B17. SOUTHERN OCEAN

FAO Statistical Areas 48, 58 and 88

by Ross Shotton *

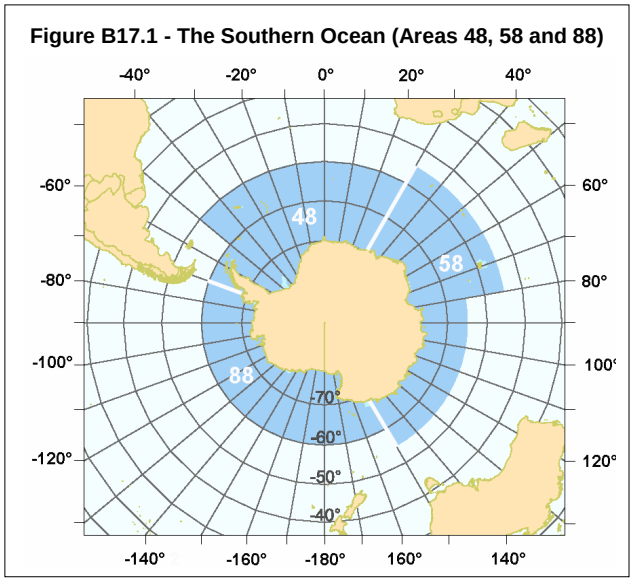


Figure B17.1 - The Southern Ocean (Areas 48, 58 and 88)

INTRODUCTION

The Southern Ocean surrounds Antarctica and represents approximately 15 percent of the world's water area. It extends from the coast of the continent northwards to the Antarctic Convergence, a physically and biologically distinct frontal zone where the cold water of the Southern Ocean encounters, and flows under, the warmer and more saline sub-Antarctic water of the Atlantic, Indian and Pacific Oceans. The position of the Antarctic Convergence varies seasonally and geographically, but is generally located near 50°S in the Atlantic and Indian sectors of the Southern Ocean and near 60°S in the Pacific sector. The Southern Ocean (Figure B17.1) is divided into three statistical areas: Area 48 (Atlantic Antarctic) between 70°W and 30°E, Area 58 (Indian Ocean Antarctic) between 30° and 150°E, and Area 88 (Pacific Antarctic) between 150°E and 70°W. Each area is further divided into subareas and divisions.

The Southern Ocean is characterized by an eastward flowing Antarctic Circumpolar Current and a series of clockwise-rotating gyres that contribute to a westward flowing East Wind Drift along the Antarctic coast. The Southern Ocean has three distinct ecological zones: an ice-free zone to the north, an extensive seasonal pack-ice zone between approximately 55-60° and 70-75°S, and a permanent pack-ice zone adjacent to the continent. Antarctic krill, *Euphausia superba*, is abundant in the seasonal pack-ice zone where it provides the staple food for many species of whales, seals, birds and fish which inhabit the region.

The marine living resources of the Southern Ocean have been harvested since 1790 when sealers first hunted fur seals for their pelts. By 1825, some populations of fur seal had been

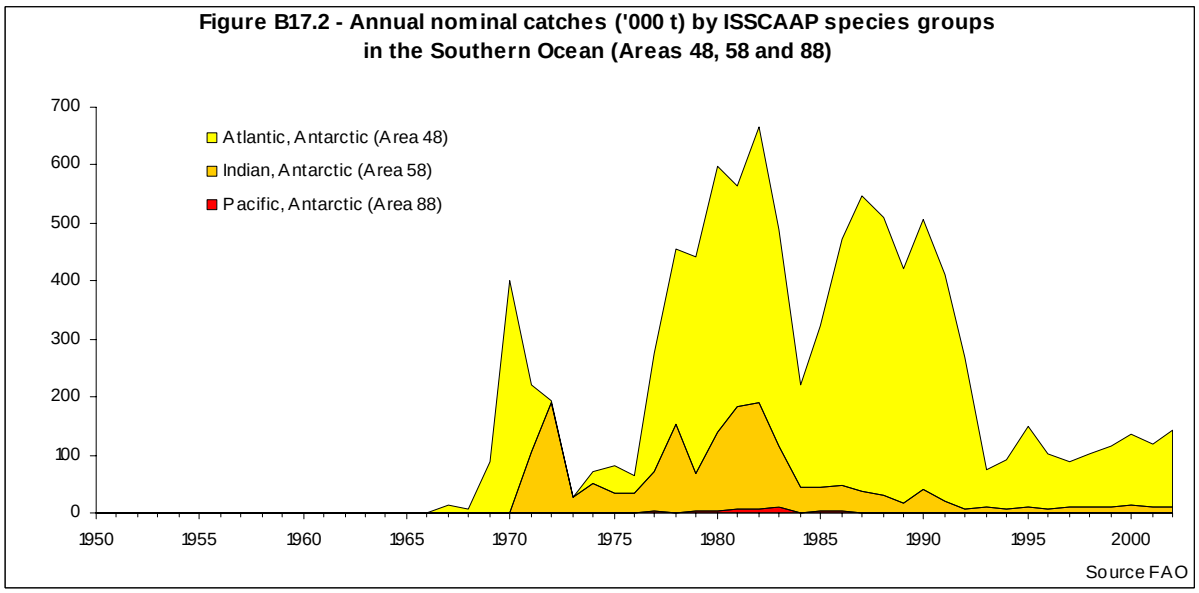


Figure B17.2 - Annual nominal catches ('000 t) by ISSCAAP species groups in the Southern Ocean (Areas 48, 58 and 88)

* FAO, Marine Resources Service, Fishery Resources Division

hunted close to extinction, and sealers begun hunting elephant seals and some species of penguins for their oil. Whaling in this area begun in 1904 and all seven species of whales found in the Southern Ocean were extensively exploited. Large-scale fishing did not begin until the late 1960s.

The harvest of marine living resources in the Southern Ocean is managed under the International Whaling Commission (IWC) established in 1946, the Convention for the Conservation of Antarctic Seals ratified in 1978, and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) established in 1982 (see http://www.ccamlr.org for further information).

PROFILE OF CATCHES

Close to 9.0 million tonnes of krill and fish were taken cumulatively from the Southern Ocean from 1969-1970, when records of commercial fishing began, to the end of 2001-2002 (the fishing year in the Southern Ocean is 1 July to 30 June of the following year). Most nominal catches (80.5 per cent) were taken in Area 48, that is Atlantic Antarctic between 1976-1977 and 1991-1992 (Figure B17.2 and Table D16), and the dominant species was krill (Figure B17.3). Next most important was the Indian Antarctic zone with 19.0 percent of the catch. But by 2002, these numbers had changed to 93 percent for the Atlantic zone, 6 percent for the Indian zone and nearly 1 percent for the Pacific zone. Important commercial species in the past included lanternfish (myctophids – principally *Electrona carlsbergi*); mackerel icefish (*Champsocephalus gunnari*), marbled rockcod (*Notothenia rossii*) and Patagonian rockcod (*Patagonotothen guntheri*), but these resources have been severely fished down. The major fishery is now for the valuable Patagonian toothfish (*Dissostichus eleginoides* and *D. mawsonii*) which in 2002 represented 63 percent of total catch by weight, excluding krill.

The commercial harvest of krill began in 1972, and annual catches from 1980 to 1992 exceeded 300 000t in most years, then decreased to 80 000-130 000t in recent years (Figure B17.3). At its peak of 528 200t in 1982, the fishery contributed approximately 13 percent of the global annual catches of crustaceans, and the subsequent lower catches (126 000t in 2002) reflect a decrease in landings, not overfishing. The fishery has operated mainly in Area 48, around the South Shetland Islands (Subarea 48.1) and South Orkney Islands (Subarea 48.2) in summer and adjacent to South Georgia (Subarea 48.3) in winter.

Reported catches in the fishery for marbled rockcod peaked at 399 700t in 1969-1970, and then declined precipitously to 101 560t in 1970-1971, and 2 740t in 1971-1972 as the stock was overfished and the fishery collapsed (Figure B17.3). Mid-water trawling for mackerel icefish started in the early 1970s, and this fishery was characterized by peaks of intense fishing (219 340t in 1978 and 162 600t in 1983) followed by periods of low catches and possible localized depletion from mid 1970s to late 1980s.

In recent years, fisheries in the Southern Ocean have targeted krill in Area 48, toothfish and icefish in Areas 48 and 58 (Figure B17.4).

Figure B17.3 - Annual nominal catches ('000t) of selected species in ISSCAAP Groups 33, 34 & 46, Southern Ocean (Areas 48, 58, 88)

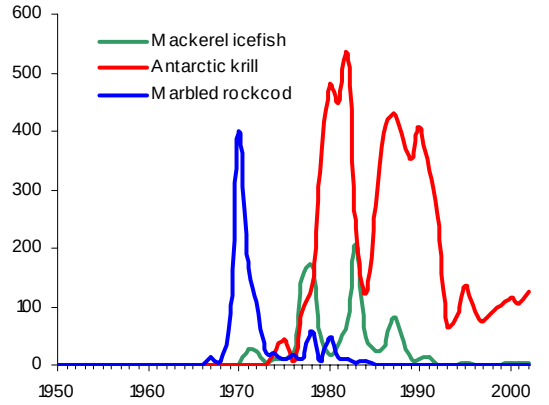
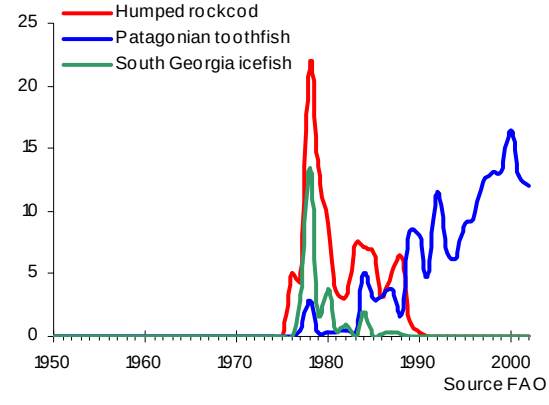


Figure B17.4 - Annual nominal catches ('000t) of selected species, Southern Ocean (Areas 48, 58, 88)



Exploratory fishing has occurred for squid (*Martialia hyadesi*) and crab (mostly *Paralomis* spp.) in Area 48. The earlier exploratory fishing for Antarctic toothfish (*Dissostichus mawsoni*) in Area 88 has developed into a small, but commercial-scale, fishery.

RESOURCE STATUS AND FISHERY MANAGEMENT

A moratorium on commercial whaling was introduced 1987, and extensive whale sanctuaries were established in the Indian Ocean in 1979 and Southern Ocean in 1994. Commercial whaling within these sanctuaries is prohibited. The recovery of whale stocks and the effectiveness of the moratorium and sanctuaries are being evaluated by the IWC. There are indications that some species of whale are recovering, but the low abundance of some of the largest species has made total numbers difficult to estimate from sightings data. Several hundred Minke whales out of an estimated 700 000 are currently taken annually in this area by Japan for research. Otherwise, recovery of the southern whale stocks proceeds slowly depending on species. Management of whales in the Antarctic, and elsewhere is the responsibility of the International Whaling Commission.

The commercial harvest of seals is regulated under the Convention for the Conservation of Antarctic Seals. Annual catch limits were set for crabeater seals (175 000 individuals), leopard seals (12 000 individuals) and Weddell seals (5 000 individuals), and the taking of fur seals, elephant seals and Ross seals for commercial purposes is prohibited. No commercial harvest has taken place in recent years.

In 1982, Parties to the Antarctic Treaty established CCAMLR under an international convention based on an ecosystem-wide approach to the conservation of marine living resources in the Southern Ocean, with conservation defined to include rational use. The conservation principles set down in the Convention require that exploited populations must not be allowed to fall below an abundance close to that which ensures their greatest net annual increase, depleted populations must be restored to such abundance, and the risks of changes to the marine ecosystem that are not potentially reversible over two or three decades must be minimized. Importantly, ecological relationships between harvested, dependent and related species must be maintained.

These stringent principles embody an ecosystem approach to the management of living resource and set the CCAMLR Convention apart from other regional marine resource management regimes. Management of fishing must not only aim to conserve the targeted species but take into account the impact of fishing on those animals that prey on, and compete with, the targeted species. In its broadest interpretation, the Convention requires that management action should take account of the impact of activities on all living organisms in the Antarctic ecosystem or sub-systems.

The status and management of the marine ecosystem of the Southern Ocean is reviewed annually by the twenty-three member countries of CCAMLR based on information gathered from the fisheries and fishery surveys, the Scheme of International Scientific Observation aboard fishing vessels, and CCAMLR's Ecosystem Monitoring Program. Fishery resources are reassessed, and the management regime is defined by Conservation Measures which regulate all existing, new and exploratory fisheries, and fishing for research purposes within the CCAMLR Convention Area (Areas 48, 58 and 88).

Complementary management measures are also in force in territorial waters adjacent to Prince Edward and Marion Islands (South Africa), and Crozet Islands and Kerguelen Islands (France) in Area 58. Of particular interest has been the recent creation of the world's largest fully protected marine reserve in the Australian sub-Antarctic. The 6.5 million-hectare Heard and McDonald Islands Marine Reserve would ensure that one of the globe's last pristine ecosystems remained intact. It surrounds the uninhabited Heard and McDonald group, and includes two large zones of the Southern Ocean. The Heard reserve is intended to protect the habitat and food sources of seals, penguins, and albatrosses, as well as marine life.

Krill

Krill is central to the food chain in the Southern Ocean, and its circumpolar standing stock is generally estimated around 500 million tonnes,

although there remains a large uncertainty over the production estimates for krill. The recent annual catches of krill of 84 000-118 705t, over the last decade with the higher figure reported for the 2001-2002 season, are well below the precautionary catch limits set by CCAMLR of 1.5 million tonnes in Area 48 (with a maximum of 620 000t per subarea), and 1.225 million tonnes in Area 58 (775 000t in Division 58.4.1 and 450 000t in Division 58.4.2).

The decline in krill catches in 1992 (Figure B17.3) was attributed to economic factors, a shift in fishing effort from krill fisheries to finfish fisheries, and the break-up of the Soviet Union which until then had dominated the fishery – its decline was not due to overfishing. Any resurgence of the krill fisheries would depend on advances in harvesting and processing technology and possibly the development of pharmaceutical products based on krill.

Krill fisheries are closely monitored because vessels target krill aggregations on the shelf or at the shelf break, in many cases close to the breeding sites of land-based krill predators such as penguins. Concern has been expressed within CCAMLR that krill catches in those areas may affect predators by locally depleting their food source. The interaction between krill fisheries and land-based krill predators is being researched under CCAMLR's Ecosystem Monitoring Program. Equally of concern has been the potential impact of global warming upon the extent of ice-sheet coverage in the Antarctic and its possible affect upon krill life history behaviour.

Toothfish

Patagonian toothfish is harvested under regulated and assessed fisheries in Area 48 (Subarea 48.3) and Area 58 (Subareas 58.6 and 58.7, and Divisions 58.5.1 and 58.5.2). Annual catches over the past 10 years have ranged from 5 613t to 17 575t, peaking in the fishing season of 1998-99; for the most recent season of 2001/02, reported catches was 12 057t (Figure B17.4). Catches outside the CCAMLR convention area were 9 017t during this season compared with 25 054t during the preceding season. Most of this catch was reportedly taken in FAO Statistical Areas 52, 57 and 87. Several new and exploratory fisheries have also been identified, some targeting both Patagonian toothfish and Antarctic toothfish (*Dissostichus mawsoni*) in the southern sectors of Areas 58 and 88. Toothfish is taken by longline, except in Divisions 58.5.1 and 58.5.2 where it is taken by trawl.

Strict regulations are in force to minimize the incidental capture of seabirds and marine mammals. These include using streamer lines, using thawed bait to ensure that bait sinks as quickly as possible, setting longlines at night with a minimum of deck lighting, prohibiting the discharge of offal during line setting, and prohibiting the use of net monitor cables in the trawl fisheries.

Catch limits and areas of operations for toothfish fisheries are defined by the Conservation Measures. For the 2002/03 fishing season, TACS for toothfish (*Dissostichus* spp.) were set at 7 810t for Area 48.3; for Area 58.5.2. (Heard and MacDonald is) a TAC of 2 879t was recommended. In several of the other Convention areas it was found not possible to offer management advice or it was recommended that the fishery be closed or remain closed (CCAMLR, 2002).

The large illegal and unregulated fishing for toothfish which has taken place in recent years is of great concern, particularly in Area 58, but is now reported as possibly happening in Areas 88.1 and Area 51. This destructive activity threatens stocks of toothfish through over-fishing, and populations of seabirds through incidental capture and mortality during longlining. Controlling such fishing is critical to fulfilling CCAMLR's objectives.

CCAMLR's Scientific Committee has recognized the need to include accurate estimates of the Illegal Unregulated and Unreported (IUU) catch of fish species in their Convention Area and recognize that including the estimate IUU catch as part of the TAC will substantially reduce the yield that would be available for legal fishing operators. It was recognized that estimating the IUU catch would be difficult and would require expertise beyond that solely available in the CCAMLR Scientific Committee.

Icefish

Stocks of icefish are believed to undergo large natural variations in abundance, and commercial

fishing for this species is restricted to peaks in abundance. Despite this, there has been no sign of any recovery of this stock which though it recorded a catch of 162 598t in 1983, has averaged an annual catch of only 1 324t over the last decade, a period in which catches were less than 100t in three of those years. Pre-recruit trawl surveys are conducted regularly to estimate the abundance of icefish; this information forms the basis of the management advice. Directed fishing on icefish in Area 48 was prohibited in the 1991-1992 and 1994-1995 fishing seasons. The catch limit for 2000/01 was set at 5 557t for Subarea 48.3, though it did not appear this amount of catch would be achieved. Thus a TAC was set for 2002/03 of 2 181t. In Area 58.5.1, Kerguelen Islands, the fishery was kept closed and in Area 58.5.2 (Heard and McDonald Islands) the TAC was set at 2 980t, an increase from 885t for the preceding season.

Other species

Commercial fishing for three other groups of target species is currently permitted under CCAMLR Conservation Measures within Area 48 (Subarea 48.3). Annual catch limits were set at 109 000t for lanternfish during 1999/00, but no catches have been reported of this species.

CCAMLR also reviews information relating to bycatch species. The major species of interest include macrourids, skates and rays, in addition to bycatch of the primary managed species, i.e. toothfish and icefish. Data are available for bycatch species taken both by trawl and by longline. CCAMLR (2002) reports that in Subareas 88.1 and 88.2 the percentage of macrourids and skates has ranged from 1 to 27 percent and 1 to 15 percent respectively. During the 2001/02 season, catches of *Macrourus whitsoni* and elasmobranchs accounted for 12 percent and 2 percent respectively of the total catch. In general, macrourids constitute about 10 percent of the total catch in most areas and elasmobranchs less than 10 percent. CCAMLR has introduced operational fishing rules that require vessels to shift their place of operation if the amount of bycatch exceeds a threshold level. For example, in Subarea 88.1 during the 2001/02 season, the “move-on” rule was triggered by macrourids in up to 20 percent of longline sets and by elasmobranchs in up to 4 percent of trawl sets.

REFERENCES

CCAMLR. 2002. Report of the Twenty-first Meeting of the Scientific Committee (Hobart, Australia, 21-25 October 2002). SC-CCAMLR-XX1. 75 pp.