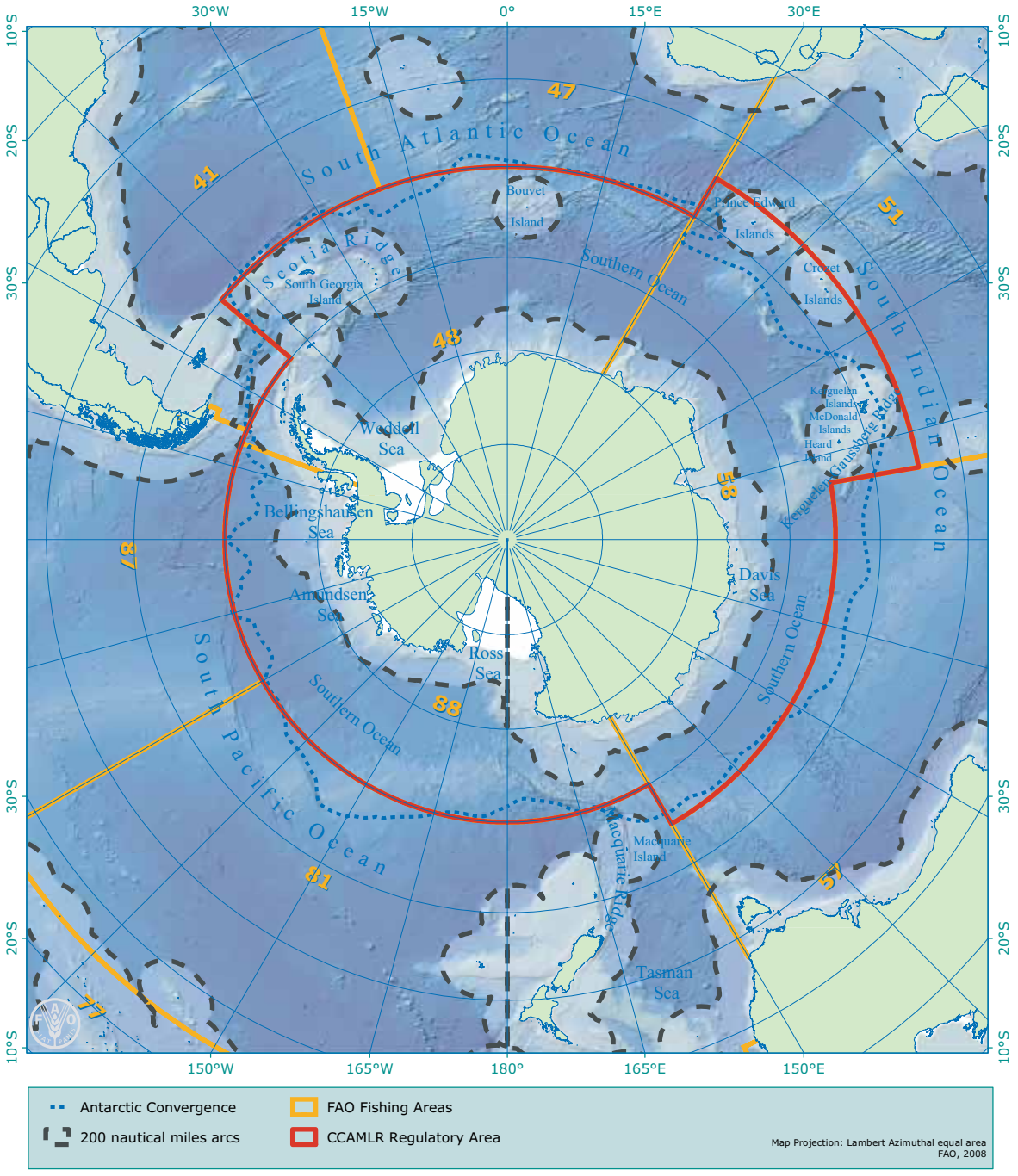
THE SOUTHERN OCEAN



MAP 1
The Southern Ocean

Southern Ocean

FAO Statistical Areas 48, 58 and 88

GEOGRAPHIC DESCRIPTION OF THE REGION

The Southern Ocean surrounds the continent of Antarctica, and constitutes about 15 percent of the world's total ocean surface (CCAMLR, 2000). Its northern boundary is the Antarctic Polar Front (or Antarctic Convergence) between 50°S to 60°S, where cold waters from the south encounter the relatively warmer waters of the Atlantic, Indian and Pacific Oceans. The sub-Antarctic regions of Macquarie Island, Heard and McDonald Islands, Kerguelen Islands, Crozet Islands, Prince Edward Islands, Bouvet Island and South Georgia lie south of, or near, the Antarctic Polar Front and are considered to be part of the Southern Ocean (Map 1).

The Southern Ocean consists of a system of deep basins separated by three large mid-oceanic ridges: the Macquarie Ridge south of New Zealand and Tasmania; the Kerguelen–Gaussberg Ridge at about 80°E; and the Scotia Ridge, or Scotia Arc, extending from the southern Patagonian shelf in an eastward arc to the South Shetland Islands and the Antarctic Peninsula.

The continental shelf is narrow, except in parts of the Weddell, Ross, Amundsen and Bellingshausen Seas: it accounts for only 3 to 5 percent of the total area of the Southern Ocean (CCAMLR, 2000). Sea ice covers vast regions of the Southern Ocean, spreading over 18 x 106 square kilometres (km^2) in winter, and recedes during summer to 3 x 106 km^2 at its minimum extent. September is frequently the month of maximum sea ice coverage, and February is almost always the month of minimum sea ice coverage (Parkinson *et al.*, 1992).

MANAGEMENT REGIME APPLICABLE TO DEEP-SEA BOTTOM FISHERIES IN THE HIGH SEAS

Regional Fisheries Management Organization/Arrangement

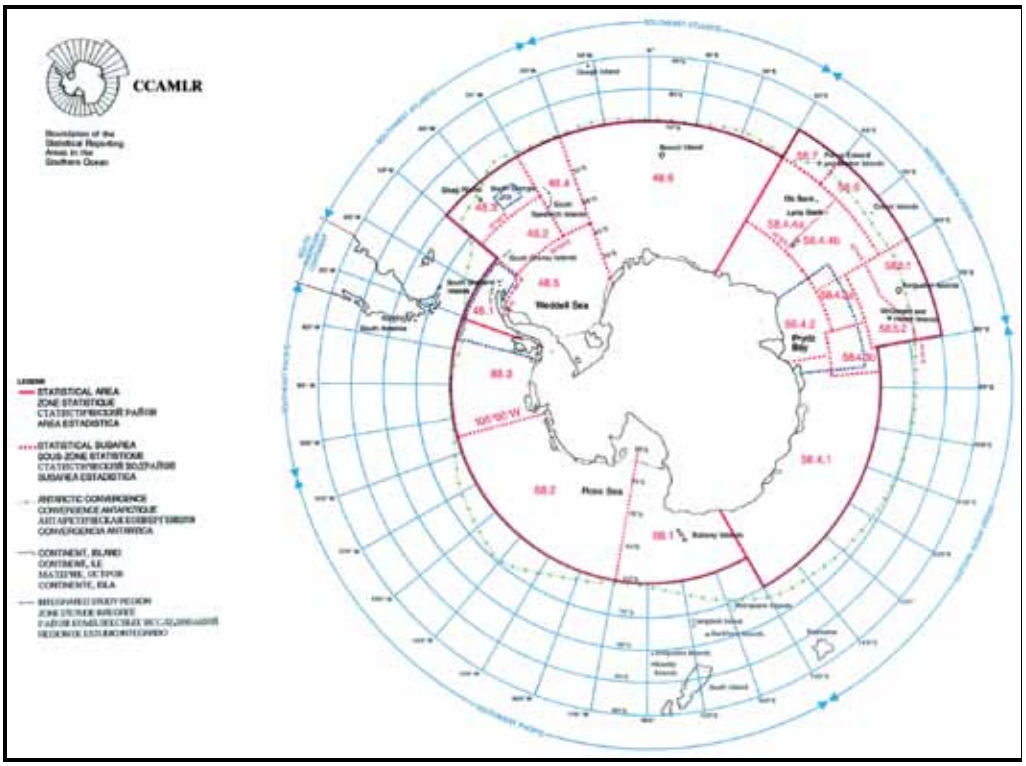
The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) is the international organization responsible for the conservation and management of marine living resources in the Southern Ocean. CCAMLR was established by an international convention in 1982, and its Convention Area is delimited to the north by the Antarctic Polar Front, and to the south by the Antarctic continent (Map 2). The steep temperature gradient across the Antarctic Polar Front means that the Convention Area is substantially a closed ecosystem. CCAMLR is currently composed of 25 members[1] who are involved in fishing and/or scientific research in the Southern Ocean. These activities are coordinated and regulated by CCAMLR and the Scientific Committee to fulfil members' obligations under the Convention. Nine other states are also parties to the Convention but they are not members of the Commission.

DESCRIPTION OF DEEP-SEA BOTTOM FISHERIES IN THE HIGH SEAS

History of fisheries

Large-scale bottom trawl finfish fisheries began at the end of the 1960s, and were initially located around the sub-Antarctic islands of South Georgia and Kerguelen. Subsequently, they developed further south, around other island groups. Fishing along the coasts of the Antarctic continent started in the early 1980s but remained at an

[1] Members of CCAMLR: http://www.ccamlr.org/pu/e/ms/contacts.htm

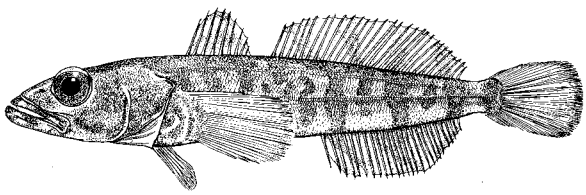


Source: CCAMLR (http://www.ccamlr.org)

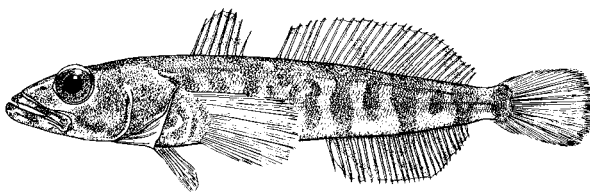
MAP 2
The CCAMLR Convention Area

FIGURE 1
Examples of species targeted by bottom fisheries in the high seas of the Southern Ocean

Patagonian toothfish *(Dissostichus eleginoides)*



Antarctic toothfish (*Dissostichus mawsoni*)



Source: FAO.

exploratory stage (CCAMLR, 2000). Many of the original targeted stocks such as marbled rockcod (*Notothenia rossii*) were overexploited and these fisheries ceased in the 1980s.

Fishing for Patagonian toothfish (*Dissostichus eleginoides*) began with exploratory fishing by Chile in the 1950s. In the 1980s, a commercial trawl fishery started around the Kerguelen Islands. Longline fishing was introduced in the mid-1980s (CCAMLR, 2000). The exploitation of the Antarctic toothfish (*Dissostichus mawsoni*) began only after 1998 (Fallon and Stratford, 2003).

Current fisheries

The main species currently targeted by bottom fishing gears in the Southern Ocean are the Patagonian toothfish (*D. eleginoides*) and the Antarctic toothfish (*D. mawsoni*) (see Figure 1).

D. eleginoides is widespread throughout the Southern Ocean and extends north into sub-Antarctic waters of the Atlantic, Pacific and Indian Oceans. In contrast, the closely

related *D. mawsoni* is endemic to the seas of Antarctica, with a circumpolar distribution, and is found in higher latitudes south of the Antarctic Convergence (Gon and Heemstra, 1990). The two species are known to overlap in the areas immediately to the south of the Antarctic Polar Front, particularly in the area to the north of the Ross Sea (Hanchet *et al*., 2003).

D. eleginoides grows slowly and matures at over ten years, at which stage it is about 80 centimetres (cm) long for males and 100 cm for females. This species has a longevity of over 35 years (Everson and Murray, 1999) and can reach 2 metres (m) in length. *D. mawsoni* has very similar biological characteristics, but is thought to grow more slowly than Patagonian toothfish (Agnew, 2000), and has a smaller maximum length (estimated at around 1.8 m). Growth rates may vary between gender and location.

TABLE 1
Main bycatch species in the bottom longline fisheries for *Dissostichus* spp. in the Southern Ocean

Common name	Scientific name
Macrourids or grenadiers	*Macrourus whitsoni*
	Macrourus carinatus
	Macrourus holotrachys
Rajids or skates	*Bathyraja eatonii*
	Bathyraja irrasa
	Bathyraja maccaini
	Bathyraja meridionalis
	Raja georgiana
Blue antimora (morid)	*Antimora rostrata*

Source: CCAMLR, 2007b.

The main bycatch species associated with the longline fisheries for *Dissostichus* spp. in the Southern Ocean are macrourids (grenadiers) and rajids (skates) (Table 1). Other species groups are also caught as bycatch (CCAMLR, 2006c).

Bottom longline fisheries for Dissostichus *spp.*

Currently, toothfish is mainly targeted by bottom longline fisheries in the CCAMLR Convention Area. The toothfish fishing grounds are distributed along the slopes, ridges and banks of the Antarctic continent and sub-Antarctic islands, and fishing depth generally ranges from 1 500 to 1 800 m.

In the high seas areas of its Convention Area, CCAMLR manages seven "exploratory"[2] deep-sea bottom longline fisheries targeting toothfish. The seven fisheries correspond to seven management areas in the South Pacific (Eastern Ross Sea Subarea 88.1, Western Ross Sea Subarea 88.2), the South Atlantic Ocean (Bouvet Subarea 48.6) and the South Indian Ocean (Ederby-Wilkes Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b). Other high seas areas in the CCAMLR Convention Area are closed to bottom fishing. The Ross Sea fishery in Subarea 88.1 is the southernmost fishery in the world (Hanchet, Horn and Stevenson, 2003). Most fishing in that area is concentrated between December and February, when vessels can fish around the sea ice.

The exploratory fisheries target *D. mawsoni* predominantly. As mentioned in the previous section, this species occurs in waters adjacent to the Antarctic continent, while *D. eleginoides* is mainly located in the northern areas of the CCAMLR Convention Area.

CCAMLR fishing seasons are from 1 December to 30 November of the following year (e.g. 2006/07: 1 December 2006 to 30 November 2007), and fishing is either permitted through that period, or during specified periods to minimize interactions

[2] In CCAMLR terms, a "new" fishery is one for a species and/or on a ground that has not previously been fished. It is also an established fishery where there is an intention to use a new fishing technique. There is a requirement at the "new" fishery stage to collect information on the target as well as dependent species, and the catch or effort (or both) may be limited. In CCAMLR parlance, a new fishery lasts for one year unless no catch is taken at which time it retains its classification. In the second year, the fishery becomes an "exploratory" fishery. Both CCAMLR's conservative approach and data collection requirements continue to allow for a full assessment of the fishery and stock(s) to be developed. A data collection plan must be followed and a research and fishery operation plan produced. All such plans are reviewed each year by the Scientific Committee (http://www.ccamlr.org/pu/e/e_pubs/am/man-ant/p4.htm#New%20and%20Exploratory).

TABLE 2
Catches of *Dissostichus* spp. reported from the CCAMLR Convention Area (Southern Ocean) in 2006/07

Region	Catch (tonnes)		
	High seas	National	Total
Atlantic	113	3 589	3 702
Indian	1 026	5 852	6 878
Pacific	3 443	0	3 443
Total	4 582	9 441	14 023

Source: CCAMLR, 2007b: Annex 5.

with breeding seabirds. During the 2006/07 season, 11 flag states and 20 vessels (Table 5) participated in the exploratory longline fisheries for *Dissostichus* spp. in the high seas areas of the CCAMLR Convention Area and a total of 4 582 tonnes of *Dissostichus* spp. was caught (Table 2).

Reported catches of toothfish in the high seas areas of the CCAMLR Convention, mainly in the Ross Sea, for the seasons 2003/04, 2004/05, 2005/06 and 2006/07 were around 4 600 tonnes per season (CCAMLR, 2007c). This represents about a quarter of the total catch of *Dissostichus* spp. reported in the CCAMLR Convention Area; the main fishing grounds for these species are located around the sub-Antarctic islands in areas where national measures are implemented (Miller, 2007).

Other fisheries in the CCAMLR Convention Area

Longline fisheries for *D. eleginoides* also occur in areas under national jurisdiction (Subareas 58.6, 58.7, 48.3 and 48.4, and Division 58.5.1 and 58.5.2). In its answer to the 2007 FAO Questionnaire on High Seas Deep-sea Fisheries (hereinafter referred to as the FAO Questionnaire – see Appendix A), France provided detailed information (Table 3) regarding the activity of seven longliners fishing in the EEZ of Kerguelen and Crozet Islands (CCAMLR Subareas 58.5.1 and 58.5.2). Although this fishery occurs in areas under national jurisdiction, it gives a good indication of levels of catch, bycatch and fishing effort for this species in the region which is not readily available.

TABLE 3
French bottom longline fishery in the EEZ of Kerguelen and Crozet Islands, 2003–2006

Year	Number of vessels	Catch (tonnes)				Fishing days
		Total	*Dissostichus* spp.	*Macrourus* spp.	Rajids	
2006	7	8 310	2 550		5 760	1 388
2005	7	6 850	500	530	5 820	1 469
2004	7	7 130	830	450	5 850	1 600
2003	7	7 490	800	770	5 920	1 637

Source: response from France to FAO Questionnaire.

Currently, there are no bottom trawl fisheries in the CCAMLR Convention Area, except at Heard and McDonald Islands where a trawl fishery targets *D. eleginoides* in the Australian EEZ.

Pelagic fisheries for Antarctic krill (*Euphausia superba*) developed in the 1970s and the annual catches peaked at 500 000 tonnes in 1981/82. In recent years, the annual catch of krill has been around 100 000 tonnes (CCAMLR, 2000).

There is also a pelagic trawl fishery for mackerel icefish (*Champsocephalus gunnari*), which currently takes place in CCAMLR Division 58.5.2 (Heard Island) and Subarea 48.3 (South Georgia).

Other fisheries, not in operation in recent years, have included pelagic trawl fisheries for mackerel icefish in Division 58.5.1 and electron subantarctic (lanternfish) (*Electrona carlsbergi*) at South Georgia, bottom trawl fisheries for rockcod (*Notothenia* spp.) in Area 48, a pot fishery for crab and a squid fishery at South Georgia (CCAMLR, 2000; CCAMLR, 2006c).

Catch and effort summary

Table 4 lists catch of *Dissostichus* spp. in CCAMLR's exploratory bottom fisheries from 2003/04 to 2006/07 and Table 5 provides an overview of the reported number of

TABLE 4
Reported catch of *Dissostichus* spp. in CCAMLR's exploratory bottom fisheries from 2003/04 to 2006/07

Season	Catch (tonnes)							
	High seas Divisions or Subareas							
	48.6	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2	All exploratory fisheries
2003/04	7	<1	20	<1	7	2 197	375	2 605
2004/05	51	480	127	110	297	3 120	411	4 594
2005/06	163	421	164	89	361	2 969	514	4 680
2006/07	113	645	124	4	253	3 096	347	4 582

Source: CCAMLR, 2007b: Annex 5.

vessels per country targeting *Dissostichus* spp.

Illegal, Unreported and Unregulated (IUU) fishing

IUU fishing in the CCAMLR Convention Area was first detected in 1988/89, and estimates are derived from longlining and gillnetting activities. IUU fishing activities targeting *Dissostichus* spp. in the CCAMLR Convention Area peaked in the mid-1990s in areas which nowadays are patrolled. Routine surveillance in the sub-Antarctic Indian Ocean led to a gradual reduction in IUU fishing, from an estimated total of 32 673 tonnes of *Dissostichus* spp. in 1996/97, to 2 178 tonnes in 2003/04. Since 2003/04, the available information indicates that IUU fishing activities have moved to the high latitude regions of the Indian Ocean (Subarea 58.4) and have increased in intensity (see Table 6). The estimated total catch of *Dissostichus* spp. taken by IUU fishing in 2006/07 was 3 615 tonnes, most of which was taken in Division 58.4.3b (2 293 tonnes).

TABLE 5
Reported number of fishing vessels targeting *Dissostichus* spp. in CCAMLR's exploratory bottom fisheries from 2003/04 to 2006/07

Flag state	CCAMLR season			
	2003/04	2004/05	2005/06	2006/07
Argentina	2	1	1	1
Australia	1	1		
Chile		1	2	
Japan	1	1	1	1
Korea, Republic of	2	2	1	3
Namibia				1
New Zealand	5	4	4	4
Norway	1	1	1	1
Russian Federation	2	2	2	2
South Africa	1			1
Spain	1	2	2	1
United Kingdom	1	1	2	2
Ukraine	3			
Uruguay	2	2	3	3
United States of America	2			
Number of vessels	24	18	19	20
Number of flag states	13	11	10	11

Source: CCAMLR, 2006c; 2007b.

CCAMLR has developed a combined IUU list of vessels from both contracting and non-contracting parties. The list was adopted by CCAMLR from 2003 to 2007, and currently includes 25 vessels (CCAMLR, 2007a).

TABLE 6
Estimated catch of *Dissostichus* spp. taken by IUU fishing in the high seas of the CCAMLR Convention Area from 2003/04 to 2006/07*

Season	Catch (tonnes)													
	High seas Divisions or Subareas						Divisions or Subareas under national jurisdiction where national measures are implemented						Unknown	All areas
	58.4.1	58.4.2	58.4.3a	58.4.3b	88.1	88.2	58.4.4	58.5.1	58.5.2	58.6	58.7	48.3		
2003/04		197		246	240	0	0	536	531	380	48	0		2 178
2004/05		86	98	1 015	23	0	220	268	265	12	60	23	508	2 578
2005/06	597	192	0	1 903	0	15	104	144	74	55	0	0	336	3 420
2006/07	612	197	0	2 293	0	0	109	404	0	0	0	0		3 615

Blank: no estimate; zero: no evidence of IUU fishing.
*IUU fishing was first detected in 1988/89, and estimates are derived from longlining and gillnetting activities.
Source: CCAMLR, 2007b: Annex 5.

STATUS OF THE STOCKS, BYCATCH AND IMPACTS ON VULNERABLE MARINE ECOSYSTEMS

Status of target stocks

CCAMLR annually reviews and updates integrated fishery assessments for *Dissostichus* spp. in Subareas 88.1 and 88.2, and assessments for *Dissostichus* spp. in Subarea 48.6 and Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b are being developed. The current status of target stocks is currently being assessed and precautionary catch limits for *Dissostichus* spp. and bycatch species are set in all exploratory fisheries.

Status of bycatch stocks

The need for assessments of the status of bycatch species or groups (particularly macrourids and rajids) has been raised as an important issue by the CCAMLR Scientific Committee in recent years. However, there is currently no information available on the status of bycatch species. Data collection and tagging programmes have been initiated for some bycatch species, in particular for rajids.

Impacts on Vulnerable Marine Ecosystems (VMEs)

Seamounts, hydrothermal vents, cold-water corals and sponge fields are considered to be VMEs in the CCAMLR Convention Area. Impacts of bottom longline fisheries on long-lived cold-water corals have been observed in some areas exploited by the toothfish fishery around South Georgia (Rice *et al*., 2007). In 2007, CCAMLR adopted Conservation Measure 22-06 (Bottom Fishing in the Convention Area) to mitigate the impacts of bottom fishing on VMEs (see following section).

CONSERVATION AND MANAGEMENT MEASURES

CCAMLR management of fisheries is based on a precautionary ecosystem approach. The conservation measures are revised annually for each fishing season (CCAMLR, 2006d). The seven exploratory longline fisheries for *Dissostichus* spp. in high seas areas are currently subject to the following requirements:

- annual notification of intent to fish;
- participation limited to members who have notified their intention to fish in a particular season;
- compliance requirements including licensing, inspections and VMS;
- participation in the Catch Documentation Scheme (CDS) for *Dissostichus* spp.;
- environmental protection;
- mitigation measures (seabirds);
- limited fishing season;
- precautionary catch limits for *Dissostichus* spp. by fishery and small-scale research units (SSRU);
- precautionary catch limits for bycatch species by fishery and SSRU;
- scientific observations appointed in accordance with CCAMLR's Scheme of International Scientific Observation (CCAMLR, 1992);
- quasi real-time (five-day) catch and effort reporting used for in-season monitoring of fishing in relation to precautionary catch limits;
- haul-by-haul catch and effort data;
- fishery-based research in SSRU;
- tagging programme for *Dissostichus* spp.

Measures are also in place to ensure minimal effects of other fisheries on the environment. Gillnetting is prohibited in the CCAMLR Convention area (Conservation Measure 22-04). Bottom trawling is currently restricted to areas for which CCAMLR has conservation measures in force for bottom trawling gear (Conservation Measure 25-04). This interim restriction entered into force for 2006/07 and 2007/08. These

measures do not apply to fishing for scientific research purposes, which is allowed under specific constraints and conditions.

In November 2007, CCAMLR adopted Conservation Measure 22-06, which aims to mitigate adverse effects of bottom fishing on VMEs. This measure limits bottom fishing until 30 November 2008 to those areas that were approved for the 2006/2007 fishing season. All bottom fisheries commencing 1 December 2009 and thereafter will be subject to an impact assessment. The measure also requires the immediate cessation of fishing in areas where VMEs are encountered in the course of fishing. This measure strengthens CCAMLR's existing monitoring and control measures for bottom fisheries, as well as requirements for data collection and research.

INFORMATION AND REPORTING GAPS

The CCAMLR Scientific Committee reports discrepancies between the data compiled by CCAMLR and the data reported by countries in STATLANT. However, detailed haul-by-haul, catch and effort, and biological data, including scientific observer data, are held by CCAMLR. These data, which are used in CCAMLR stock assessments, are confidential and subject to CCAMLR's rules for access and use (CCAMLR, 2006a; 2006b).

SOURCES OF INFORMATION

In their reply to the FAO Questionnaire sent to states known as having a high seas deep-sea fishing fleet, four countries (Japan, New Zealand, Norway and the Republic of Korea) officially replied with some information regarding deep-sea fishing in the high seas of the Southern Ocean. Other countries such as France and Australia reported fishing activity in the Southern Ocean, but limited to areas under their national jurisdiction. Various documents published by CCAMLR have been used for this review.[3] The CCAMLR *Report of the Twenty-Fifth Meeting of the Scientific Committee* and its annexes, in particular the Fishery Reports prepared by the Working Group on Fish Stock Assessment (WG-FSA), have been the main source of information for the description of the fisheries. The 2007 electronic version of the CCAMLR Statistical Bulletin has also been used. Responses to the FAO Questionnaire from Ukraine and others have provided additional information.

Limited information on fishing effort was available in STATLANT data published in CCAMLR's Statistical Bulletin (CCAMLR, 2007c).

SUMMARY TABLE FOR 2006/7

Main flag states involved in fisheries*	Argentina, Australia, Chile, Japan, Republic of Korea, Namibia, New Zealand, Norway, Russian Federation, South Africa, Spain, Ukraine, United Kingdom, United States of America, Uruguay
Estimated total number of vessels*	20
Total reported catch (tonnes)*	4 582

Main fisheries				
Gear	**Target species**	**Fishing grounds**	**Regional area**	**Jurisdiction**
Bottom longline	Antarctic toothfish Patagonian toothfish	Slopes, ridges and banks of the Antarctic continent and sub-Antarctic islands	Divisions 58.4.1, 58.4.2, 58.4.3a and 58.4.3b, and Subareas 48.6, 88.1 and 88.2	High seas

* The seven exploratory bottom longline fisheries (see section on Current fisheries).

[3] http://www.ccamlr.org/pu/e/e_pubs/intro.htm

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