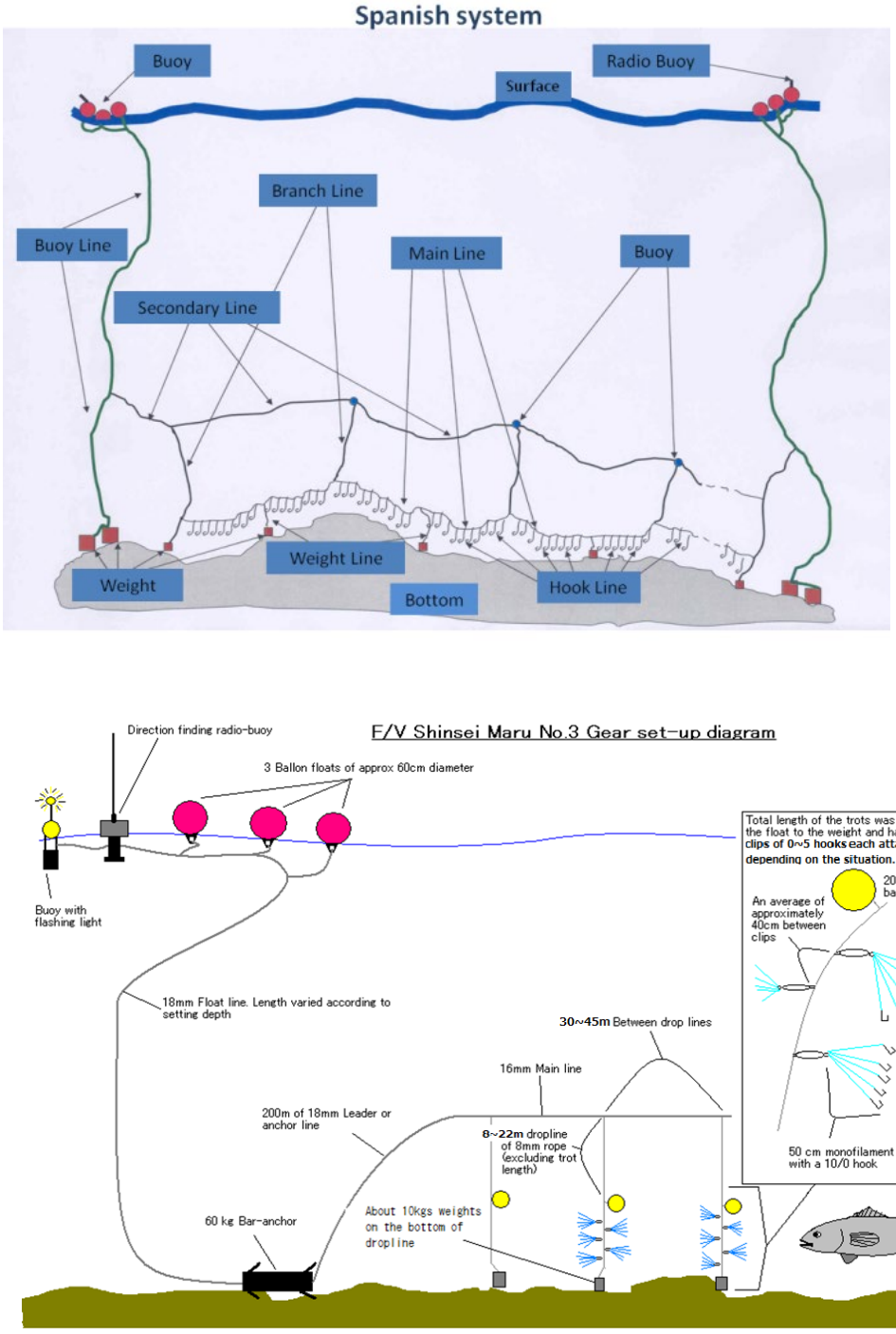
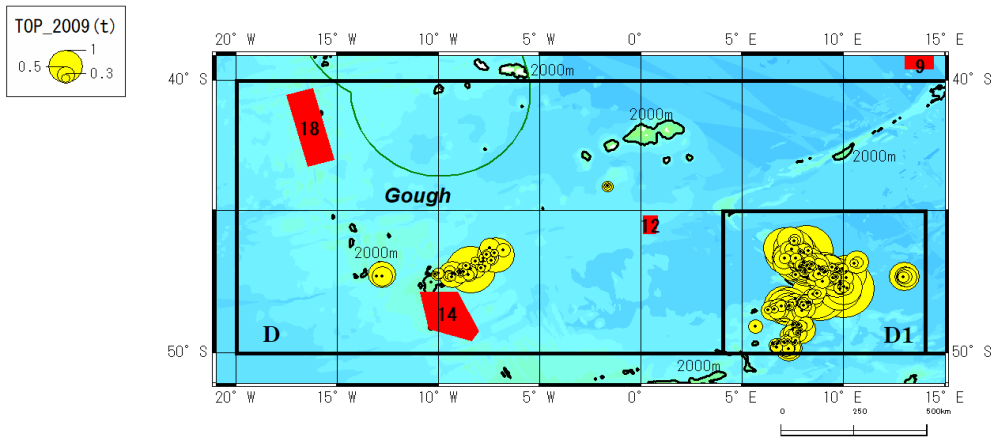


Figure 1: Fishing gears used to fish *D. eleginoides*: Spanish longline system (top) and the Trotline (bottom).

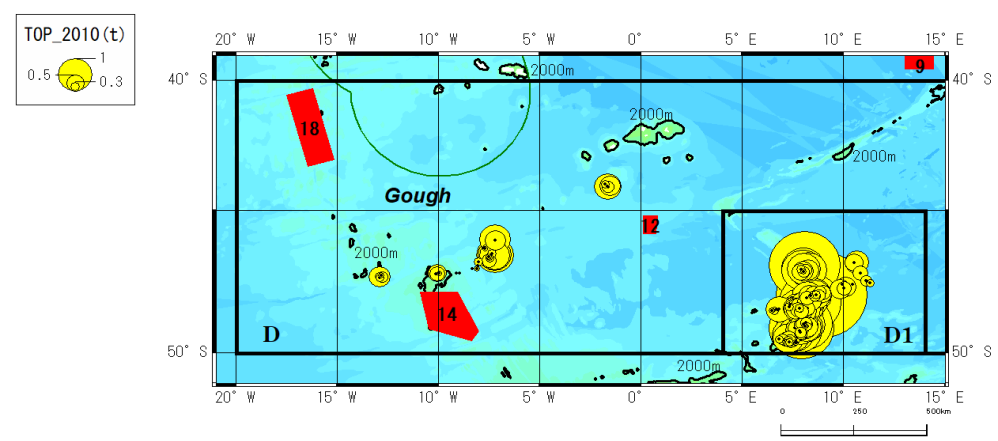
1.2 Spatial and temporal distribution of fishing

In SEAFO CA, the fishery has been conducted in Sub-Area D, being concentrated over seamounts in Division D1, at Discovery seamount (central part of Sub-Area D) and also at seamounts located in the western part of Sub-Area D (Fig. 2).

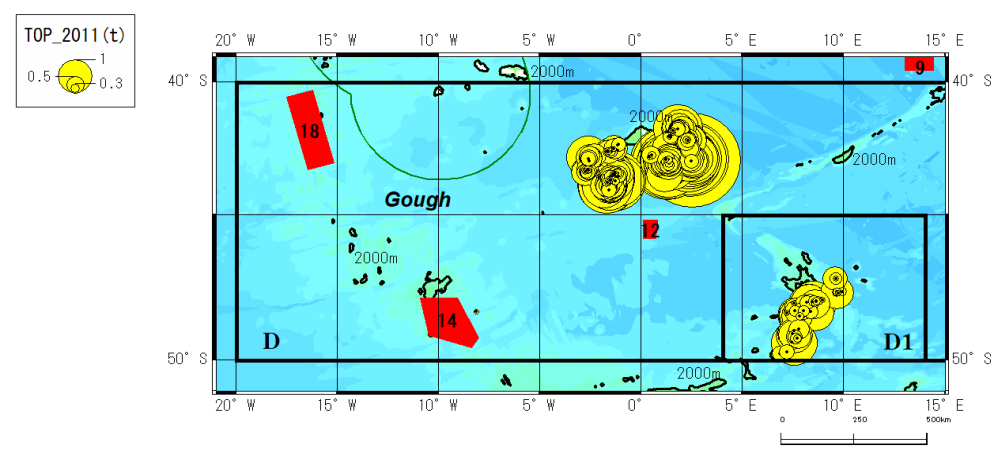
2009



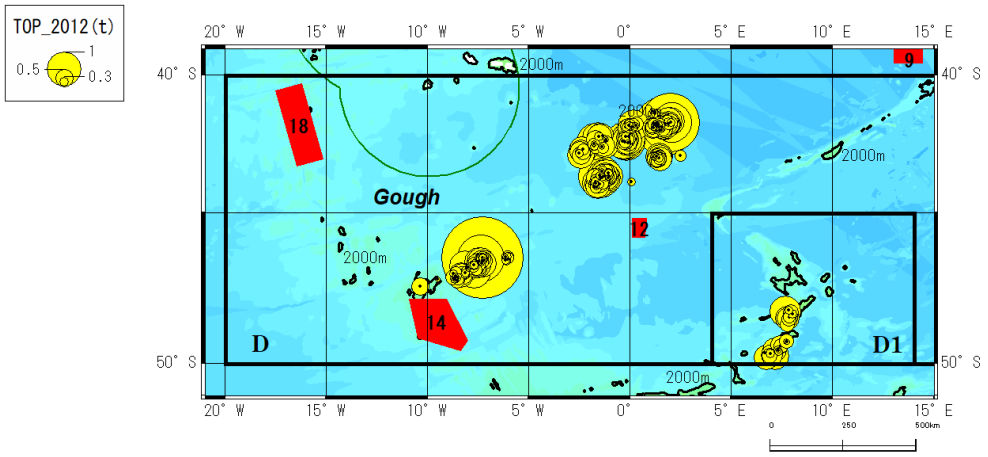
2010



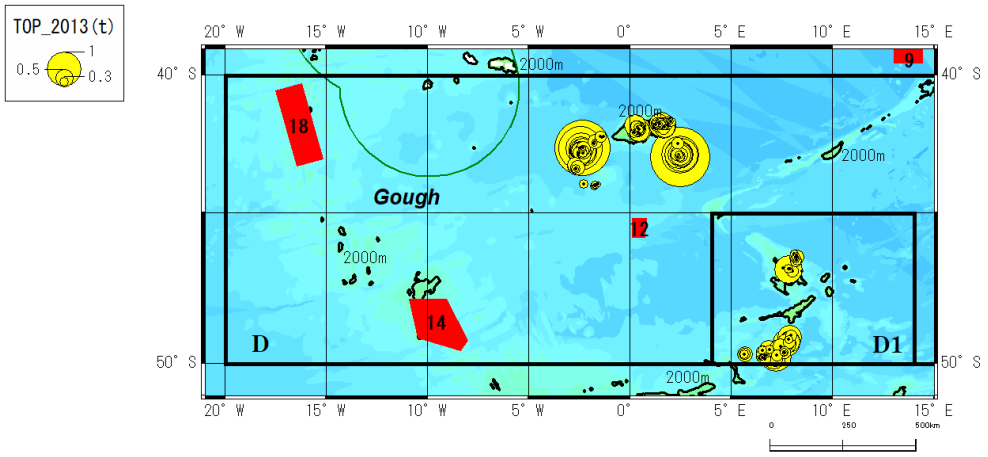
2011



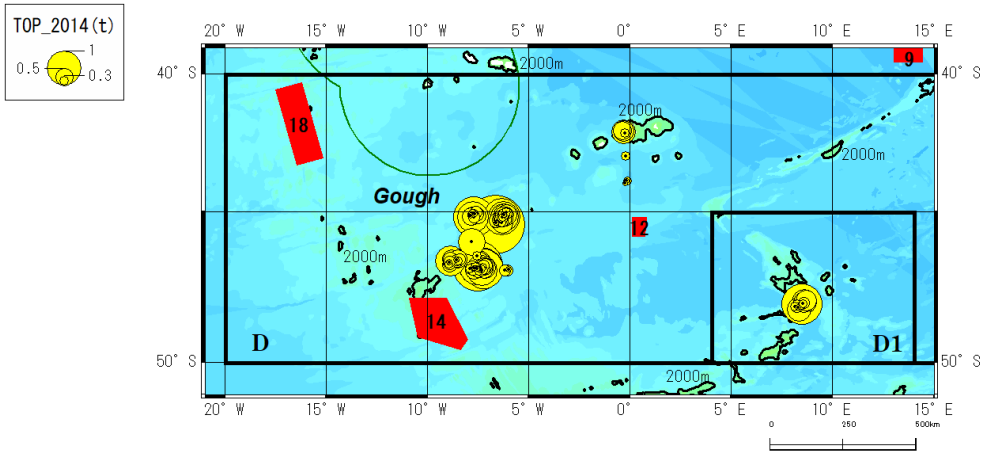
2012



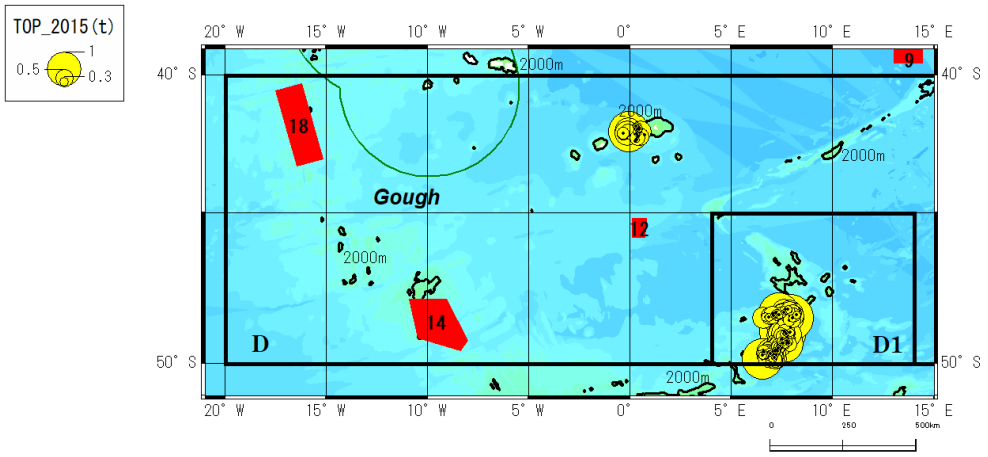
2013



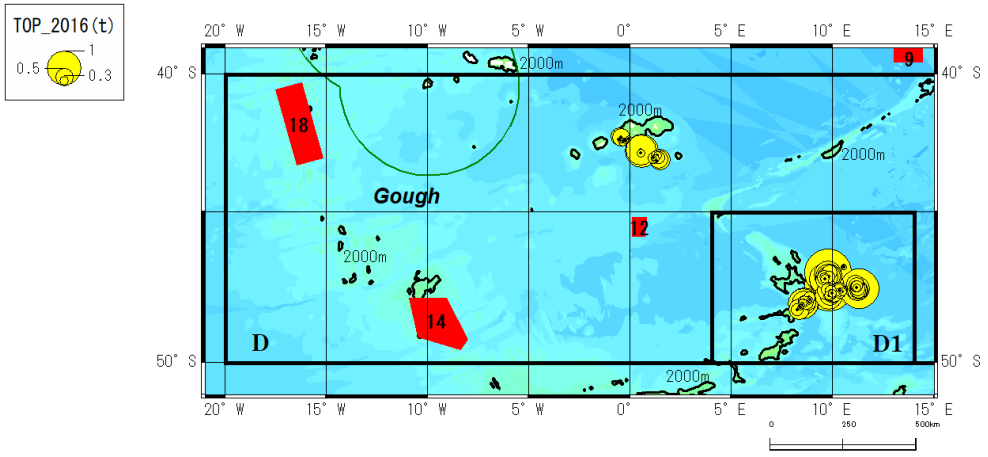
2014



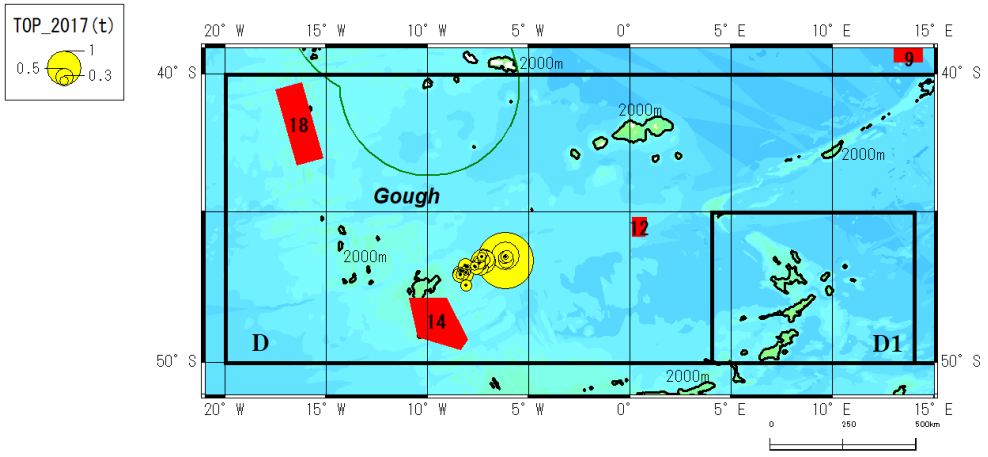
2015



2016



2017



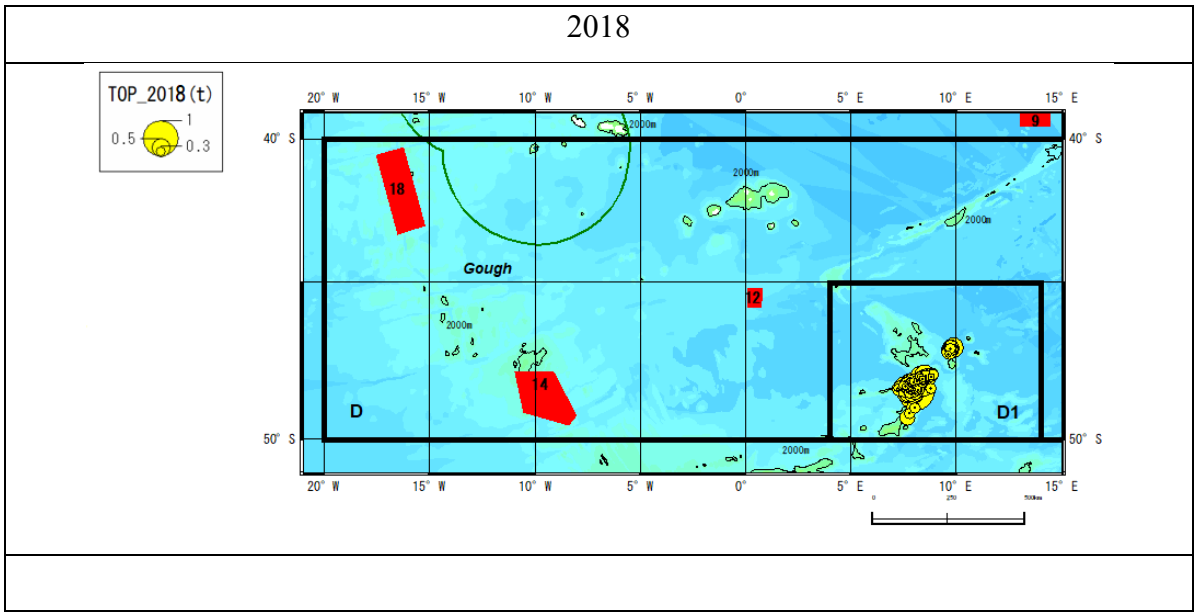


Figure 2: Catch distribution of Patagonian toothfish (*Dissostichus* eleginoides) (2009-2018).

Table 1 shows that the main fishing ground is located on Discovery seamount and also in D1 but less hauls were deployed in the western seamounts of Sub-Area D.

Table 1: Number of sets by year and location

Year	Western	Discovery	D1- Meteor
2010	27	5	118
2011	1	207	54
2012	68	207	25
2013	0	108	57
2014	100	64	13
2015	0	24	127
2016	0	22	67
2017	34	0	0
2018	0	0	100

1.3 Reported retained catches and discards

Table 2A presents data on Patagonian toothfish catches and discards (2002-2018) listed by country, as well as fishing gear used and the management area from which catches were taken. Annual catches varied between 12 tonnes (2017) and 393t (2003).

Discards were mainly due to parasite infection of fish. In the last three years with complete data (2016, 2017 and 2018) retained catches were 60, 12 and 57 tonnes respectively and the annual weight of discarded specimens was less than 2 tonnes in the three years period.

Table 2A: Catches (tonnes) of Patagonian toothfish (*Dissostichuseleginoides*) by South Africa, Spain, Japan and Korea (2002-2018)

Nation	Spain		Japan				Korea				South Africa			
Fishing method	Longlines		Longlines				Longlines				Longlines			
Management Area	D0		D0		D1		D0		D1		D0		D1	
Year	Retain	Discard	Retain	Discard	Retain	Discard	Retain	Discard	Retain	Discard	Retain	Discard	Retain	Discard
2002	18													
2003	101		47				245							
2004	6		124											
2005	N/F	N/F	158				10							
2006	11		155											
2007	N/F		166											
2008	N/F	N/F	122	0	N/F	N/F	76							
2009	N/F	N/F	86	0	74	0	16	0	46	0	N/F	N/F	N/F	N/F
2010	26	0	N/F	N/F	54	2	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F
2011	N/F	N/F	159	6	N/F	N/F	N/F	N/F	N/F	N/F	15	0	28	0
2012	N/F	N/F	86	3	N/F	N/F	N/F	N/F	N/F	N/F	24	0	12	0
2013	N/F	N/F	41	2	19	1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F
2014	N/F	N/F	47	<1	6	<1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F
2015	N/F	N/F	52	<1	7	<1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F
2016	N/F	N/F	7	<1	53	<1	N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F
2017	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
2018*	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 = No Fishing. Blank fields = No data available * Provisional (September 2018).

Table 2B: Atlantic toothfish (*Dissostichus mawsoni*). (TOA) catch and discards

Nation	Japan			
Fishing method	Longlines			
Management Area	D0		D1	
Year	Ret..	Disc.	Ret..	Disc.
2014	< 1	0	0	0
2015	0	0	0	0
2016	0	0	0	0
2017	0	0	N/F	N/F
2018	N/F	N/F	0	0

Ret. = Retained Disc. = Discarded *Provisional (September 2018).

Retained and discarded bycatch from the Patagonian toothfish fishery are presented in Table 3. The two most important species (in terms of weight) are grenadiers (GRV) and Blue antimora (ANT).

1.4 IUU

IUU fishing activity in the SEAFO CA has been reported to the Secretariat latest in 2012, but the extent of IUU fishing is at present unknown.

Table 3: Retained and discarded bycatch from the Patagonian toothfishfisheries (kg).

	2009				2010				2011		2012				2013				2014			
	Retained		Discarded		Retained		Discarded		Retained	Discarded	Retained		Discarded		Retained		Discarded		Retained		Discarded	
Species	**D0**	**D1**	**D0**	**D1**	**D0**	**D1**	**D0**	**D1**	**D0**	**D0**	**D0**	**D1**	**D0**	**D1**	**D0**	**D1**	**D0**	**D1**	**D0**	**D1**	**D0**	**D1**
GRV			89	5 833	4 047	1 936	93	2 601		22 414			23 705	186			7 273	869				267
ANT			126	4 786			453	1 348		4 794			4 442	65			796	610			329	106
BYR	1 221		573																			
MCC			336	896																		
BYR																						
BEA	360																					
MZZ								168														
SRX										30			124				20					
MRL			108					1		2			37				1					
COX			2							21			75									
SKH			90																			
LEV			36				4															
KCX				1			3	35									83	10				
HYD													31				17					
BUK							17															
NOX										7												
MWS										6												
ETF																	3					
SEC													2									
SSK							2															
CKH							1	1														
KCF			1																			
TOA																			99			
RTX																					1122	

BSH: Blue shark (*Prionace glauca*); ETF: Blackbelly lanternshark (*Etmopterus Lucifer*); HIB: Deep-water arrowtooth eel (*Histiobranchus bathybius*); LEV: Lepidion codlings nei (*Lepidion spp*);ANT:Blue antimora (*Antimora rostrata*); BEA:Eaton's skate (*Bathyraja eatonii*); BYR:Kerguelen sandpaper skate (*Bathyraja irrasa*); COX:Conger eels, etc. nei (*Congridae*); CKH:Abyssal grenadier (*Coryphaenoides armatus*); BUK:Butterfly kingfish (*Gasterochisma melampus*); HYD:Ratfishes nei (*Hydrolagus spp*); LEV:Lepidion codlings nei (*Lepidion spp*); KCX:King crabs, stone crabs nei (*Lithodidae*); MCC:Ridge scaled rattail (*Macrourus carinatus*); GRV:Grenadiers nei (*Macrourus spp*); MWS:Smallhead moray cod (*Muraenolepis microcephalus*); MRL:Moray cods nei (*Mur aenolepis spp*); NOX:Antarctic rockcods, noties nei (*Nototheniidae*); MZZ:Marine fishes nei (*Osteichthyes*); KCF:Globose king crab (*Paralomis formosa*); ETF:Blackbelly lantern shark (*Etmopterus lucifer*); SEC:Harbour seal (*Phoca vitulina*); SRX:Rays, stingrays, mantas nei (*Rajiformes*); SKH:Various sharks nei (*Selachimorpha(Pleurotremata*)); (Rajiformes); SSK:Kaup's arrowtooth eel (*Synaphobranchus kaupii*).

	2015				2016				2017				2018			
	Retained		Discarded		Retained		Discarded		Retained		Discarded		Retained		Discarded	
Species	D0	D1	D0	D1	D0	D1	D0	D1	D0	D1	D0	D1	D0	D1	D0	D1
GRV			1221	1579	1197.7			2496.7			1338.3					7632.88
ANT			452	598			27.4	117.6								1114.41
BYR																
MCC																
BYR																
BEA																
MZZ																
SRX			16								19					
MRL			2				0.7				0.2					
COX																
SKH																
LEV																
KCX					9.1			1.4			2.1					
HYD			233													
BUK																
NOX																
MWS																
ETF			1													
SEC																
SSK																
CKH																
KCF																
TOA																
RTX			146													
BSH			89													
ETF																
HIB			18				0.9									
LEV			5													
CSS							0.68	3.88			6.91					2.76
GGW							0.01	9.54			1.41					0.6
AXT								0.12			303					0.94
PFR								0.84			0.52					
OWP								0.6								
AGZ											0.06					
AJZ											0.06					
AQZ											0.1					0.04
AZN											0.59					1.46
GSK											12					
GWD											0.08					
NTW											0.02					
OEQ											1.14					1.04
ZOT											1.12					
HXY																0.3
BZN																0.08
DMO																0.02

2. Stock distribution and identity

Patagonian toothfish is a southern circumpolar, eurybathic species (70-1600m), 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.

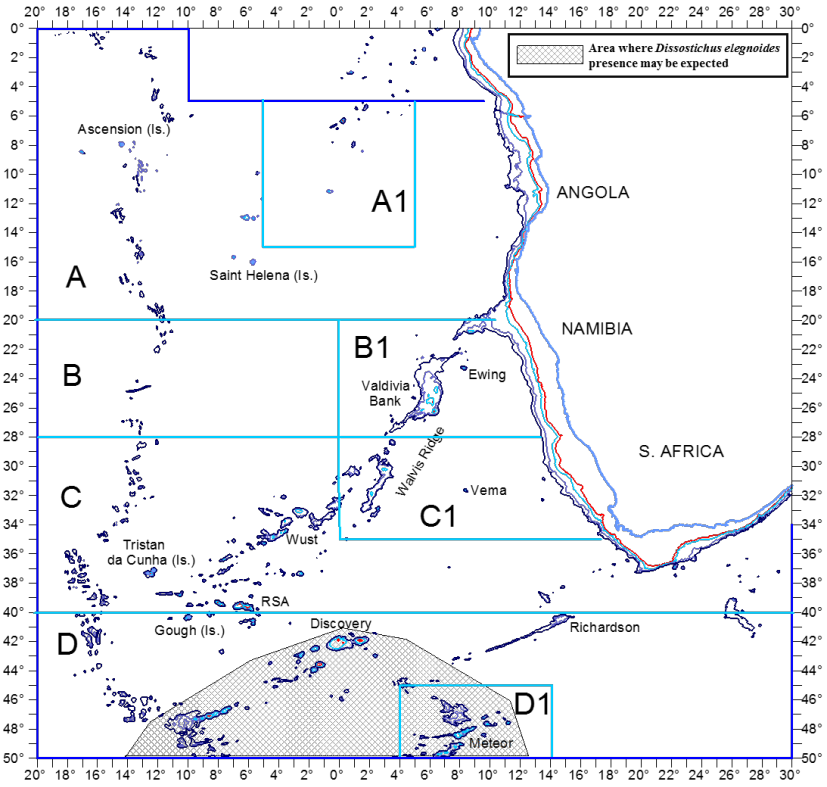


Figure 3: Species geographical distribution in the SEAFO CA (source: Species profile on the SEAFO website).

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

3.1 Fisheries and survey data

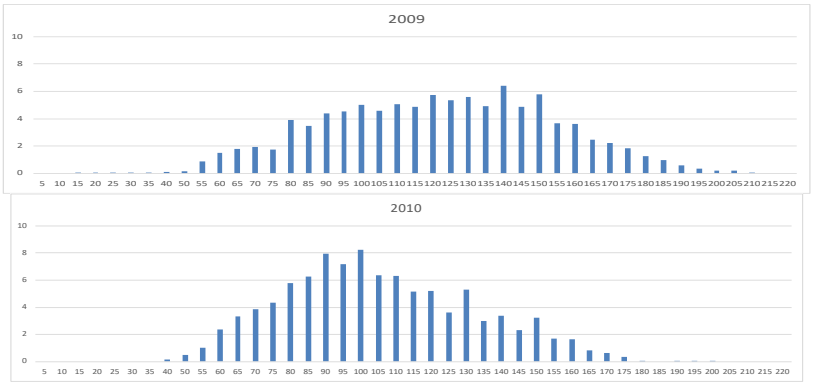
The number of fishing sets sampled from 2006 onwards indicates a good sampling level in line with the SEAFO preliminary guidelines for data collection (Table 4). On average 21 specimens were measured per sampled fishing set, which is considered acceptable given the length range of the exploited population. It will be necessary to apply in future this sampling effort of 20 individuals in all sampled fishing sets.

Table 4. Annual analysis of sampling effort conducted on board fishing vessel (2006-2018)

Year	No. of Sets Observed	Mean Individuals	Min. Individuals	Max. Individuals
2006	146	22	1	31
2007	222	12	1	57
2008	120	24	2	110
2009	275	18	1	58
2010	125	27	1	60
2011	263	33	1	60
2012	298	21	1	57
2013	164	20	1	70
2014	176	26	3	50
2015	149	17	1	23
2016	88	18	2	20
2017	32	15	1	25
2018	92	21	20	40
Average	165	21	3	51

3.2 Length data and frequency distribution

Figure 4 shows the annual total length frequency distributions of Patagonian toothfish catches based on the observer data from all fleets submitted to SEAFO.



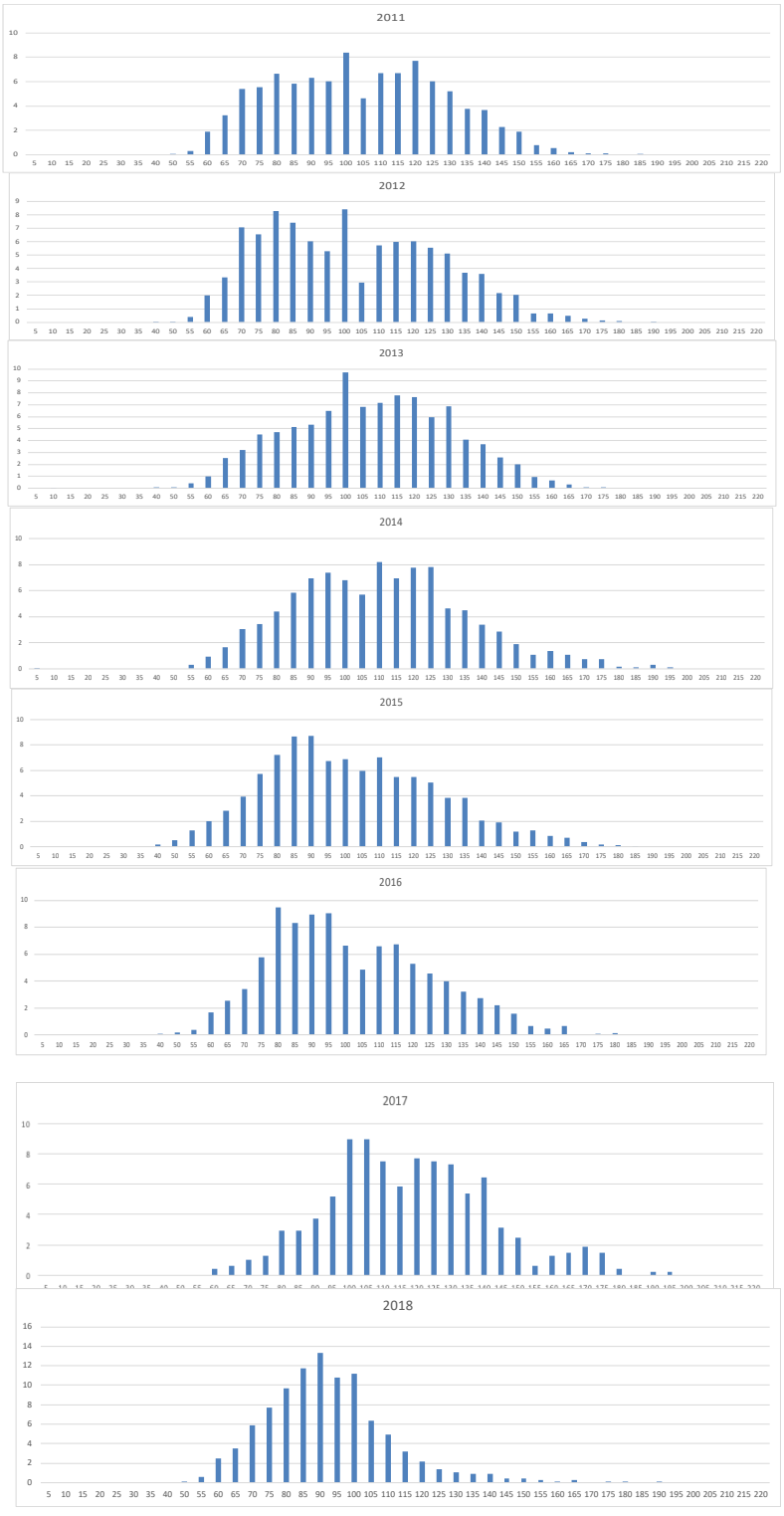


Figure 4: Annual size % freq. distributions *D. eleginoides* in Sub-Area D (2009-2018)

3.3 Length-weight relationships

Table 5 shows the length-weight relationships by sex based on observer data from Japanese fleet in 2013.

Table 5: Length-weight relationships by sex (based on 2013 Japanese observer data)

Samples	a	b	r^2	n
Males	1E-06	3.4484	0.9768	405
Females	2E-06	3.4296	0.9579	860

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

Eleven specimens were tagged in Subarea D in 2006 and fourteen in 2010 (Spanish flagged Viking Bay vessel). However, there is no available information on recoveries of tagged specimens or on tagged specimens tagged at adjacent areas of CCAMLR.

4. Stock assessment status

There were preliminary stock assessments in SC9 (2014) by Y/R analysis, length cohort analysis and ASPIC (production model). However, there was no consensus on results because the time series were too short and r2 (correlation coefficient) of standardized CPUE was too low (r2 < 30%). However, SC9 (2014) agreed that all results provided the perception that current harvesting rate (F) is below Fmsy in 2014 (SC9, 2014 report). After 2015, annual average catches decreased from 171 tonnes (2002-2014) to 47 tonnes (2015-2018) (73% reduction) and annual average number of boats operated decreased from 2.2 to 1.0 (46% reduction). The harvesting rate (F) is most likely below Fmsy in 2018.

5. Incidental mortality and bycatch of fish and invertebrates

5.1 Fish bycatch

Table 6 shows the bycatch species in the Patagonian toothfish (*Dissostichus eleginoides)* Fishery and its weights based on the observer reports. SC noted that the major bycatch is grenadiers (Macrouridae - GRV) and the bycatch is discarded.

5.2 Incidental mortality (seabirds, mammals and turtles)

In the SEAFO database there are records of three seabirds having been caught during Japanese longline daytime fishing in 2014. The seabirds caught were recorded by the ID codes "PUG" – *Puffinus gravis* (Great shearwater) & "DIM" – *Thalassarche melanophris* (Southern black-browed albatross).

5.3 Invertebrate bycatch (VME taxa)

Table 6 shows the bycatch of VME species and its amount based on the observer data for the period 2010-2018. Figure 5 shows their geographic location.

Table 6: VME Bycatch from Patagonia toothfish fishery (kg)

	Species	Gorgonians (Gorgoniidae)	Hard corals, madrepores nei (Scleractinia)	Black corals and thorny corals (Antipatharia)	Basket and brittle stars (Ophiuroidea)	Sea pens (Pennatulacea)	Soft corals (Alcyonacea)	Feather stars and sea lilies (Crinoidea)	Hydrocorals (Stylasteridae)	Erect bryozoans	Sponges
	FAO code	GGW	CSS	AQZ	OWP	NTW	AJZ	CWP	AXT(AZN)	BZN	DMO
2010	D0	33.9	2.1	3.9	1.3	1	0.2	0.9			
	D1	13.6	0.1	0.5	2	0.3	1	0.1			
2011	D0	3.8	15.4								
	D1										
2012	D0	30.3	17.6	0.2		0	1.2				
	D0	2.3	0.3								
2014	D0	2.6	2.8								
	D1	1.2									
2015	D0										0.4
	D1	0.35			4.9				1		
2016	D0	0.01	0.68						1.2		0.84
	D1	9.54	3.88					0.6			
2017	D0	1	7	0.1		0.02	0.06		0.59		0.37
	D1										
2018	D0										
	D1	0.6	2.76	0.04					2.4	0.08	0.02

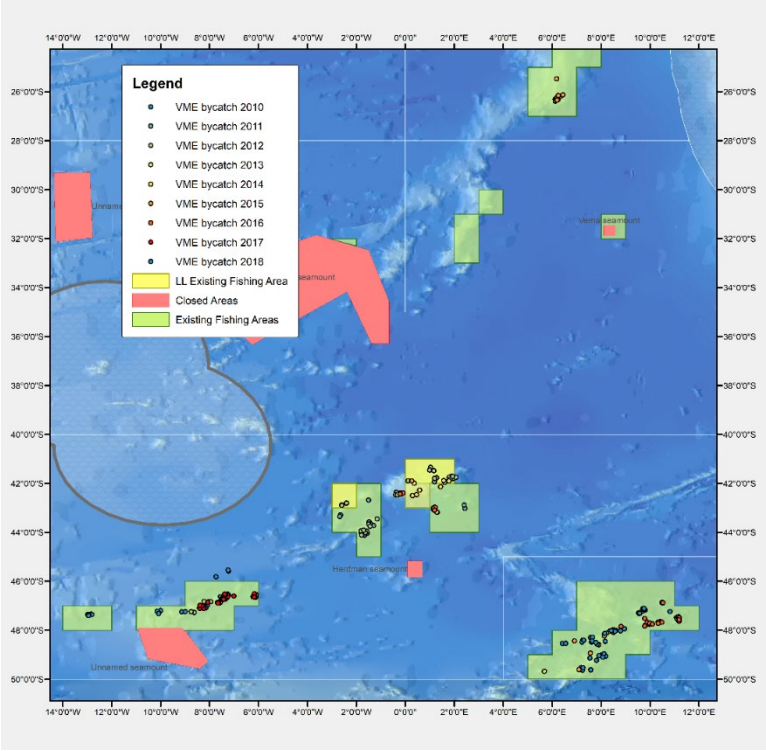


Figure 5: Locations for incidental bycatch of VME species (2010-2018).

5.4 Incidental mortality and bycatch mitigation methods

Offal dumping during hauling and bird scaring devices (Tori lines) are mandated to mitigate seabird bycatch.

5.5 Lost and abandoned gear

Figure 6 shows locations and amount of the lost gears based on the observer data (2010-2018). Note: no lost gear (2014-2017).

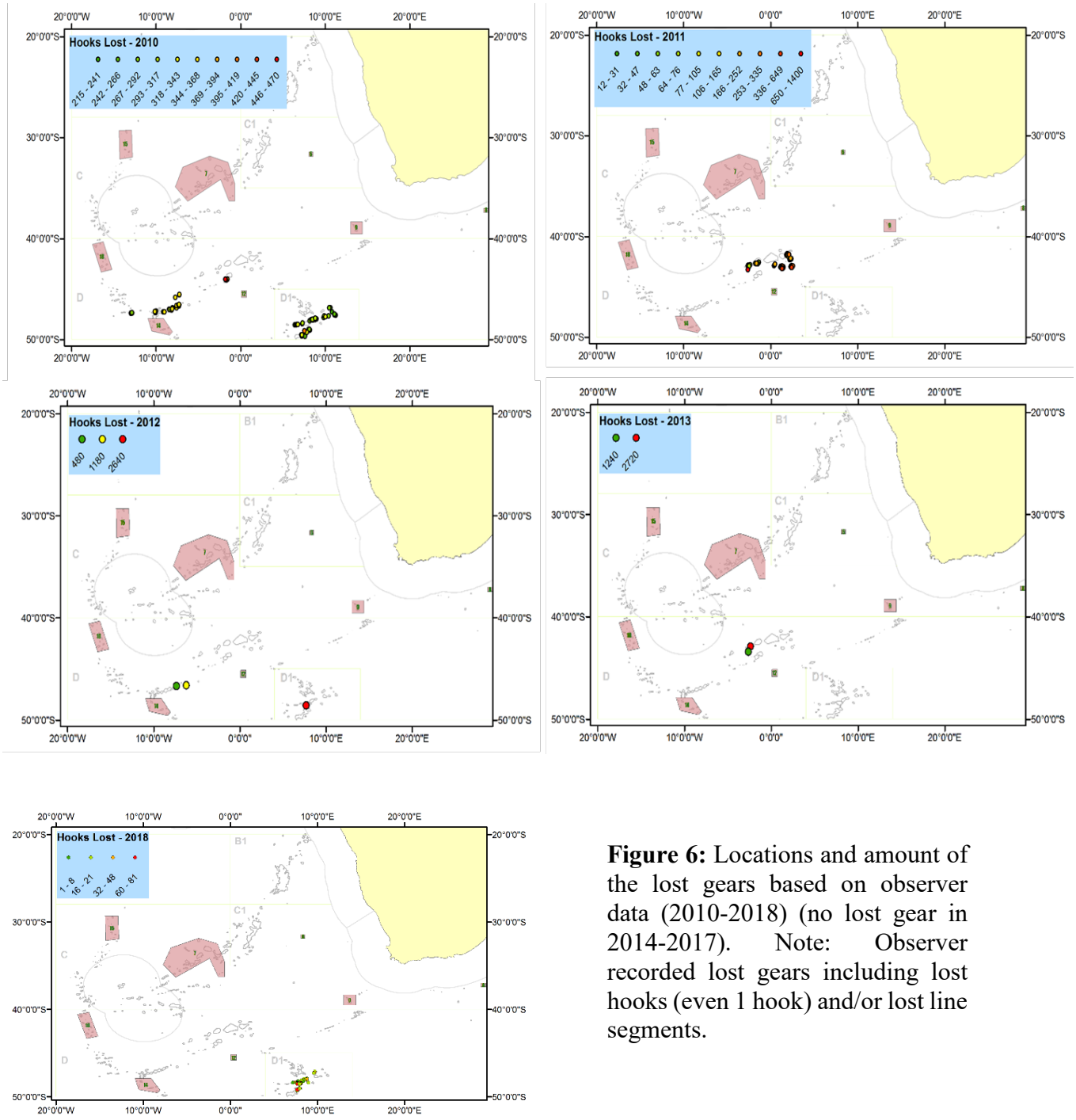


Figure 6: Locations and amount of the lost gears based on observer data (2010-2018) (no lost gear in 2014-2017). Note: Observer recorded lost gears including lost hooks (even 1 hook) and/or lost line segments.

6. Current conservation measures and management advice

In 2015, the Commission adopted Harvest Control Rule (HCR) to decide TAC if no agreed stock assessments are available. This HCR had been applied in NAFO (Greenland halibut) and CCSBT (southern bluefin tuna), which uses average of slopes of CPUE in recent 5 years (Fig. 7).

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

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.

Fig. 7 HCR for Patagonian toothfish adopted by the Commission in 2016

In the HCR, standardized CPUE is preferable to apply. Although SC estimated standardized CPUE using generalised linear models (GLM) in 2014 and 2015, all results indicated that correlation coefficients (goodness of fitness) were too low (r2 < 30%) to provide the plausible standardized CPUE for the HCR. Please note that it was also confirmed in 2016 and 2018.

Then SC12 (2016) agreed to apply nominal CPUE for the HCR. As nominal Japanese CPUE in the Meteor and Discovery seamounts areas are continuously available (2003-2018), SC12 (2016) agreed to use the slope of average of two nominal CPUE and applied in 2016.

Using the same method, TAC for 2019-2020 is computed as 275 tonnes for Subarea D (Fig. 7) (note: a zero TAC for the remainder of the SEAFO CA).

Slope (2014-2018) (Discovery) = -0.527
Slope (2014-2018) (Meteor) = +0.495
Slope (2014-2018) (based on average N_CPUE in 2 areas) = +0.0341

TAC (2019-20) = TAC (2017-2018) * (1+0.0341) =266(ton)*1.0341=275(ton)
Difference (%) = (275-266)/266=0.034(3.4%) < 5%
Hence TAC (2019-2020) = 275 tonnes

Applying the HCR based on an average of the CPUE slopes on Meteor and Discovery a TAC estimate of 275 tonnes was derived. **The SC recommends a TAC for Subarea D of 275 tonnes and a zero TAC for the remainder of the SEAFO CA for the years 2019 and 2020.**

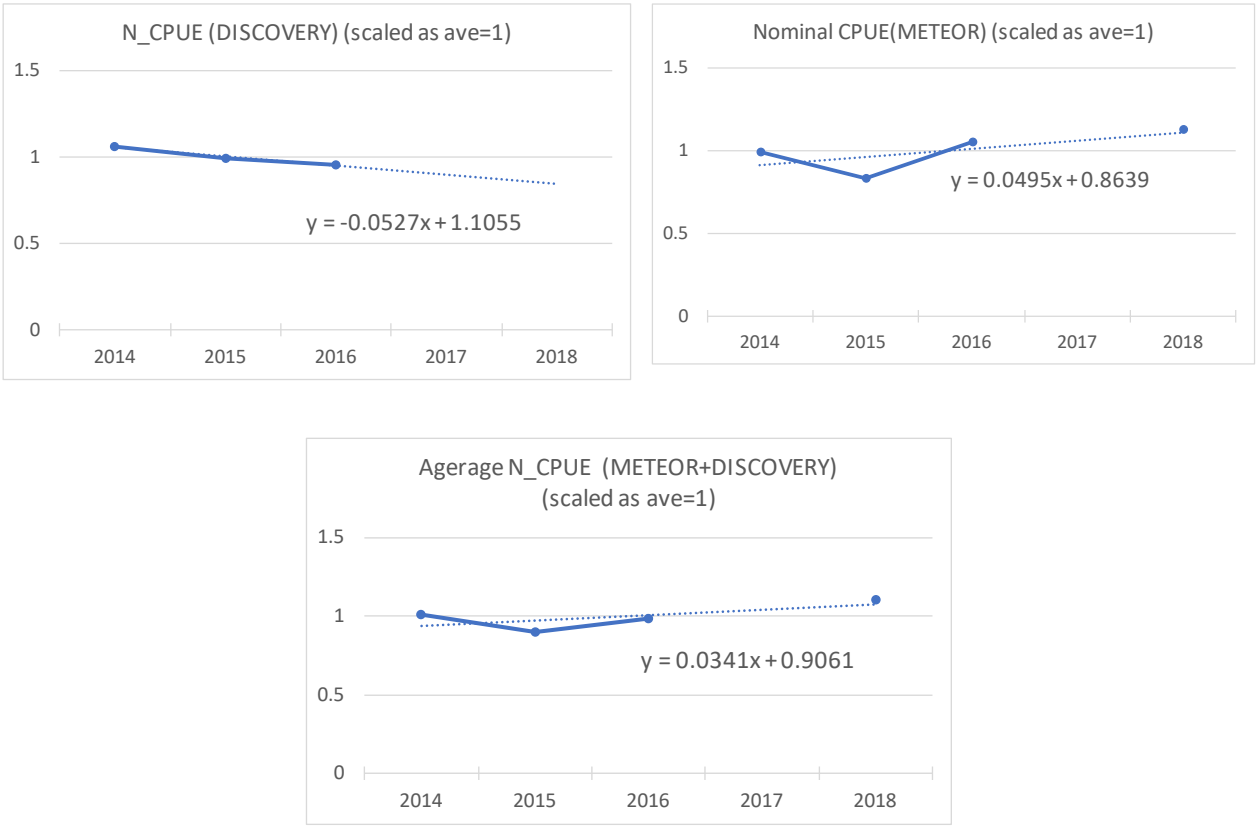


Figure 7

Upper: Nominal CPUE trend and its slope in Meteor (left) and Discovery(right) areas in recent 5 years (2012-2016).
Lower: Average CPUE trend of two nominal CPUE and its slope.

Other Conservation Measures that are applicable to this fishery can be seen in Table 7.

Table 7: Other Conservation Measures that are applicable to this fishery.

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 32/16	On Total Allowable Catches and related conditions for Patagonian Toothfish, Deep-Sea Red Crab, Alfonsino, Orange Roughy and Pelagic Armourhead for 2017 and 2018 in the SEAFO Convention Area.

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Annex A: Biological data collected (Table 8-10)

Table 8 Number of sex information collected by species (2009-2018)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
ANT								15	76	
BOA										
BSH							1	1		
BYE									1	
BYR										
CGE								2		
ETF								1		
GRV		134						1		
GSK										
HIB										
KCU										
KCX								1		
MCC							164	183		
MCH							463		150	
MRL								1		
QMC							197			
RTX										
SRX							2			
TOA						11				
TOP		482				1,747	2,563	1,531	246	1,953

Table 9 Number of TOP otolith collected (2009-2018)

number of otoliths collcted									
2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
0	0	0	0	0	533	732	749	141	479

Table 10 Summary of gonad samples collected by species (2010-2018)

	species code															
	ANT		BSH	BYE	GRV	MCC		MCH	MRL		QMC	SRX	TOA		TOP	
	Gonad Weight (g)	Maturity Stage	Maturity Stage	Maturity Stage	Maturity Stage	Gonad Weight (g)	Maturity Stage	Maturity Stage	Gonad Weight (g)	Maturity Stage	Maturity Stage	Maturity Stage	Gonad Weight (g)	Maturity Stage	Gonad Weight (g)	Maturity Stage
2010					134											432
2014													11	11	1,746	1,746
2015			1				165	463			198	2			2,563	2,564
2016	15	15				183	183		1	1					1,529	1,530
2017				1											472	472
2018															1,935	1,955