

## A SHORT HISTORY OF THE FISHERIES OF CROZET ISLANDS<sup>39</sup>

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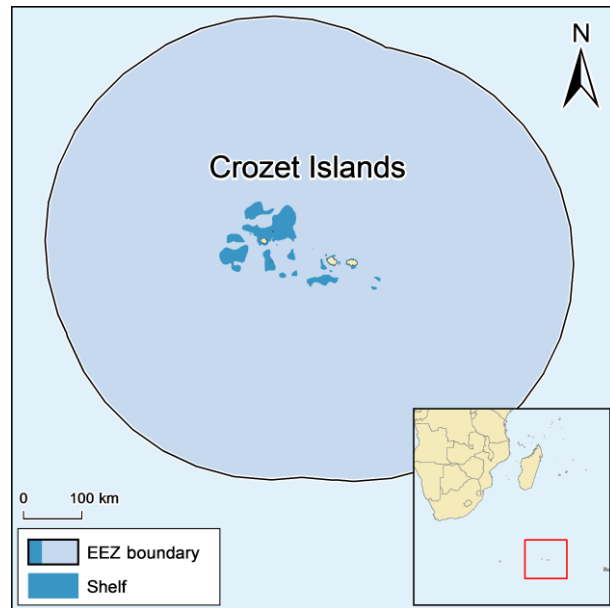
### Abstract

Crozet Islands are part of the French Antarctic and sub-Antarctic Territories (TAAF), where in 1996, distant-water fisheries began to conduct annual operations. The target species of the longline fishing fleet is the Patagonian toothfish *Dissotichus eleginoides*, Smitt, 1898. Catches were obtained from Statistical Bulletins of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) for Area 58.6. Data from the TAAF region are provided to the CCAMLR by the French government from the PECHEKER database through the TAAF's fishing observers program. Judicial sanctions and increased surveillance imposed by the French government in the 2000s appears to have stabilized longline catches and reduced illegal fishing after a long period of very high level of illegal fishing.

### Introduction

The Crozet Islands are a small sub-Antarctic archipelago (land area of 352 km<sup>2</sup>; with an exploitable water area of 10,000 km<sup>2</sup>) from 45°95' and 46 50' S and 50°33' and 52°58' E (Figure 1). They are part of the French Antarctic and sub-Antarctic Territories (TAAF), which also include the islands of Kerguelen, Amsterdam and St. Paul ([www.taaf.fr](http://www.taaf.fr)). The area was exploited in the 19th century by sealers and whalers, while the current toothfish fishery in the islands began in the mid-1990s (Duhamel and Welsford 2011).

Preliminary fishing surveys were conducted by vessels flying the USSR flag from 1967 to 1973, by a Japanese vessel in 1977 (i.e., the JAMARC expedition), and by the French trawler *Austral* in 1984-1988. These initial trawl surveys reported viable catches of marbled rockcod (*Nothothenia rossii*), grey rockcod (*Lepidonotothen squamifrons*) and Patagonian toothfish (*Dissostichus eleginoides*) in the sub-Antarctic zone (CCAMLR 1990a). However, the trawl fishery did not grow rapidly following these preliminary surveys because the sea floor was too rugged to run trawling operations smoothly



**Figure 1.** The sub-Antarctic archipelago of the Crozet Islands (45°95' and 46 50' S and 50°33' and 52°58' E) of the French Antarctic and SubAntarctic Territories, CCAMLR area 58.6, with its Exclusive Economic Zone.

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(Duhamel *et al.* 2005). Ukrainian longliners began exploratory commercial fishing in the Kerguelen Archipelago in the early 1990s, and we assume that they also explored other sub-Antarctic islands, including Crozet. In 1996, a fleet of French longliners began operating in the Kerguelen archipelago and extended their operations to Crozet, leading to a joint Franco-Japanese exploratory fishing survey performed on the Japanese longliner *Anyo-Maru 22*, which identified commercially viable Patagonian toothfish concentration and provided evidence that longline fishing, being more adapted to rugged terrain, increased the area available for fishing (Duhamel *et al.* 2012). The results of this survey led to the establishment of a regulated longline toothfish fishery with quota set at 700 t·year<sup>-1</sup>, under the control of the TAAF administration, with fishing grounds that follow the geographic and bathymetric range of Patagonian toothfish, from the shelves to the deep-sea down to 2,000 m. Fishing is conducted during the austral summer, i.e., February to March, at depths of 500-1,800 m (Duhamel *et al.* 2012). The catch from this fishery mainly supplies the Japanese and American markets.

The considerable increase in the market price of Patagonian toothfish which then occurred attracted foreign fishers, and thus illegal fishing, which led to a significant overexploitation of this fish. To remedy this, a series of preventive measures were put in place, viz.: increase in the number and frequency of aerial and maritime Franco-Australian surveillance patrols complemented by satellite monitoring; issuance of fishing and export licenses (as part of the Catch Documentation Scheme established in 2000; see CCAMLR 2000), and judicial sanctions and French diplomatic intervention with the countries of origin of fishing vessels operating illegally. Sanctions against illegal fishers include fines, confiscation of the catch and may go as far as permanent confiscation of the boat; in some cases, boats were destroyed and sunk. About 20 illegal fishing vessels caught in the region were confiscated during the period 1997-2000<sup>40</sup>.

Currently, seven French longliners are licensed to exploit this area, where they mainly target Patagonian toothfish, with grenadiers and rays as bycatch. Each longliner allowed in this zone must have an observer onboard, tasked with submitting reports to the National Museum of Natural History (Paris, France; see Gasco 2011), which is mandated by the French government to collect fisheries data (i.e., observations recorded by fisheries controllers) within the French Antarctic Territories. The data are stored in the PECHEKER database<sup>41</sup> (Martin and Pruvost 2007) and provided annually to the French government and then to CCAMLR (Pruvost *et al.* 2011).

**Table 1.** Legal reported catch and illegal, unreported and unregulated catch (IUU) of Patagonian toothfish, *Dissostichus eleginoides* in the Crozet Islands (French EEZ, Subarea 58.6.), as reported by year by CCAMLR (1990a, b; 1993; 2003; and 2013), in tonnes. Note that catches of 0 imply <0.5 t.

Season	Reported	IUU	Total removals
1977	6	0	6
1978	370	0	370
1983	17	0	17
1987	488	0	488
1988	21	0	21
1994	56	0	56
1995	115	0	115
1996	76	7,875	7,
1997	466	11,760	12,226
1998	1,053	1,758	2,811
1999	1,152	1,845	2,997
2000	1,096	1,430	2,526
2001	1,027	685	1,812
2002	1,225	720	1,945
2003	571	302	873
2004	607	380	987
2005	639	12	651
2006	801	55	856
2007	436	0	436
2008	878	153	1,031
2009	908	0	908
2000	741	0	741
2011	735	0	735
2012	704	0	704

<sup>40</sup> <http://taaf.fr/Peche-illicite>.

<sup>41</sup> <http://www.mnhn.fr/mnhn/UMR7208/equipe4/pecheker.php>

## Materials and Methods

CCAMLR estimates the gross weight of the catch by applying a conversion coefficient on the production of fillets, gutted fish and other fish products from empirical relationships of the fish product and whole fish wet weight, obtained onboard per target species per vessel per fishing trip (CCAMLR 2010a, b). Finally, this estimated gross weight of the catch is corrected at the end of a vessel's fishing trip as a function of the landed weight.

Patagonian toothfish catches (Table 1) were obtained from 'Annual Bulletins' for the period 1970-1979 from CCAMLR (1990a), 1980-1989 (CCAMLR 1990b), 1983-1992 (CCAMLR 1993). The years 1993-2002 were reconstructed from CCAMLR (2003) and those from 2003-2012 from CCAMLR (2013; see also CCAMLR 2010a, b). Statistics are reported per fishing season, i.e., December to November; however, they can be extracted from the CCAMLR database by calendar year (i.e., January to December).

The bycatch of the longline fisheries includes grenadiers, skates and antimore gadids, in order of importance (see Table 2). The CCAMLR statistics bulletin reports three taxa for rays (*Amblyraja taaf*, *Raja* spp. and *Rajiformes*), all of which can be considered as catches of the whiteleg skate, *Amblyraja taaf*, because it is the only skate species that occurs in Crozet Island (Duhamel *et al.* 2012). Similarly, grenadiers are reported as *Macrourus carinatus* and *Macrourus* spp., which can be combined as catches of the ridge-scaled rattail, *Macrourus carinatus*, i.e., the only species of grenadier (or rattail) reported from around Crozet Island. Catch statistics for these bycatch species were recorded by the licensed fishing fleet only from 1999. To estimate bycatch for 1996-1998, annual catch for each species was expressed as a proportion of the legal Patagonian toothfish catch and averaged over the period 2007-2012, i.e., the period when reporting was reasonably accurate. These ratios were then multiplied by the legal toothfish catch to obtain estimates of bycatch by the legal fishery for 1996-1998 and in order to account for the suspected under-reporting of bycatch by this fishery for 1999-2011. This bycatch was systematically discarded until 2007, when the major bycatch species began to acquire market values sufficient for them to be retained and then landed.

Illegal fishing of toothfish species were adapted from CCAMLR<sup>42</sup> estimates, obtained from landings of processed fish products (frozen cut and gutted fish loins) by foreign fishing vessels (listed in illegal vessel sighting reports) in major ports, e.g., Port Louis (Mauritius), Walvis Bay (Namibia), and Beira (Mozambique) (Duhamel *et al.* 2012). Bycatch generated by this illegal fishery was estimated using the ratios as detailed above.

**Table 2.** Catch of bycatch species (ridge-scaled rattail, *Macrourus carinatus*; whiteleg skate, *Amblyraja taaf*; blue antimore, *Antimora rostrata*) taken by the longline fishery for Patagonian toothfish, *Dissostichus eleginoides* in the Crozet Islands (French EEZ in Subarea 58.6) as reported by year by CCAMLR (2013), in tonnes.

Season	Rattail	Skate	Antimore
1997	11	2	—
1998	19	2	3
1999	66	4	6
2000	72	11	7
2001	77	14	1
2002	191	41	1
2003	144	80	0
2004	96	67	0
2005	91	13	86
2006	71	32	78
2007	71	3	1
2008	138	46	68
2009	195	45	78
2010	116	56	79
2011	95	29	24
2012	99	75	21

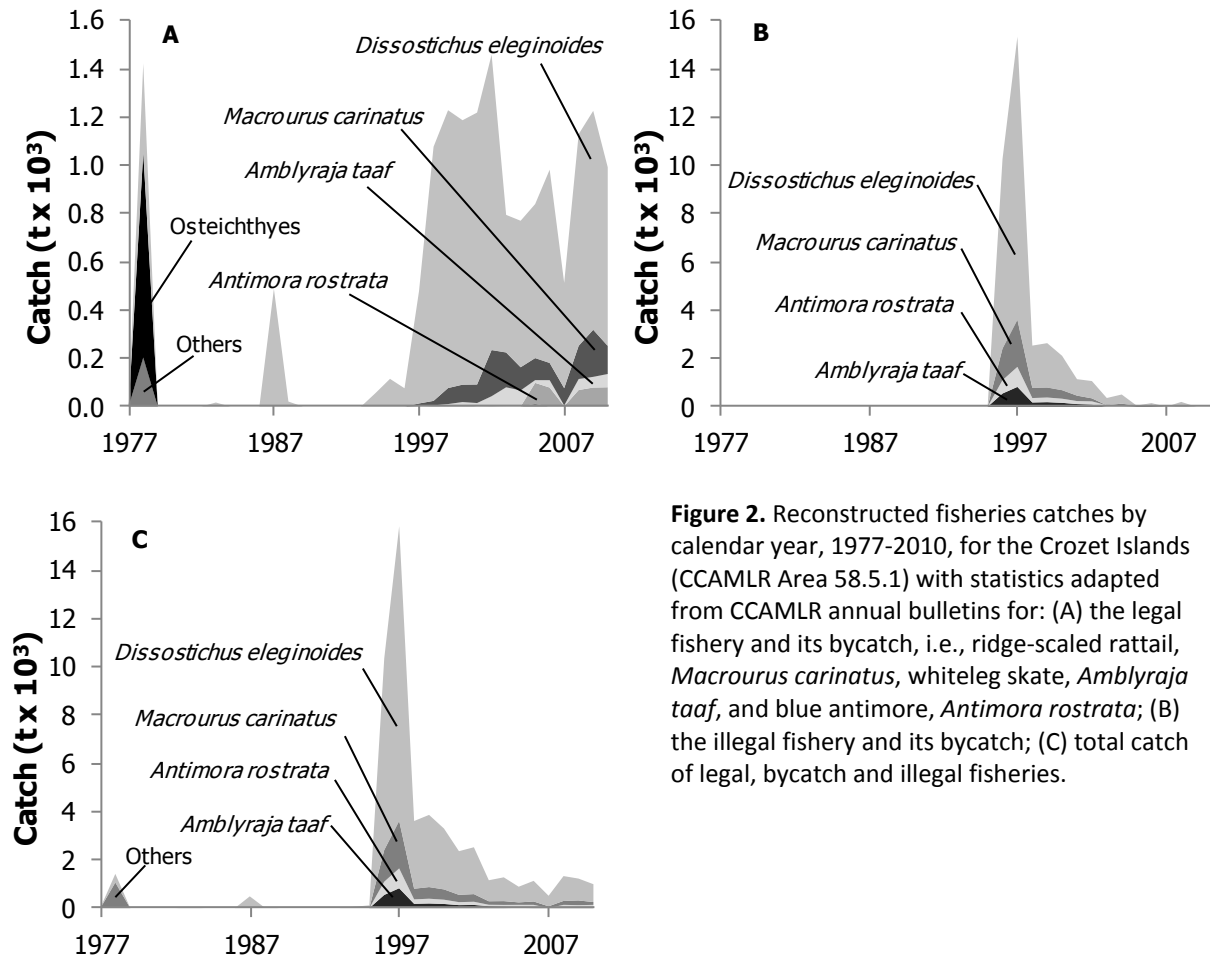
<sup>42</sup> <http://www.ccamlr.org/en/compliance/catch-documentation-scheme-cds>.

## Results and Discussion

Figure 2 shows the catches presented in Tables 1 and 2 and the re-estimation of bycatch species using the average ratio of bycatch to toothfish catch (i.e., 0.17 for *M. carinatus*, 0.07 for *A. taaf*, and 0.07 for the blue antimore, *Antimora rostrata* for French catch and 0.07, 0.002, and 0.03, respectively, for South African catch) obtained from the 2007-2012 values and applied to the 1996-2006 catch data (see Table 3). The highest levels of illegal Patagonian toothfish catches were observed during the period 1996-2000 (over 642% more than the reported catches), which gradually decreased towards 2007 and was considered eradicated at the end of the time period. The corrected declared bycatch of *M. carinatus* amounted to 15 % of the legal toothfish catch and the bycatch associated with the illegal toothfish catch is 273% of the declared bycatch of this species. For *R. taaf*, the corrected declared bycatch is 6% of the legal toothfish catch and the illegal catch is 327% of the declared bycatch of this species. Finally, the bycatch of *A. rostrata* is 6% of the legal toothfish catch and the illegal catch is 398% of the declared bycatch for this species.

Our results also point to possible overestimations of the reported bycatch for skates and rattails during the 2002-2003 fishing season and for antimores during the 2004-2005 season. We have no idea how this might come about, except maybe for possible observer documentation errors. In addition, we feel that the resulting volume of reconstructed antimore bycatch might be overestimates, as this species is smaller and inhabits waters deeper than any of the other species caught by the longline fleet. However, we believe that our results more or less reflect reality, notably because of the improved documentation of CCAMLR for these exploited species in this zone since 2007.

Our results indicate that over 55,000 t of fish biomass has been removed from the Crozet Island EEZ since the exploratory fishing expeditions of 1975, of which 84% were taken within an 11-year period (1996-2006) of persistent illegal fishing. This indicates an annual removal rate of about 4,200 t per year during that period. Regulation of the toothfish fishery at the beginning of the 2000s reduced this annual removal rate to about 970 t per year or about 4 times less than that of the previous period. This implies a decreased fishing pressure on the stock of Patagonian toothfish and its bycatch species by the current licensed fishing fleet. Active mitigation through a relatively long series of documentation via fisheries observers and a strong political will to implement regulation seems to have worked, in this case within a short period (in 5 years). We recommend that this exercise be continued in order to monitor the trends of this fishery, which will hopefully tend towards stabilization.



**Figure 2.** Reconstructed fisheries catches by calendar year, 1977-2010, for the Crozet Islands (CCAMLR Area 58.5.1) with statistics adapted from CCAMLR annual bulletins for: (A) the legal fishery and its bycatch, i.e., ridge-scaled rattail, *Macrourus carinatus*, whiteleg skate, *Amblyraja taaf*, and blue antimore, *Antimora rostrata*; (B) the illegal fishery and its bycatch; (C) total catch of legal, bycatch and illegal fisheries.

**Table 3.** Reported landings (Rep.) and illegal, unreported and unregulated (IUU) catches taken by longliners within the Crozet Islands (French EEZ in Subarea 58.6) for Patagonian toothfish (*Dissostichus eleginoides*) and its bycatch species, i.e., ridge-scaled rattail (*Macrourus carinatus*), whiteleg skate (*Amblyraja taaf*), and blue antimore (*Antimora rostrata*), re-expressed in calendar years. The average ratio (%) of bycatch species to the reported toothfish landings allowed the estimation of under-reported bycatch (Unrep.) by the licensed fleet (% \* Rep. - Rep.). Note that negative values resulting from this may be considered as over-reporting, i.e., an overestimation of the bycatch, but were simply treated as a zero here. Following the same principle, these ratios were multiplied with the IUU estimates to estimate the bycatch taken by the IUU fishing fleet within this EEZ.

Year	Toothfish			Rattail					Skate					Antimore					Reconst. total catch
	Rep.	IUU	Catch	Re p.	%	Unrep	IUU	Catch	Rep.	%	Unrep.	IUU	Catch	Rep.	%	Unrep.	IUU	Catch	
1977	6	0	6	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	6
1978	370	0	370	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	340
1983	17	0	17	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	16
1987	488	0	488	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	447
1988	21	0	21	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	60
1994	56	0	56	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	51
1995	115	0	115	0	-	-	-	-	0	-	-	-	-	0	-	-	-	-	110
1996	76	7,875	7,951	0	-	6	1,306	1,311	0	-	0	541	542	0	-	3	546	549	11,109
1997	466	11,760	12,226	11	0.02	6	1,950	1,955	2	0.00	3	808	812	0	-	7	816	823	18,151
1998	1,053	1,758	2,811	19	0.02	130	291	422	2	0.00	53	121	174	3	0.00	60	122	182	5,142
1999	1,152	1,845	2,997	66	0.06	109	306	415	4	0.00	60	127	186	6	0.01	64	128	192	4,155
2000	1,096	1,430	2,526	72	0.07	116	237	353	11	0.01	61	98	159	7	0.01	71	99	170	3,677
2001	1,127	685	1,812	77	0.07	112	114	225	14	0.01	62	47	109	1	0.00	76	48	123	2,707
2002	1,225	720	1,945	191	0.16	6	119	126	41	0.03	39	49	88	1	0.00	81	50	131	2,651
2003	571	302	873	144	0.25	0	0	0	80	0.14	0	0	0	0	0.00	38	21	59	1,192
2004	607	380	987	96	0.16	2	59	61	67	0.11	0	0	0	0	0.00	39	26	66	1,233
2005	639	12	651	91	0.14	8	2	10	13	0.02	26	1	27	86	0.13	0	0	0	819
2006	801	55	856	71	0.09	59	9	68	32	0.04	22	4	26	78	0.10	1	0	1	1,141
2007	436	0	436	71	0.16	0	0	0	3	0.01	0	0	0	1	0.00	0	0	0	610
2008	878	153	1,031	138	0.16	0	25	25	46	0.05	0	11	11	68	0.08	0	11	11	1,335
2009	908	0	908	195	0.21	0	0	0	45	0.05	0	0	0	78	0.09	0	0	0	1,219
2010	741	0	741	116	0.16	0	0	0	56	0.08	0	0	0	79	0.11	0	0	0	935
2011	735	0	735	95	0.13	0	0	0	29	0.04	0	0	0	24	0.03	0	0	0	853
2012	704	0	704	99	0.14	0	0	0	75	0.11	0	0	0	21	0.03	0	0	0	864

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