Main features

**STATUS**
Patagonian toothfish and mackerel icefish **not overfished**; status of byproduct species **uncertain**

**RELIABILITY OF THE ASSESSMENT**
Robust for toothfish and icefish; less for byproduct species

**CURRENT CATCH (2001-02)**
- Patagonian toothfish 2567 t
- Mackerel icefish 852 t

**LONG-TERM POTENTIAL YIELD**
- Patagonian toothfish 3000–4000 t per year

**MAIN MANAGEMENT OBJECTIVE**
Management arrangements are consistent with (and extend) the principles and conservation measures of CCAMLR. These principles are precautionary, minimise risk under conditions of uncertainty, and account for ecological links between target species and other species and marine communities (the ecosystem approach)

**MANAGEMENT METHODS**
Limited entry (three boats); total allowable catches for target and byproduct species; moving to Statutory Fishing Rights that will be based on a minimum holding of useable quota
Highlights

- The fishery is a trawl and bottom-longline fishery in the Australian Fishing Zone around Heard Island and McDonald Islands in the subantarctic waters of the Indian Ocean. The target species are Patagonian toothfish and mackerel icefish (trawl only), but a small suite of bycatch species is also taken.

- The fishery, which developed over the past eight years, is managed by the Australian Fisheries Management Authority under the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) and its associated Commission.

- A major management issue is the illegal, unregulated and unreported fishing in Australia’s Exclusive Economic Zone and more widely across Antarctic waters.

Background

History of the fishery

Heard Island and McDonald Islands are Australian external territories, lying in the southern Indian Ocean about 4000 km southwest of Perth. They have been described as the only example of an unmodified sub-Antarctic island ecosystem, and are included on the Register of the National Estate and the World Heritage List because of their outstanding biological, geological and scientific values. The islands and their surrounding territorial waters (out to 12 n.mile) form the Heard Island Wilderness Reserve, which is managed under a formal management plan by the Australian Antarctic Division. The plan prohibits commercial fishing within this 12 n.mile zone. Waters between 12 n.mile and 200 n.mile are part of the Australian Fishing Zone (AFZ) and are under the jurisdiction of the Australian Fisheries Management Authority (AFMA).

As the islands lie to the south of the Polar Front (Antarctic Convergence), they are also
under the jurisdiction of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). The Commission, comprising 24 member nations, seeks to manage the Southern Ocean Antarctic ecosystem cooperatively. Its objective is the conservation (including the rational use) of Antarctic marine living resources. The Heard Island and McDonald Islands (HIMI) Fishery is in the portion of the AFZ within CCAMLR Statistical Division 58.5.2. AFMA has separate arrangements for activities in the remainder of the AFZ around Heard and McDonald Islands (the southern segment), which is within Division 58.4.3. Under the Antarctic Marine Living Resources Conservation Act 1981, the Australian Antarctic Division is responsible for administering Australia's harvesting of Antarctic marine living resources in the remaining high seas areas of the CCAMLR area, and has a primary role in coordinating Australian fisheries research and assessments there.

Substantial catches of nototheniid (Antarctic cod) and channichthyid (icefish) fish have been taken on the adjacent Kerguelen plateau since the early 1970s. Around Heard Island and the McDonald Islands, however, there was only limited Soviet and Polish fishing through the 1970s. Following a joint Soviet–Australian exploratory fishing expedition in 1987, Australia made a series of exploratory cruises between 1990 and 1993. The cruises assessed the abundance and distribution of fish stocks in the HIMI sector of the AFZ, finding commercial quantities of Patagonian toothfish (*Dissostichus eleginoides*) and mackerel icefish (*Champsocephalus gunnari*). The surveyed biomasses of these species were estimated to be much lower than those calculated for the neighbouring Kerguelen plateau and, in the case of icefish, were seasonally and spatially variable.

Based on yields calculated from the exploratory trawl surveys, CCAMLR initially set total allowable catches (TACs) in 1995 for Statistical Division 58.5.2 at 297 t for toothfish and 311 t for icefish, and limits of 50 t each for other deepwater species in that division. In Division 58.4.3 it set a combined TAC of 200 t for both species of toothfish (Patagonian, and the Antarctic toothfish *D. mawsoni*). AFMA subsequently endorsed two Australian fishing operators to trawl in the new areas, but they did not fish in 1996.

For the 1996–97 season, CCAMLR increased the TAC for toothfish in Division 58.5.2 to 3800 t, based on the results of an improved method of estimating recruitment and a refined version of the model used to estimate yield. AFMA responded with an interim management policy, concerned that the large increase in TAC could create enforcement problems and might result in an unsustainable increase in fishing activity. The interim policy, modelled on the management policy developed for the Macquarie Island Developmental Fishery, restricted fishing to a maximum of three vessels, and to demersal and pelagic trawling only. Conditions included the carriage of two observers on every trip, the provision of data, and the development of a fishing plan with a research component. Fishing under the interim policy began in March 1997.

In 1998, AFMA released the *Heard Island and McDonald Islands Fishery Management Policy 1998–2000*, allowing for a maximum of two HIMI Fishery permits. The Policy was amended each year to incorporate the annual CCAMLR decisions, particularly with regard to TACs and bycatch provisions.

The *Heard Island and McDonald Island Fishery Management Plan 2002* came into force on 29 May 2002, providing for a system of transferable quotas, to be issued as statutory fishing rights, and specifying a minimum quota holding (25.5% of the total) before an operator may fish. Retention of quota was conditional on completion of a specified amount of research annually. Statutory Fishing Rights were granted and became effective from the December start of the 2002–03 fishing season.

The Department of Environment and Heritage approved a proposal to trial longline fishing during the 2002–03 season in specific areas (within and outside the HIMI Fishery) subject to conditions to reduce seabird deaths and injury. Subsequently, CCAMLR supported a New and Exploratory Fisheries proposal for longlining during the 2002–03 season in Divisions 58.5.2 (in the HIMI Fishery, under a Scientific Permit
under the HIMI Management Plan); 58.4.2 (off the Australian Antarctic Territory); 58.4.4(a) (Elan Bank); and 58.4.4(b) (Banzare Bank). There was a single longlining trip in the HIMI Fishery.

**Biology**

The designated target species of the fishery are Patagonian toothfish and mackerel icefish. In 1998 CCAMLR prohibited directed fishing for any other species.

Patagonian toothfish live around most sub-Antarctic islands and submarine plateaus. These areas are separated by large expanses of abyssal basins, which were until recently thought to inhibit interchange of fish. Recent fish-tagging and genetic work indicates a separation of stocks between the ocean basins, but with evidence of stock connection within the Indian Ocean region. The recapture of 11 tagged toothfish from the HIMI Fishery in the French waters around Crozet Island and Kerguelen Island led the CCAMLR Working Group for Fish Stock Assessment to conclude that Patagonian toothfish in the Indian Ocean probably comprise a meta-population where adults move from east to west and larvae from west to east. Toothfish in the Indian Ocean Sector are therefore a straddling stock, extending across national Exclusive Economic Zones and inside and outside the CCAMLR area.

Toothfish are found on the shelf and upper-slope areas at depths of 300 m to more than 2000 m. They are large, active predators, maturing at about 70–110 cm (6.5–8 years) and growing to more than 2 m and 100 kg in weight. Their maximum age is thought to be at least 40 years. Their diet is mainly mid-water squid and fish, but benthic animals such as prawns, crabs and echinoderms have been recorded regularly enough to indicate that bottom feeding is also important. Individuals appear to feed infrequently. Fecundity is moderate.

Mackerel icefish are found along the Scotia Arc from Shag Rocks and South Georgia in the north, to west of Adelaide Island (Antarctic Peninsula) in the south, around Bouvet Island and on the Kerguelen–Heard Plateau. They are a shallow-water shelf species, found mainly between 100 m and 350 m, but known to occur as deep as 700 m. They grow to 45–66 cm and, depending on location, can live between 5 and 15 years. Fecundity is high, but recruitment is also highly variable, resulting in quite variable levels of available biomass and TAC from year to year. A separate small population of icefish (with a different breeding season and length distribution) occurs on Shell Bank on the eastern edge of the Heard Island Plateau. Its commercial exploitation is prohibited.

**The 2003–04 fishery**

Two trawlers and one longliner were approved to operate in the HIMI Fishery during 2003–04. The target-species TACs were 2567 t for Patagonian toothfish and 852 t for mackerel icefish, with ancillary measures for other species and groups (see table). The mackerel

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**Graphs:**

**Mackerel icefish**

- **Catch (thousand tonnes)**
  - 1994-95: 0.5
  - 1996-97: 1.0
  - 1998-99: 2.0
  - 2000-01: 3.0
  - 2002-03: 4.0

- **TAC**
  - 1994-95: 0.5
  - 1996-97: 1.0
  - 1998-99: 2.0
  - 2000-01: 3.0
  - 2002-03: 4.0

**Patagonian toothfish**

- **Catch (thousand tonnes)**
  - 1994-95: 0.5
  - 1996-97: 1.0
  - 1998-99: 2.0
  - 2000-01: 3.0
  - 2002-03: 4.0

- **TAC**
  - 1994-95: 0.5
  - 1996-97: 1.0
  - 1998-99: 2.0
  - 2000-01: 3.0
  - 2002-03: 4.0

* not available
Icefish TAC was one tenth that in 2002–03 to account for the succession of relatively weak 1999 and 2000 cohorts after a strong 1997 cohort. Vessels were also to adhere to “move on” requirements in areas where icefish of 290 mm or less were taken, to prevent exploitation of two-year-old pre-recruits. Recent seasonal catches of Patagonian toothfish and mackerel icefish have been close to TACs. Because little longlining took place during 2002–03, Australia’s sub-Antarctic Fisheries Assessment Group (SouthMAC—which coordinates the research of agencies such as the Australian Antarctic Division and CSIRO) decided that at least one further season of trials was required for proper assessment of the acceptability of longlining under the management plan.

Illegal fishing

The incidence of illegal, unregulated and unreported (IUU) fishing within the CCAMLR region—including the HIMI AFZ—has grown dramatically over the past decade. Demersal longliners target Patagonian toothfish almost exclusively and are taking well in excess of CCAMLR-agreed TACs. Poor information about past and potential IUU catches seriously undermines efforts to apply agreed precautionary stock-assessment methods.

In the HIMI Fishery region the IUU activity appears to involve a highly organised longline fleet. It seriously disadvantages legal fishers: CCAMLR estimates that 10 000–18 000 t of toothfish were taken illegally in Statistical Division 58.5.2 (the HIMI area) in 1997, and a further 520–3500 t in 1998. In the 2001–02 season an estimated 2500 t of toothfish was taken by illegal fishers, probably mostly in the AFZ. The estimate was based on two seizures—the Lena, with 122 t whole weight aboard, and the Volga with 221 t—and detection of 10 unidentified illegal vessels, each estimated to have taken 216 t.

CCAMLR estimates that 39 000 to 93 000 birds were killed in 2001–02 during IUU fishing, threatening extinction for several seabird populations within the CCAMLR region.

CCAMLR measures to counter IUU fishing include the mandatory use of automated, satellite-based vessel-monitoring systems. A certification scheme was introduced in 2000 so that only certified catches of toothfish could be imported to the markets of CCAMLR parties. For its part, Australia has steadily increased its commitment to surveillance and enforcement actions, in cooperation with adjoining nations.
of the CCAMLR region. In May 2003 a Coalition of Legal Toothfish Operators—comprising some 25 fishing companies from Argentina, Australia, New Zealand, Spain, France, South Africa, Chile, Uruguay, Falkland Islands/Isles Malvinas, and Namibia—was formed to combat the illegal take.

Australia has made eight apprehensions in the HIMI Fishery:

<table>
<thead>
<tr>
<th>Name (Flag State)</th>
<th>Date of Apprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salvora (Belize)</td>
<td>16.10.1997</td>
</tr>
<tr>
<td>Aliza Glacial (Panama)</td>
<td>17.10.1997</td>
</tr>
<tr>
<td>Big Star (Seychelles)</td>
<td>21.02.1998</td>
</tr>
<tr>
<td>South Tomi (Togo)</td>
<td>29.03.2001</td>
</tr>
<tr>
<td>Lena (Russia)</td>
<td>04.02.2002</td>
</tr>
<tr>
<td>Volga (Russia)</td>
<td>07.02.2002</td>
</tr>
<tr>
<td>Viarsa 1 (Uruguay)</td>
<td>28.08.2003</td>
</tr>
<tr>
<td>Maya V (Uruguay)</td>
<td>24.01.2004</td>
</tr>
</tbody>
</table>

Current monitoring and research

Boats fishing in the HIMI Fishery must always carry two observers who, in addition to monitoring compliance with permit conditions, collect basic fisheries data and environmental and ecological information, including observations on seabirds, marine mammals and bycatch. They also tag fish, and collect data and material for specific research programs (for example, genetic studies). CCAMLR has further data-provision requirements, including the reporting of catch-and-effort information every 10 days.

Each permit holder has to contribute to research in the fishery by undertaking surveys and tagging fish. The trial longlining of the past two seasons was under a scientific permit that included specified research obligations. Longlining generally catches larger fish than trawling and can be used on untrawlable ground.

SouthMAC coordinates Australian research. The stock assessments of toothfish and icefish are based largely on data gathered during an annual trawl survey within the HIMI Fishery.

Status of stocks

CCAMLR requires that the abundance of target and bycatch species remains sufficiently high to avoid the likelihood of declining recruitment and to meet the needs of dependent species. A stock-projection model, using trawl-survey estimates of recruitment and its variability, is used to determine TACs that satisfy the CCAMLR criteria.

For toothfish, the catch limit must be chosen so that, over 20 years:
- the probability of the spawning biomass dropping below 20% of its pre-exploitation median level is less than 10%;
- the median spawning biomass remains at or above 50% of its pre-exploitation median level.

The most recent assessments of Patagonian toothfish and mackerel icefish for the HIMI Fishery, calculated by the standard CCAMLR methods, were made after an April–May 2003 trawl survey. The toothfish assessment indicated that the low recruitment since 1999 was continuing, and gave a revised long-term sustainable-yield estimate of 2680 t. The estimated spawning biomass has been declining recently, but remains above the reference point.

The size-composition of toothfish in experimental longlining catches in the 2002–03 season was similar to that in trawl catches, whereas elsewhere, longlining takes larger fish. However, size data may have been confounded due to the different fishing depths associated with the two gear types; deeper sets will be made during the experimental longlining in the 2003–04 season.

Because of the importance of mackerel icefish as a prey item, its spawning-biomass reference level is set at 75% of the pre-exploitation median level. In addition, the projection is shorter than 20 years to account for the species’ short lifespan and the large annual differences in cohort abundance. The abundance of fully recruited icefish (2+ years old) was assessed as only 20% of that in the previous season. This results from attrition of the strong 1997 cohort, and subsequent replacement by a series of relatively weak
Confirmation that another strong cohort of fish is entering the fishery will need to await assessment of the results of the May 2004 trawl survey. Management that stabilises the icefish yield over time might be possible, but it is more likely that substantial yield variability will remain a feature of the HIMIF because of recruitment variability and the small number of year-classes exploited.

**Reliability of the assessment**

The assessments are reasonably reliable because many sources of uncertainty are taken into account explicitly in the projection model. The consequent precautionary TACs are expected to satisfy CCAMLR criteria. While the catch-documentation scheme provides a better estimate of the toothfish catch, the lack of knowledge of the size of the annual illegal catch remains a source of uncertainty in assessments. The extent to which there is interchange of HIMI fish with those of neighbouring areas—such as Kerguelen—has not yet been quantified, complicating the determination of appropriate yields for the HIMIF and adjacent fisheries.

**Environmental issues**

The stringent trawling and longlining operational restraints on Australian boats in the HIMIF appear to be working well, with very few observations of interactions that cause death or injury to seals or seabirds.

Increasingly, precautionary TACs are being set for a variety of non-target species or species groups in Division 58.5.2 (see table), and fishing must stop if any are exceeded. Separate TACs are set for the trawl and longline sectors, but are competitive between vessels within these sectors. Additionally, if a single haul catches more than 1 t of a non-target species or more than 2 t of a non-target species-group, the vessel must move at least 5 n.mile and not return to the location for at least five days.

Elephant seals (*Mirounga leonina*) are predators of toothfish, and fur seals (*Arctocephalus* spp.) and king penguins (*Aptenodytes patagonicus*) are predators of icefish. An essential element of the precautionary approach adopted by CCAMLR is its requirement that the spawning biomasses of toothfish and icefish be maintained above specified minima to provide for these predators (see *Status of stocks*, above). Elephant seals and toothfish potentially compete for squid; hence, research on predator–prey interactions is ongoing.

Participants in the fishery are required to satisfy strict conditions to lessen environmental impacts. Plastic packaging bands must not be used on bait boxes, and plastic waste must not be discarded at sea. The loss of fishing gear and other non-biodegradable items must be reported. Bycatch species, offal and other waste products from fish processing must be retained on board to avoid attracting birds and mammals.

Discharge of poultry products is prohibited because of disease risks to seabirds. Discharge of brassicas (the plant family that includes broccoli) is prohibited because of the possibility of establishing pests on the islands. On-board lighting must be kept at a minimum to avoid seabird collisions, and any death or serious injury to a marine mammal or seabird must be reported.

Observers monitor the interactions of marine mammals and seabirds with fishing vessels. Over the 2000–02 seasons, the deaths of five Antarctic fur seals (*Arctocephalus gazella*) and one southern elephant seal were attributed to trawling; few interactions with seabirds were observed in trawling. No seabirds were killed during the Australian experimental longlining.
voyage during the 2002–03 season; three birds entangled during line hauling were released alive.

Illegal foreign fishing poses a significant threat to sustainability, in terms of both toothfish catches and the incidental mortality of marine mammals and seabirds (see Illegal fishing above).

In 2002, the HIMI Fishery was assessed and approved under strategic-assessment provisions of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), which allows export of its product. In addition, the industry operators in the HIMI Fishery are seeking certification of the mackerel icefish sector from the Marine Stewardship Council—an independent non-profit organisation that promotes responsible fishing practices, particularly through environmental certification and labelling.

The Heard Island and McDonald Islands Marine Reserve was declared under the EPBC Act in October 2002 after consultation between the Department of Environment and Heritage and HIMI Fishery stakeholders. The reserve encompasses some 65,000 square kilometres, 85% of which is zoned as highly protected marine reserve (IUCN category 1a: fishing prohibited). The remaining 15% is zoned as conservation; its conservation values, fishing resources and fishing impacts are being assessed to determine whether to include this area in the HIMI Marine Reserve. Fishing may continue in these conservation areas under specified conditions.

Further reading


Management performance

AFMA’s stated objectives with respect to the HIMI Fishery are drawn from the Fisheries Administration Act 1991 and the Fisheries Management Act 1991. AFMA is also required to be consistent with CCAMLR Conservation Measures and to have regard to the Heard Island Wilderness Reserve Management Plan. Pending the implementation of a formal HIMI Fishery Management Plan, AFMA is taking a precautionary approach to the fishery’s development.

AFMA considers that the current CCAMLR Conservation Measures are consistent with AFMA’s legislated objectives. With respect to the wilderness reserve, AFMA prohibits fishing within 13 n.mile of the islands (the 12 n.mile reserve plus a 1 n.mile buffer zone), imposes conditions on fishing permits to limit possible environmental effects, and cooperates with agencies to improve knowledge of the marine habitat around the islands.

The management of the HIMI Fishery differs from that of other fisheries in important ways. First, basic information on the status of the stocks was available before fishing began, and precautionary TACs were established from the outset rather than after the fishery had become established (and possibly overcapitalised). The existence of CCAMLR, the involvement of the Australian Antarctic Division, and an established stock-assessment process facilitated this. Second, environmental effects, including effects on non-target species (both direct and indirect), are accepted as legitimate considerations in determining operating conditions for the fishery. This is reflected in the diverse membership of groups such as SouthMAC, the level of cooperation by permit holders, and the amount of effort directed at such topics as predator–prey interactions.

AFMA has responded to this atypical situation with detailed management arrangements that impose strict controls on the fishery. The effectiveness of these controls depends on the extent of illegal fishing in the area. From 1998, the Australian Government committed A$16.3m over four years towards surveillance and enforcement, and intends to strengthen fishery laws relating to illegal fishing. This is in addition to its strong support for CCAMLR’s mandatory use of automated, satellite-based vessel-monitoring systems and the catch-certification scheme. Recent apprehensions indicate that, although illegal fishing persists, every effort is being made to enforce compliance.