Management of Shared Fish Stocks
Australian Case Studies

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Caton, A (in press), Fishery Status Reports 2000-2001, Resource Assessment of Australian Commonwealth Fisheries*, Agriculture, Fisheries and Forestry Australia, Bureau of Rural Sciences 252pp.*

INTRODUCTION

Australia is involved in the management of a number of potentially shared fish stocks, including transboundary stocks with neighbouring countries (Papua New Guinea and Indonesia), straddling stocks between the Australian Fishing Zone (AFZ) and the high seas (deep sea Orange Roughy stocks) as well as in several Regional Fisheries Management Organisations relating to highly migratory species. However to remain within the scope of the Expert Consultation, which is focusing on transboundary stocks and straddling stocks, Australia has prepared the following case studies that demonstrate a wide degree of divergence in terms of the political landscape, players involved and degree of success. These are:

- South Tasman Rise
- Arafura/Timor Sea fisheries
- Torres Strait fisheries
- Heard and MacDonald Islands

For each case study, the following are described:

The fishery
: A brief description of the present fishery

Fishery development
: Description of how the fishery developed, the players involved and involvement in shared management

Management arrangements
: Description of current management

Knowledge of the resource
: Scientific research and current knowledge on the stock structure, extent of the resource and sustainable yield.

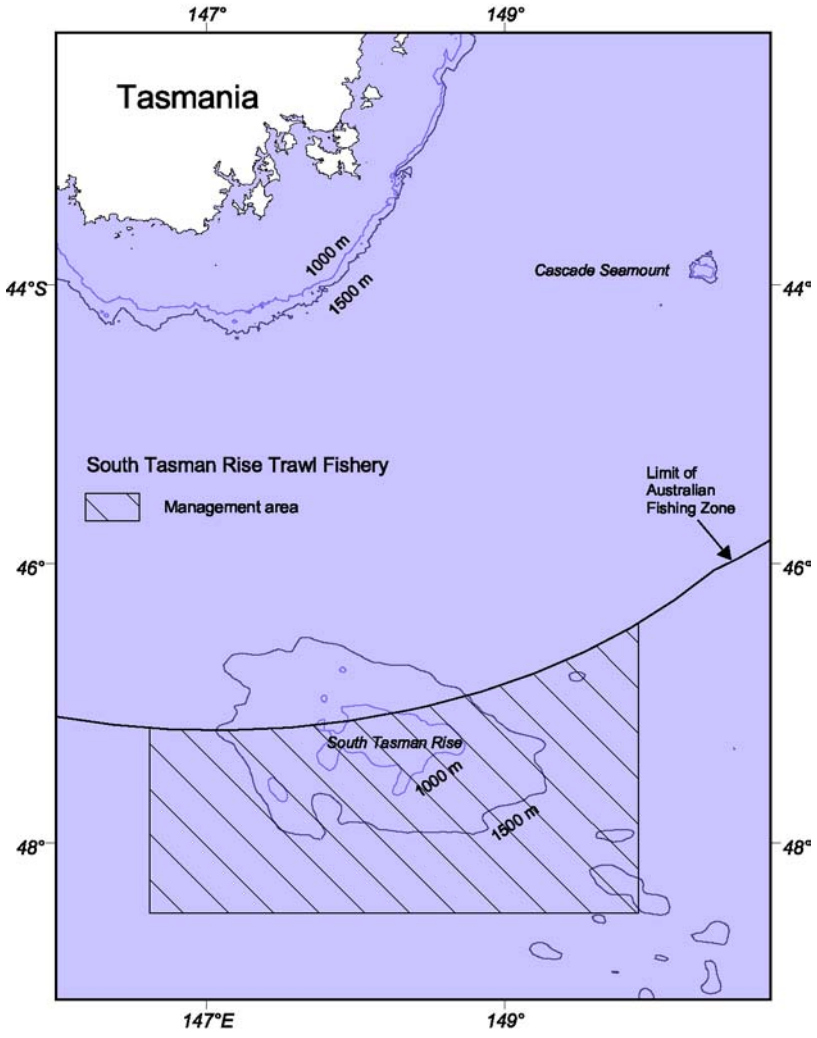
Management performance
: Brief comments of how the shared management arrangements are performing against the criteria given as part of the TORs for the Expert Consultation, including the mandate for management, political will, institutional arrangements and decision making process.

SOUTH TASMAN RISE TRAWL FISHERY

The Fishery

The South Tasman Rise is a large, submerged plateau due south of Australia and the island of Tasmania between 46º30'S and 48º30'S, an area that straddles the Australian Fishing Zone (AFZ). It rises to within 1000 m from the surface at its shallowest point. The portion lying outside the AFZ in the high seas is known as the South Tasman Rise Trawl Fishery. This is primarily a deepwater demersal trawl fishery, targeting orange roughy (*Hoplostethus atlanticus*), smooth oreo (*Pseudocyttus maculatus*) and spiky oreo (*Neocyttus rhomboidalis*). Fishing occurs throughout the year with the main catches being taken when orange roughy form large spawning aggregations in winter around the sea mounts at depths ranging from 800 to 1,000m.

Orange roughy are very vulnerable to fishing because of their low productivity and their propensity to form spawning aggregations in winter. They live for well over 100 years and have a very low natural mortality. They mature between 20 years and 30 years and fecundity is also very low.



Fishery Development

Although there has been sporadic exploratory trawling on the South Tasman Rise since the mid-1980s, catches were generally small and mainly of oreos. However, in

late 1997, significant aggregations of orange roughy were discovered and the fishery rapidly increased and Australian vessels had landed over 1500 t by the end of the year.

As the bulk of these fish were taken outside the AFZ, the fishery also attracted vessels from the New Zealand deepwater trawl fleet. During 1997, the two fleets made a total catch of over 2000 t of orange roughy and about 1100 t of oreos. Concern was expressed that uncontrolled fishing by both fleets would swiftly decimate the orange roughy population(s) of the rise. Fisheries officials from both countries agreed in late 1997 to establish a precautionary TAC for orange roughy within a proclaimed area of international waters encompassing the known fishery. The TAC level was based on the verified 1997 catch level (2100 t) and apportioned between the two countries accordingly (80% Australia, 20% New Zealand). The fishing year was split into two six-month periods, each with half the TAC, to encourage fishing over a longer period to obtain more information on the extent of the fishery. It was also agreed that a joint research project should investigate the stock-structure of orange roughy and attempt to assess the size of this resource.

The fishery has been harvested every year since but in 2001–02 the catch was only 188 t of orange roughy and 25 t of oreos, one-fifth of the catch in 2000–01. Fishing effort also declined markedly from 1100 to 150 shots. For 2002–03, the TAC management zone was extended to include the area of the rise lying within the Australian EEZ. The global TAC was reduced from 2400 t to 1800 t. If 2002–03 catches remain low, a TAC reduction of much greater magnitude will be warranted.

Management Arrangements

Australia claims the right, under the United Nations Convention on the Law of the Sea, to manage the orange roughy fishery as a straddling stock, specifically paragraph 5 of Article 3 of the UN Fish Stocks Agreement which states "Where there is no subregional or regional fisheries management organization or arrangement to establish conservation and management measures for a particular straddling fish stock or highly migratory fish stock, relevant coastal States and States fishing on the high seas for such stocks in the subregion or region shall cooperate to establish such an organization or enter into other appropriate arrangements to ensure conservation and management of such stocks and shall participate in the work of the organisation or arrangement".

A formal Memorandum of Understanding (MOU) based on an agreed TAC was ratified in late February 1998 between the two countries to take effect from 1 March 1998. In February 1998, Australian vessels landed 2052 t before either the MOU or the TAC took effect. Australia's allocation of the orange roughy TAC under the terms of the MOU was 1669 t; New Zealand's was 431 t. Because the second half of the fishing season would not start until 1 September 1998, a further 300 t were set aside as a research quota (150 t Australia, 150 t New Zealand) so that samples could be obtained during the July–August orange roughy spawning season. It was anticipated—correctly—that the TAC for the first half-season would be filled well before that time. Subsequent landings by Australian and New Zealand vessels fishing within the 1998–99 TAC period totalled 1194 t and 404 t, respectively. A further 346 t (130 t Australia; 216 t New Zealand) were caught during three research cruises during the 1998 spawning season so that, cumulatively, close to 4000 t of orange roughy were taken in 1998.

The MOU expired on 28 February 1999 and was not renewed, due to disagreement between the parties. New Zealand claimed the Australian catch of 2052 t taken immediately before the MOU started was a breach of the spirit of the agreement. Australia in turn was concerned that New Zealand had exceeded its allocation during the period of the Agreement (175 t—81% over the New Zealand TAC) and during the research cruise (66 t—31% over the agreed limit).

To resolve the impasse, Australia agreed that New Zealand should have, on the basis of the 80%:20% share, a one-off additional catch of 250 t. Both countries agreed to cap overall catch at 2100 t. Australia undertook to manage its fleet on the basis of the old MOU. Both fleets started fishing again on 1 March 1999 the Australian Fisheries Management Authority (AFMA) closed the fishery to Australian vessels when their catch exceeded 1700 t. However, New Zealand was unable to stop its vessels, which caught more than 1600 t, bringing the total of orange roughy removals in 1999 to over 3300 t.

As a matter of urgency, the respective Fisheries Ministers agreed to several points of a proposed new arrangement, including an increased TAC of 2400 t, shared 75% (1800 t) to Australia and 25% (600 t) to New Zealand. This new arrangement meant that New Zealand had already over-caught its quota by more than 1300 t. Although New Zealand accepted this figure, it did not agree with Australia that its quota should be backdated to 1 March 1999. Despite these difficulties, both countries agreed to close commercial target fishing for orange roughy on the South Tasman Rise until 29 February 2000. As Australian fishers had retained a small portion (60 t) of their TAC to allow for orange roughy bycatch when targeting oreos, they were permitted to target oreos until the orange roughy TAC was filled.

Management of this fishery was further complicated by the appearance of three South African and one Belize-flagged freezer-trawlers in South Tasman Rise 'high-seas' waters during the 1999 winter-spawning season. Australia and New Zealand swiftly made representations to these two countries, resulting in the eventual withdrawal of the vessels. Logbook records from the South African vessels showed them to have caught 750 t of orange roughy from the rise, but as they also fished the newly discovered Madagascar Ridge orange roughy fishery en route back to South Africa, it is uncertain whether this was the true amount. Anecdotal reports from the fishing industry claim that close to 5000 t was taken. The quantity of fish caught by the Belize vessel is also unknown, but an anecdotal report suggested it was about 1200 t. At that time, there was no legal basis to force foreign vessels to cease fishing. By law, Australia could only approach the flag-state of the vessels and request cooperation in managing this straddling stock. The approach is in line with obligations contained in the United Nations Law of the Sea Convention and the United Nations Agreement on highly migratory and straddling fish stocks. With the latter Agreement now in effect, Australia has a legal basis to exert greater control over the South Tasman Rise fishery.

Thus, while the total validated catch of orange roughy during the 1999–2000 'season' (in effect the 1999 calendar year) was 4420 t (with Australia landing 2040 t, New Zealand 1630 t and South Africa 750 t) it may have exceeded 10 000 t if anecdotal reports are accurate.

Australia and New Zealand agreed on a new MOU ("Arrangements between the Government of Australia and the Government of New Zealand for the Conservation and Management of Orange Roughy on the South Tasman Rise") for the 2000–01

fishing year, coming into effect on the 1 March, replacing the previous 1998 MOU and settling two main areas of concern:

- A long-term management arrangement for the high seas area of the South Tasman Rise of 2400 t and split 75/25 between Australia and; and
- The dispute over catch of orange roughy from the fishery in past seasons, with New Zealand also agreeing to 'repay' 640 t of its previous over-catch over seven years.

In early 2002, Australia and New Zealand conducted annual negotiations under the arrangement and as a result the TAC for the 2002-03 season was reduced from 2400 tonnes to 1800 tonnes in recognition that catches in the 2001-02 season were well below the 2001-02 TAC. In addition to the reduction in the TAC it was agreed that the Australian allocation of orange Roughy TAC under the arrangement now applies to the entire area of the South Tasman Rise geographical feature, both inside and outside Australia's EEZ. This is clearly a more precautionary approach than that taken previously.

Knowledge of the resource

While more research is required to assess the size of the resource and the extent of fish movement across the Australian Exclusive Economic Zone (EEZ) boundary, all available scientific evidence indicates that the current South Tasman Rise orange roughy fishery is based on a single discrete stock that straddles the Australian EEZ boundary. A joint Australian/New Zealand study during 1998 examined stock structure through fish samples from summer commercial catches and from three winter (spawning season) research cruises. Genetic analyses were carried out by New Zealand's National Institute of Water and Atmospheric Research, and otolith microchemistry studies by the Commonwealth Scientific and Industrial Research Organisation (CSIRO). The genetic research data indicate that a common orange roughy stock straddles the Australian EEZ and that it might be distinct from the stock off eastern and southern Tasmania. Microchemical analyses of otoliths found that fish from Tasman Sea sites (for example, Lord Howe Rise, South Tasman Rise, Cascade Plateau) had a distinctive chemical composition from mainland fish from Australia and New Zealand, which indicated there were separate spawning stocks at each site and very limited movement away from such sites. Again, no differences were found between South Tasman Rise fish inside and outside the EEZ, indicating a common straddling stock. The principal recommendation of a joint scientific workshop to discuss research findings, held in Wellington in December 1998, was that the current South Tasman Rise fishery should be managed as a single discrete stock.

Surveys of the spawning aggregations based on Australian industry funded have occurred in 2000, 2001 and 2002. A general monitoring survey was also conducted in 2000. The results of this research feed into the stock assessment process for orange Roughy for the STR. Precise estimates of the sustainable yield are not available, but recent massive declines in catches and catch rates are of concern. Further study is being undertaken with the aim of trying to establish the size of orange Roughy stocks on the STR Fishery.

Management performance

- **Mandate for management.**

The mandate for Australian management of the South Tasman Rise (STR) Orange Roughy fishery came from Australia's intention at the time the fishery was being developed to become a party to the Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of The Sea and the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (the UN Fish Stocks Agreement).

- **Political will of national authorities and regional organisations to promote cooperative management.**

As a signatory to the UN Fish Stocks Agreement, Australia is bound to promote cooperative management arrangements for fisheries such as the STR. In recognition of this, Australia and New Zealand signed a Memorandum of Understanding on how the STR fishery was to be managed. In 2000, Australia and New Zealand negotiated and signed an arrangement entitled "Arrangement Between the Government of Australia and the Government of New Zealand for the Conservation and Management of Orange Roughy on the South Tasman Rise" (the "2000 Arrangement").

- **Institutional arrangements and the capacity of national authorities and regional organisations to promote management.**

The STR fishery management arrangements are clearly stated in the 2000 Arrangement where the responsibilities of both parties in the management of the STR fishery are set out.

- **Use of decision-making procedures and criteria for the allocation of shared resources based on transparent and equitable criteria.**

The 2000 Arrangement was drafted to ensure that the process for decision-making procedures for the STR fishery was clearly stated. With regard to the allocation of catch under the 2000 Arrangement, the allocation of resources was originally negotiated between the parties (Australia and New Zealand) as a tonnage allocation based on catch history during the period 1 January 1997 to 17 December 1997. This was further refined by the 2000 Arrangement whereby the Total Allowable Catch (TAC) was based on an administratively simpler and equitable percentage split.

- **Access provisions for new entrants, with respect to Article 63, paragraph 2 shared stock fisheries.**

The 2000 Arrangement was developed to allow cooperation with third countries that have a real interest in the management of orange Roughy on the STR and requires parties to consider Article 11 of the UN Fish Stocks Agreement ("New Members or Participants") with regard to third countries wishing to be a party to the arrangement.

- **Membership and participation rights that are based, inter alia, on harvesting interests as well as environmental interests (e.g. eco-system and biodiversity interests).**

The 2000 Arrangement has been developed with the long-term sustainability of the fishery as a clear objective. Parties to the arrangement have agreed to a program of

scientific research, exchange of information and monitoring of party's vessels within the STR. The annual TAC is to be considered taking into account outcomes of scientific research.

- **Mechanisms for the sharing of fisheries management functions and responsibilities as well as the sharing of management costs; and**

The 2000 Arrangement requires a collaborative approach be taken to a program of scientific research, the exchange of information on catches and effort, and surveillance of third country fishing activity. These activities are undertaken by both parties simultaneously. The 2000 Arrangement has not been drafted to affect neither a sharing of management functions nor a sharing of the cost of management activities and responsibilities.

- **Prevention and elimination of IUU fishing activities.**

Due to the previous plundering of the STR by non-party interests at the expiry of the original MOU, the parties have committed, through the 2000 Arrangement, to cooperate in surveillance for and reporting of IUU fishing activities (those by parties not signatory to the 2000 Arrangement or by vessels of parties not authorized to fish there). Where fishing by a vessel of a third country threatens the effectiveness of the 2000 Arrangement, the 2000 Arrangement requires the parties to be proactive in approaching the flag state of a vessel from a third country seeking that country's cooperation in conservation and management arrangements for the fishery.

- **Conclusions.**

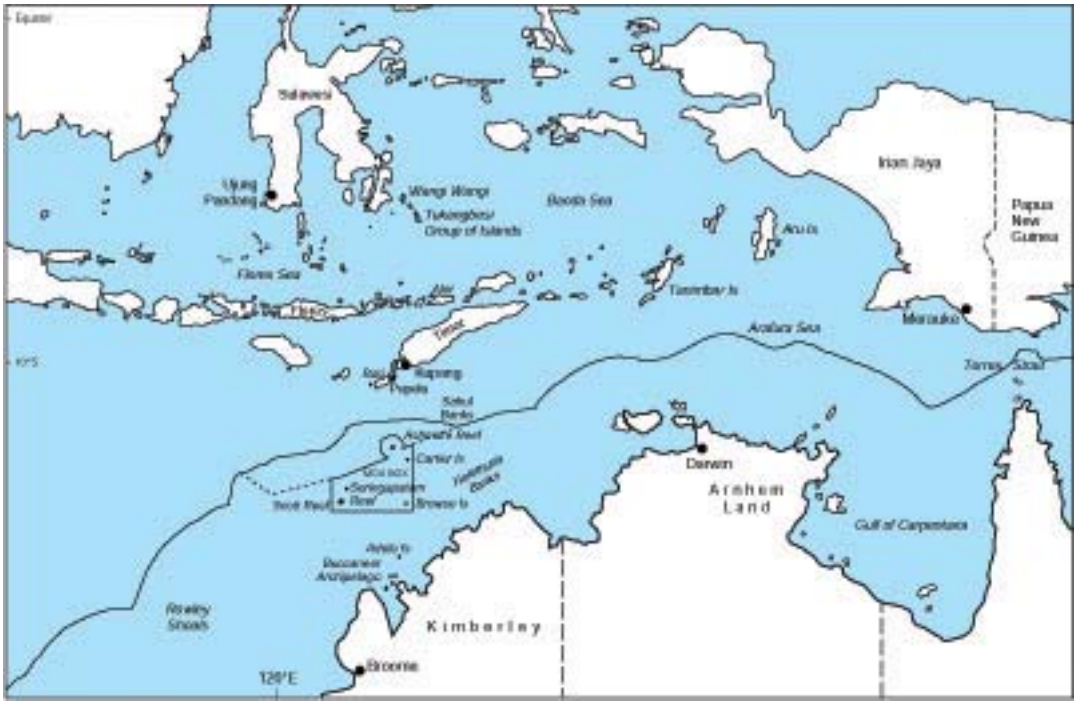
In short, the MOU worked insofar as it prevented unfettered exploitation by the Australian & New Zealand fleets and facilitated some research on the developing fishery. However, there was much debate over the TAC setting and allocation process and much 'bad-blood' between the respective industries. In hindsight, the TACs were set too high and the 1999 "illegal" fishing (the full quantum of which remains unknown) resulted in a rapid depletion of the roughy stock. Current indicators suggest a low remaining biomass and low future yields.

ARAFURA/TIMOR SEAS FISHERIES

The Fisheries

There is a large demersal fish resource in northern Australia, made up of a diversity of species. Relatively few of them are considered commercially important to Australian fishers. High costs of operating in a remote region and protracted delays in finalising Australia's Offshore Constitutional Settlement negotiations hindered development of finfish trawling. Currently one licensee targets the preferred species for Australian and overseas markets, namely, saddle-tail snapper or scarlet sea perch (*Lutjanus malabaricus*) and other large red snappers (*L. erythropterus*, *L. sebae*). A small demersal trap-and-line fishery also exists, as well as the Timor Reef fishery, an annexed component of the demersal fishery targeting mostly goldband snapper (*Pristipomoides multidens*) using baited lines and traps. The 1999 catch of the Timor Reef fishery was approximately 250 t, valued at A$1.25m.

Although finfish trawling effort by Australian vessels in the region is low, the fact that stocks straddle the Australian and Indonesian fishing zones means that consideration must be given to the impact of fishing effort in Indonesian waters, which has expanded rapidly over the past few years.



A significant shark resource also occurs in Australian northern waters, the principal commercial species being two species of black-tip shark (*Carcharhinus tilstoni* and *C. sorrah*). Hammerhead sharks (Sphyrnidae) and mackerels (principally grey mackerel, *Scomberomorus semifasciatus*) also form a significant part of the catch. Shark fishing takes place mainly in inshore areas across northern Australia. The major fishing method is pelagic gillnetting. Sharks are also often taken incidentally by handline, longline, haul net, bait net and barramundi fishing in northern Australia. There are also significant catches of shark from the Northern Prawn Fishery (NPF), which operates throughout much the same region as the northern shark fisheries. A study published in 1991 by the Northern Territory Department of Primary Industry and Fisheries showed an annual NPF catch of at least 100 t of black-tip shark. Restrictions

in the NPF currently limit the amount of all shark species on board at any one time to 100 trunks or an equivalent of 250 kg of skinless fillet. Also, no more than 100 sets of shark fins are permitted on board. Approximately 3 t of shark fillet, 2 t of shark fin and 800 kg of shark trunks were recorded on NPF logbooks in 1998.

Australia allows access by traditional Indonesian fishers to a limited area of the AFZ off northwestern Western Australia (the MOU Box). The extent of the catches taken by these vessels and by Indonesian vessels operating illegally in Australian waters is unknown. Indications are, however, that the species composition of the catch taken by Indonesian vessels is different from that taken by domestic shark vessels.

Development of the fishery

Foreign trawlers have fished the region for many years prior to establishment of the AFZ in 1979, and continued to do so under licence until 1990 when they were phased out to make way for expanding domestic interest. Several domestic finfish trawl licences were issued, but by 1995 only one active trawl licensee remained, the other licences having lapsed.

In Australia, until February 1995, finfish trawling was managed under complementary Commonwealth and State or Territory controls. In February 1995 responsibilities changed as a result of Offshore Constitutional Settlement agreements establishing separate Commonwealth– Northern Territory (NTFJA) and Commonwealth–Queensland (QFJA) Joint Authorities, which now manage the fishery under Territory or State law.

Sharks have also been fished commercially off northern Australia from the early 1970s. Between 1974 and 1986 a pelagic gillnet fishery was operated by vessels from Taiwan. Catches of shark and other pelagic species reached a peak of about 10 000 t in 1977. With the declaration of the AFZ, a catch quota of 7000 t processed weight was implemented for a maximum of 30 licensed foreign gillnetters. Concerns about the incidental capture of dolphin saw a regulation introduced in May 1986 banning the use of gillnets longer than 2.5 km. At the time, the foreign vessels had been using gillnets up to 20 km long. The restriction effectively rendered foreign fishing uneconomic and, despite some attempts to switch to longlining as an alternative, the vessels from Taiwan had ceased shark fishing in the AFZ by mid-1986.

Australian gillnetters commenced direct involvement in about 1980, mainly in inshore waters close to Darwin. Remoteness from markets hindered expansion and only a small number of operators are active in these fisheries but there is considerable latent effort. The catch of this species declined to approximately 39 t in 1999–2000 from 65 t the previous year.

There is growing interest in shark fishing, and markets are developing for a range of shark products other than flesh, including fin, cartilage, liver and skin. Dried shark fin can fetch over A$250/kg on Asian markets.

Management arrangements

No formal management arrangements exist between the two countries apart from the MOU Box, which recognises that Indonesian line fishing vessels have traditionally fished in areas off northwestern Australia for a long period of time. Special arrangements have been made under a Memorandum of Understanding (MOU) between Indonesia and Australia for continued access to a limited area off Western Australia. However there is considerable concern about the status of target stocks and

other natural resources in the MOU Box. Australia recognised that any options to address this issue must take account of the situation of traditional fishers and their need for an ongoing livelihood. Australia has proposed that Indonesia join with them in developing a management strategy for the Box. A MOU Box Management Committee has recently been formed further discuss the four themes: research; management measures; alternative livelihoods; and education and training.

For the remaining Arafura and Timor Sea areas, a number of informal meetings between Indonesian and Australian fishery managers and scientists have been held in an attempt to develop cooperative management arrangements. These were based on a *1992 Fisheries Cooperation Agreement* that is still in place. It was agreed in April 2002 to form a Working Group that would act as the main forum for fisheries and marine cooperation between Australia and Indonesia. It was noted that fisheries and marine issues had been discussed in a variety of different fora in the past, and that this WG should assume responsibility for these issues in the future. The Australia-Indonesia Ministerial Forum Working Group on Marine Affairs and Fisheries is a group of officials whose purpose is:

- To provide a forum for the discussion of marine affairs and fisheries issues that are of mutual interest and are related to the following themes:
  a) Poverty Reduction;
  b) Combating illegal, unreported and unregulated (IUU) fishing;
  c) Marine, coastal and small islands development and management;
  d) Marine and fisheries research;
  e) Fisheries management;
  f) Aquaculture;
  g) The marine environment;
  h) Marine biotechnology;
  i) Fishery products, safety, quality, product development and trade promotion;
  j) Education, training and capacity building; and
  k) Other marine cooperation.

- To facilitate practical cooperation on priority issues.
- To facilitate cooperation on commercial matters.
- To provide a progress report to the Australia-Indonesia Ministerial Forum, reviewing the effectiveness of cooperative actions.

Knowledge of the resource

A number of collaborative research projects have been undertaken by Australian and Indonesian marine scientists, including collaborative stock assessment for potentially shared red snapper, shark and tuna stocks. Past research by Australian scientists has established good baseline information in the MOU Box area, particularly on current biomass of a number of target species. Definitive information on the stock structure of the major finfish species, however, is not available, although a recent study indicates that at least one species, *Pristomoides multidens,* has significant genetic structuring both with Australian waters and between Australia and Indonesia. The Timor Sea is regarded as having a fish fauna distinct from that of the Arafura Sea but the extent to which Indonesia shares the fish stocks with Australia across the Arafura Sea is not known.

Rough estimates of annual sustainable yields based largely on survey data exist for the Australian portion of the Arafura Sea, and range between 3700 t and 6800 t, and for the Gulf of Carpentaria between 2900 t and 9000 t. The ranges incorporate large sampling variances for some of the survey data, and a range of values for the effective 'swept area' of the net. In October 1996 the Northern Territory Department of Primary Industry and Fisheries revised the sustainable yield for Arafura Sea red snapper to a more conservative level of 1500 t to 2500 t per year

Detailed genetic studies have been conducted for the shark species, *Carcharhinus tilstoni* and *C. sorrah*, on samples collected throughout the range of the fishery. The results of these studies indicated that there is only one population of each species in these waters, a conclusion supported by tag recaptures showing long-distance movements and indicating sufficient mixing and interbreeding to provide gene flow between widely separated areas. It is likely that Taiwanese gillnetters operating in Indonesian waters also fish the same stocks of shark. However, historical differences in catch rates of sharks between inshore and offshore fisheries, as well as some local spatial differences, suggest that spatial structuring is important.

It is thought that current catches of shark species in Australian waters are below estimates of sustainable yield, but the estimates are not particularly robust. The most recent estimate of sustainable yield for black-tip shark is at least 2,000 t per year for the Northern Territory, Queensland and Western Australia fisheries combined. Catch rates have declined in this fishery since the 1980s and this may be attributable to foreign fishing, although it is also possible that declines in domestic catch rates have been due to slow depletion of an inshore, resident component of the overall stock.

Little consideration has been given to impacts of fishing on other species. The assessments of blacktip shark rely on parameters such as age, growth, mortality and reproductive capacity, which are estimated with varying degrees of uncertainty. The impact of catches taken by traditional Indonesian fishers in Australian waters is unknown. In addition, the significant catches of shark taken in Indonesian waters have an unknown impact on shark within the AFZ.

Recent surveys in the MOU Box have showed that high-value trepang and trochus are heavily depleted on most shallow reef areas. Lower value trepang stocks are also suffering depletion. It was also concluded that current fishing levels for sharks might be seriously depleting the reef shark population.

Management performance

- **Mandate for management.**

Australia and Indonesia have yet to formalise any agreed cooperative management measures, apart from the MOU box.

- **political will of national authorities and regional organisations to promote cooperative management**

Both Australia and Indonesia are keen to engage in cooperative engagements but funding is a problem – international aid will be important in the future to facilitate and implement the process. Although there is good will between the two countries, the main constraints are the remote nature of the fishery to both Governments and the lack of appropriate resources to managing the fishery sustainably.

- **institutional arrangements and the capacity of national authorities and regional organisations to promote management.**

The newly established Working Group on Marine Affairs and Fisheries will have an important role in promoting cooperative management.

- **use of decision making procedures and criteria for the allocation of shared resources based on transparent and equitable criteria**

Not yet applicable.

- **access provisions for new entrants, with respect to Article 63, paragraph 2 shared stock fisheries**

Not yet applicable, although Australia considers that the resources are fully utilized.

- **membership and participation rights that are based, inter alia, on harvesting interests as well as environmental interests (e.g. eco-system and biodiversity interests)**

Not yet applicable.

- **mechanisms for the sharing of fisheries management functions and responsibilities as well as the sharing of management costs**

Not applicable.

- **prevention and elimination of IUU fishing activit**ies.

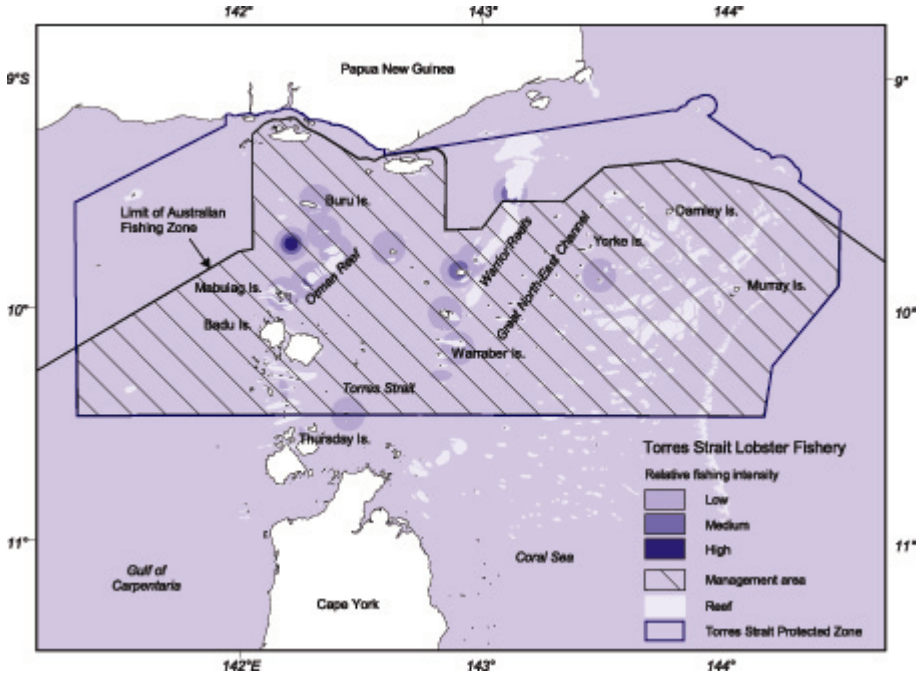
Australia is concerned about the scale and nature of illegal fishing in its northern waters. Illegal fishing in Australia's northern EEZ is mainly of Indonesian origin, and there is an average of about 80 apprehensions per year. The main area of apprehension is outside the MOU Box, and the species targeted is usually shark. Australia believes that the depletion of stocks in the MOU Box may lead fishers to travel into other areas of the Australian EEZ in search of fish and the MOU Box may provide a springboard for these activities. Indonesia has a similar problem with illegal fishing by traditional Filipino vessels in the Indonesian EEZ.

TORRES STRAIT FISHERIES

The Fisheries

Torres Strait is located between the tip of Cape York and Papua New Guinea and consists of over a hundred islands and reefs. Eighteen of these islands are currently inhabited.

Torres Strait is a biologically productive area, the waters of which yield large amounts of seafood for local consumption and for sale in Australia and overseas. Apart from food freighted in from the mainland, sea-based food is the staple diet of Torres Strait Islanders, as well as being central to traditional island culture. The Strait is culturally and strategically important to Australia and is also one of Australia's most vulnerable borders, especially in terms of quarantine.



Torres Strait Islanders are among the world's highest consumers of seafood. Dugong meat and turtle eggs are especially valued as food, and turtle meat is a staple source of protein in the central islands. Fishing for reef species and combing the reefs for animals that live there is also integral to Islander culture.

Commercial fishing is the most economically important activity in the region and provides the greatest opportunity for financial independence and stability of Islander communities. Fisheries operating in Torres Strait are:

- prawn trawling
- dugong and turtle hunting
- tropical rock lobster diving
- traditional fishing
- Spanish mackerel trolling

- finfish fishing (multi-gear)
- pearl shell diving and pearl farming
- trochus diving and gathering
- crab
- beche-de-mer gathering

Prawn Trawling

Prawn trawling is a major economic activity, carried out mainly by non-Torres Strait Australian fishers. The main prawn-trawling ground in Torres Strait is to the east of the Warrior Reef complex, centred on Yorke Island. Australian-licensed trawlers remain on the fishing grounds for extended periods because they are supported by mother ships and fuel-barges that operate out of several anchorages in Torres Strait. Trawlers up to 20 m long tow two pairs of nets with a combined headrope and footrope length of 88 m and a mesh size of 45 mm. They work at night over areas of flat seabed, using prior experience to select grounds where they can target different prawn species. Few vessels fish in Torres Strait exclusively; most have Queensland east coast licenses, and some are also licensed for the Northern Prawn Fishery. They move between fisheries in an attempt to maximise catch rates.

Seven trawlers licensed by Papua New Guinea may fish in Australian waters under a Torres Strait Treaty catch-sharing arrangement. However, only three have done so (after catches declined in the Gulf of Papua).

Annual catches since 1980 comprised 30–69% endeavour prawn and 29–61% tiger prawn. The red-spot king prawn (*Melicertus longistylus*), caught mainly near reefs, made up most of the remainder (1–5%). In 2000, the Torres Strait Prawn Fishery catch was 1617 t. A total of 78 vessels were licensed for Torres Strait and 75 of them fished. All but one were also endorsed for the Queensland east coast prawn fishery, and 17 were also endorsed to fish in the Commonwealth-managed Northern Prawn Fishery.

New management initiatives for the Torres Strait fishery were introduced in 2001: specifying a new boat-replacement policy; reducing the maximum length of net (combined headrope and footrope length of 88 m); and, from 2002, mandating the use of turtle-excluder and bycatch-reduction devices.

Dugong and turtle hunting

Hunting skills have been highly esteemed in Torres Strait Islander communities. Hunters would spear sea turtles or dugongs with a specially designed harpoon or *wap* from a platform built on a reef flat. Sea turtles were also caught from canoes with a remora, or suckerfish, tied by the tail and released near the turtle. The remora would attach to the turtle with its suckers and the turtle and canoe could be dragged together. Sea turtles were also captured on beaches when nesting.

Hunting remains a major traditional-fishing activity in Torres Strait, but is now almost always done from outboard-powered aluminum dinghies. In the three decades since

the introduction of dinghies, hunters have modified their practices and increased the area covered. Hunters now chase turtles from the dinghies and either harpoon them or jump into the water to grab them. Turtles are also simply overturned on beaches as they crawl up to nest. These methods do not require the planning and skill of earlier hunting methods and do not attract the same community status.

There are six species of sea turtles found in Torres Strait—green, hawksbill, loggerhead, flatback, olive ridley and leatherback (which is rare). All species of marine turtles in Australia are listed in appendix I of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES). The International Union for the Conservation of Nature (IUCN) lists leatherback, green, hawksbill and olive ridley turtles as endangered, and the loggerhead turtle as vulnerable.

The dugong or sea cow, *Dugong dugon* is found around coastal northern Australia from Shark Bay to Moreton Bay. Commercial hunting of dugong is prohibited in both Australia and Papua New Guinea, but the indigenous inhabitants of both countries may hunt them for non-commercial use. The flesh of pregnant females is prized for its high fat content, and the unborn calves are a special food for the very old and the very young.

The dugong has high biodiversity value, as it is the only living species in the Family Dugongidae and one of only four species in the Order Sirenia. Other sirenians—the three species of manatee—all use fresh water to varying degrees. The only other recent sirenian, the seven-metre-long Steller's sea cow (*Hydrodamalis gigas*), was hunted to extinction within 40 years of its discovery in the eighteenth century.

Along with the manatees, the dugong is listed in the IUCN *Red Book of Threatened Species* as vulnerable to extinction. The dugong is also listed as a vulnerable species under the regulations associated with the *Nature Conservation Act 1992* (Queensland) and is listed in CITES appendices.

Tropical rock lobster diving

As tropical rock lobsters do not enter baited traps, these are mostly taken by divers with spears. However, an increasing number of lobsters are now being caught live with hand-held scoop nets, either by diving or by reef walking with lamps at night. Divers generally work in pairs from small dinghies and either free-dive or use a 'hookah' that supplies compressed air from the surface. Free divers generally work in waters to about 4 m deep, while hookah divers work in waters to around 20 m. Between 300 and 500 dinghies and 15 small freezer boats are used in the combined Australian and Papua New Guinea Torres Strait Lobster Fishery.

Under the catch-sharing arrangements of the Torres Strait Treaty, 27 lobster dinghies and 3 freezer vessels from Papua New Guinea are currently permitted to operate on the Australian side of the Torres Strait Protected Zone. No Australian operations are licensed for the Papua New Guinea side because most of the catch is taken in Australian waters. The lobster catch taken by Papua New Guinea fishers throughout the zone in recent years has been about 40% of the Australian catch.

Frozen lobster tails are sold on the domestic and overseas (mainly the United States) markets. The trade in live lobsters, which began in the mid-1990s, is continuing to grow, and there are now both domestic and export markets for them. Whole live lobsters fetch a similar price per kilogram to frozen tails, making each live animal about 2.5 times more valuable than its frozen tail. Live lobsters are often caught at night and stored in sea cages. Wells and tanks for holding lobsters live on board vessels were introduced in 1997 and are now widely used.

Mackerel trolling

Mackerel is the target of a small commercial fishery in Torres Strait and an important source of income for some Islanders. Traditional fishermen also take a subsistence catch of around 10 t a year. Fishery development has stagnated somewhat since the 1980s because of the generally low market price. Most mackerel is processed into fillets for the fish-and-chip trade on Thursday Island and in north Queensland.

The fishery targets the narrow-barred Spanish mackerel (*Scomberomorus commerson*), but school mackerel (*Scomberomorus queenslandicus*) and double-lined or shark mackerel (*Grammatorcynus bicarinatus*) are also caught.

Finfish

The Torres Strait Finfish Fishery is a multi-species, multi-gear fishery targeting a variety of reef and inshore fish. The line-fishing sector focuses, in particular, on coral trout (*Plectropomus* spp.); mackerels other than Spanish mackerel; various reef fish (*Lutjanus* spp. and *Lethrinus* spp.); and numerous species of rock cods (*Epinephelus spp.*). Only traditional inhabitants may participate in the fishery. A total of 57 Torres Strait Islander vessels are presently licensed for the fishery. Finfish in the line-fishing sector are taken by hand-held lines, fishing rods or mechanically operated reels and lines. The fishery is expected to grow in the future, as there is continuing demand for these well-regarded food fish.

The net-fishing sector is catching mainly barramundi (*Lates calcarifer*), mullet (*Mugil* spp.) and king salmon (*Polydactylus sheridani*), using gill, seine, bait or set nets. The current level of participation is relatively low because other fisheries, such as that for tropical rock lobster, are more profitable. There is little information on either the quantity of reef fish taken by Torres Strait Islanders under community fishing arrangements or, similarly, the quantity taken in the course of traditional fishing.

Pearl shell diving

The pearl oyster (*Pinctada maxima*; commonly known as the goldlip or silverlip mother-of-pearl shell) and, to a very minor extent, the blacklip mother-of-pearl (*P. margaritifera*) are the species fished in Torres Strait. Another five species—*Pinctada albina, P. chemnitzi, P. fucata, P. maculata* and *P. albina sugillata*—also occur in the area.

Historically an important fishery in the area (see Development of the Fishery) but participation in the fishery has been low since the late 1980s and the 1990s, partly a result of high mortality rates of shells during transport from pearling grounds to the

farms, and partly because most boats licensed for pearl shell are also licensed for tropical rock lobster, which is much more profitable and easier to handle. Encouragingly, adoption of on-board handling protocols that promote cleanliness and speed in transporting live shell has cut the post-harvest mortality level markedly in the last few seasons.

Prospects for Queensland pearl farming changed dramatically in 1998 when a successful hatchery operation was established at Roko Island near Cape York. The hatchery now supplies good-quality spat to farms in Torres Strait and down the Queensland east coast. The availability of hatchery-produced spat has created a huge potential for Islander-based pearl farming uninhibited by the size of natural stocks or fishing-mortality rates, and may allow regeneration of traditionally fished pearl-shell beds. To date there is no survey information to test whether there has been any consequent change in wild-shell stocks.

Trochus

The Torres Strait Trochus Fishery is a small, single-species commercial and subsistence fishery. Trochus (*Trochus niloticus*), also known as top shell because of its shape when upturned, is collected for shell and, to a lesser extent, for its meat. The shell, like mother-of-pearl, is used mainly for buttons and fashion accessories.

It is an important source of income for some Islanders, especially women and children. The level of participation in the fishery is low at present, largely due to a recent decline in overseas markets for shells to make buttons. The fishery was historically important between 1920 and 1950 and again in the 1970s and 1980s. Effort in the fishery is strongly influenced by market forces.

Trochus is usually taken by free diving, although SCUBA and hookah are also used. Fishers operate from dories or dinghies with a crew of two or three. Trochus can also be collected from reef tops at low tide. Only Australian traditional inhabitants are permitted to collect trochus in Torres Strait; and about 47 dinghies are licensed.

The taking of trochus is restricted to hand-collection and the use of hand-held, non-mechanical implements, but the use of underwater-breathing apparatus is permitted. A minimum-size limit of 80 mm and maximum-size limit of 125 mm applies to all fishing (except for traditional use).

Activity in the fishery is low compared to historic levels, although small catches continue to be taken at the central and eastern Islands. Some 24 t of trochus were taken in 1999.

Crabs

The Torres Strait Crab Fishery targets mainly mud crabs (*Scylla* spp.) although a small quantity of blue-swimmer crab (*Portunus pelagicus*) is also retained as by-product. Crabs are harvested with pots and dillies.

The status of crab stocks is uncertain. Effort in the fishery appears to be concentrated around the northwestern section of the Torres Strait, at Saibai, Boigui and Duan islands, and further south around Cape York Peninsula. About 31 Torres Strait Islander dinghies are licensed to fish commercially for crab in Torres Strait. Traditional fishers take an unknown, but small number of mud crabs incidentally.

Regulations prohibit the taking or possession of female crabs, restrict the number of prescribed crab-apparatus units to less than 50, and prescribe a minimum size of 15 cm carapace length. There is also a recreational-sector bag limit of 10 crabs per person.

Beche-de-mer

The Torres Strait Bêche-de-mer Fishery is also an important commercial fishery to Torres Strait Islanders. Its main catch was sandfish (*Holothuria scabra*) in the recent past, but harvesting of this species has been discontinued. Current fishing effort focuses on other bêche-de-mers: surf redfish (*Actinopyga mauritiana*), black teatfish (*Holothuria nobilis*), white teatfish (*Holothuria fuscogilva*) and, to a lesser extent, a couple of lower-value species.

Fishing for bêche-de-mer in Torres Strait is mainly by free diving from dinghies crewed by two or three fishers, or by hand collecting along reefs at low tide. Once collected, the animal is gutted, graded, cleaned, boiled, smoked and dried. This labour-intensive process is usually carried out on processing vessels or at shore-based facilities.

Development of the fisheries

Islanders and other indigenous groups around Torres Strait have hunted sea turtles for meat and for ceremonial purposes before documented history. Hunting green turtles for meat and collecting the eggs of various turtle species were traditional forms of exploitation identified by the early anthropological studies of the Torres Strait Islanders. The Islanders still hunt turtles as part of their traditional-fishing activity, and turtle fishing is specifically cited for protection under the Torres Strait Treaty.

The pearling industry in Torres Strait has a long history. In the early part of the twentieth century, collecting mother-of-pearl shell was the chief industry in Torres Strait. Thursday Island was the focal point for the Queensland pearling industry, which supported over 350 boats and 2500 people at its peak in 1904.

In 1931 the market for pearl shell collapsed. Resurgence after the Depression was soon interrupted by the outbreak of the Second World War, and even though there was an upturn in the market after the war, the industry declined again within a decade. The death knell for the pearl-shell industry, as it was for trochus fishing, was the introduction of plastics, which replaced mother-of-pearl shell for the manufacture of buttons and other items.

In 1956, in response to increased Japanese pressure to fish for pearl shell in Australian waters, the Commonwealth Fisheries Office surveyed the pearling beds of northern

Australia to support the development of a local pearl-culture industry. By 1971 there were seven pearl-culture farms in Torres Strait, employing 300 people.

The pearl shell industry started collecting live shells for the farms, thereby stimulating a partial recovery of the industry. Between 1990 and 1995 the annual take of live pearl-shell from Torres Strait ranged from 13 000 to 39 000 shells. Data collection in this fishery is difficult because lobster fishermen take much of the catch opportunistically. An annual survey of Torres Strait pearl-shell fishermen was introduced in 1993 to replace the voluntary logbook system and obtain a more complete picture of the number of live pearl-shell collected.

The commercial tropical rock lobster fishery in Torres Strait began in the late 1960s. The annual catch of tropical rock lobster by Australian divers in Torres Strait and North Queensland waters between 1970 and 1980 ranged between 68 t and 124 t of tails, about 15% of which came from the east coast of Cape York. Catches between 1981 and 2000 ranged from 130 t to 350 t and averaged 199 t. The average Australian catch over the past 10 years was 195 t, and in Papua New Guinea was 79 t. Annual catches trended upwards through the 1990s, but dropped dramatically in 1999 and 2000 down to the low levels of the early 1990s. The 1999 Australia and Papua New Guinea lobster catch of 226 t tail weight (including live) was the lowest since 1992, and the year-2000 catch was even lower at 215 t. These low catches have been attributed to reduced abundances of both the 1+ and 2+ year-classes.

Diver-fishing effort has increased substantially since the fishery began, and catch rates have declined to about one-third of those recorded 20 years ago. Only part of the stock is resident on shallow reefs and available to free divers, so fishing effort tends to concentrate in readily accessible areas, and at times appears to cause localised depletions. Hookah divers fish more extensively and in deeper waters.

The prawn trawl fishery in Torres Strait began in the mid-1970s, extending the prawn fishery of the Queensland east coast. When the Torres Strait fishery began, all east coast and Northern Prawn Fishery prawn trawlers were entitled to fish in Torres Strait, effectively allowing access to 1500 vessels. When the Torres Strait Treaty was ratified in 1985, the Torres Strait Prawn Fishery became separate from the east coast fishery, and an effort-reduction strategy was adopted. Further arrangements to reduce effort were introduced in 1993: each prawn trawler was allocated a quota of access-days—transferable between license holders—that limited its total time in the fishery in a season. The restructuring of the fleet resulting from the management regime was consistent with the Treaty aim of conserving Torres Strait prawn stocks, taking optimal catches and maximising economic efficiency.

Management arrangements

The Torres Strait Protected Zone Joint Authority, under an international treaty between Australia and Papua New Guinea, manages most of the Torres Strait fisheries. In 1984 the Australian and Papua New Guinea governments ratified the Torres Strait Treaty, which came into effect in February 1985 and the Australian Government passed the Torres Strait Fisheries Act 1984 that gave effect, in Australian law, to the fisheries elements of the Treaty. The treaty gives very clear guidance as the objectives of fisheries management in the Torres Strait - in particular the protection of the traditional way of life and livelihood of the traditional inhabitants,

including their traditional fishing. The Torres Strait Treaty, requires both Australia and PNG to cooperate in the conservation, management and optimum utilisation of the commercial fisheries of the Torres Strait Protected Zone (TSPZ). The Treaty also defined jurisdiction over islands and areas of sea in the zone, and of the fisheries and seabed resources. Under the Treaty arrangements for Australian waters, the Commonwealth and Queensland governments managed some fisheries jointly and solely Queensland managed others. On 1 April 1999, TSPZ fisheries that were Queensland-managed—including finfish, crab, trochus and bêche-de-mer—were placed under Joint Authority management.

Under Articles 22 and 23 of the Treaty, arrangements have been put in place to allow for sharing of the catch on both sides of the border. A 3-year agreement covering the period 7 March 1997 to 6 March 2000 provided for:

- 7 Papua New Guinea vessels to fish for prawns in the Australian sector of the TSPZ;
- 5 Australian vessels (3 at any one time) to take pearl shell in the Papua New Guinea sector of the TSPZ;
- 27 Papua New Guinea dinghies and their associated freezer boats to take tropical rock lobster in the Australian sector of the TSPZ;
- 10 Papua New Guinea dinghies and their associated freezer boats to take Spanish mackerel in the Australian sector of the TSPZ;
- monitoring and taking of dugong for traditional purposes; and
- monitoring and taking of turtle for traditional purposes in Australian waters and artisinal purposes in Papua New Guinea waters.

Following receipt of vessel nominations from PNG, endorsements were issued by Australia for PNG vessels in September 1998 for the following fisheries:

- 1 vessel to fish for prawns;
- 27 dinghies and their associated freezer boats to take tropical rock lobster; and
- 7 dinghies and their associated freezer boats to take Spanish mackerel.

Management of Torres Strait fisheries has been very well supported by research, as there has been a dedicated Australian research fund operating under the TSPZ Joint Authority since the ratification of the Torres Strait Treaty in 1985. Queensland has also contributed throughout that period. Research and management are overseen by a committee drawn from Islanders, industry and the Commonwealth and Queensland governments.

The number of fishers, the variability of participation in the fisheries, and the activities of Papua New Guinean coastal fishers make management of the artisanal and small-scale commercial fisheries in Torres Strait very difficult. With the recent change in management responsibility, with jurisdiction over all fisheries now lying with the TSPZ Joint Authority, a more structured approach to research and

management will be possible, and data on which to base management are expected to become more reliable.

The TSPZ Joint Authority has established a working group to examine the long-term management needs for the rock lobster, line and mackerel fisheries.

Knowledge of the resource

Prawn Trawling

The brown tiger prawn (*Penaeus esculentus*) and blue endeavour prawn (*Metapenaeus endeavouri*) are endemic to tropical and subtropical Australia. They are highly fecund, fast growing, sexually mature by about six months old, and they live for one or two years. The fishery targets adults, but also takes a bycatch of juveniles. Tiger prawn catches are typically taken on fine-grained mud bottom, and endeavour prawn catches on coarser, sandy sediments, but their habitats overlap.

The estimated long-term sustainable yield for the fishery is 1900 t per year: 680 t of tiger prawns, 1035 t of endeavour prawns and 185 t of king prawns. The catch varies from year to year because of variable recruitment and changes in fishing effort. Current stock assessment results indicate that the average annual catch of tiger prawns in Torres Strait since 1991 (656 t) approximates the maximum sustainable yield (MSY).

Estimates of the annual effort required to fish Torres Strait prawns efficiently vary between 8400 and 12 600 boat-days, depending on the value used for prawn catchability. The current catch and effort, and the fact that latent effort can effectively account for the total quota of 13 570 access-days, indicate that the fishery is fully fished.

Prawn trawling in Torres Strait also takes a wide range of commercial byproduct species, including Moreton Bay bugs (*Thenus orientalis*), scallops (*Amusium pleuronectes*), and several species of squid, finfish and shark. Since 1996, some vessels have recorded their bycatch of sea turtles. The rate of capture suggests that the fleet caught between 300 and 1050 turtles a year. As most are returned to the sea alive (96% survival) only 12 to 42 of the turtles would have died. In July 1999, the Torres Strait Protected Zone Joint Authority endorsed a bycatch action plan for the Torres Strait Prawn Fishery, and in late 2001 agreed to mandate the use of bycatch-reduction devices (including turtle-excluder devices) from the start of the 2002 season. A number of Torres Strait fishers collaborated with researchers from the Queensland Department of Primary Industries Southern Fisheries Centre to trial the devices.

Dugong and turtle hunting

The dugong is long-lived (about 70 years). It matures between 9 and 17 years old, producing a calf after 13 months' gestation and suckling for at least 18 months. The period between calving is 3–7 years. Dugong therefore have a high investment in each offspring. Population simulations indicate that, even with the most optimistic combinations of life-history parameters, a dugong population is likely to increase at less than 5% per year.

The Torres Strait dugong population size was estimated by aerial survey in November 1987, November–December 1991, and November 1996. All surveys covered the western and central waters of Torres Strait and adjacent coastal waters of Cape York north of 10º52´S. The population estimate obtained from the 1996 survey was not statistically different from the 1991 estimate. These results suggest that the dugong population in Torres Strait was stable during 1991–96 and that the dugong harvest was sustainable for those years.

Sea turtles are known to be long-lived animals even though there are no reliable methods to age them. Published data strongly suggest that turtles from the Pacific region are slow growing, taking 30–50 years to reach maturity. Information on growth comes mainly from tagging studies of older turtles and from growth rates in captivity. Growth varies within and between populations, depending on feeding grounds and latitude.

The levels of turtle harvest, based on best estimates over the last two decades, indicate neither an increasing nor decreasing trend in the catch. Estimates made in the mid-1970s, in the mid-1980s and in the 1990s indicate that the catch of sea turtles on the Australian side of Torres Strait has remained in the range of 2000 to 4000 turtles per year.

Tropical rock lobster diving

The ornate tropical rock lobster (*Panulirus ornatus*) forms the basis of the Torres Strait commercial fishery. During summer, female tropical rock lobsters brood between two and four clutches of eggs, which they carry under their tails. The eggs hatch after about a month, and the planktonic larvae develop over the next four to six months. In winter, the post-larvae settle onto the seabed. Juvenile lobsters grow quickly and recruit to the fishery about a year later when their tails are 115 mm long and weigh about 290 g. Most lobsters taken in the fishery have tails weighing between 250 g and 450 g, corresponding to a whole-lobster weight of 625–1100 g.

In spring each year, most of the three-year-old lobsters emigrate from Torres Strait to breed. Tagging studies have shown that some of the lobsters move northeast into the Gulf of Papua, while they are becoming sexually mature, and some move on as far as the eastern Gulf of Papua where, for a few months each summer, they form the basis of a seasonal artisanal fishery around Yule Island. Studies done at Yule Island, at the end of the main migration path, concluded that post-emigration lobsters die after breeding. In the 1970s and 1980s, prawn trawlers targeted migrating lobsters, but this activity was banned in 1984 due to the danger it posed to the breeding stock.

Tagging studies have shown that few, if any, lobsters move between the east coast of Queensland and Torres Strait or Papua New Guinea. However, lobsters from the two areas are genetically indistinguishable and for assessment purposes are considered part of the same stock.

Seagrass beds in the northern area of the fishery appear to fluctuate in both area and density. In the past decade, there have been two periods (1992–93 and 1999–2000) in which large tracts of seagrass were replaced by bare sand. Depending on their extent, and when this happens, changes in the benthic environment would change food

availability for juvenile lobsters, which might in turn increase or decrease future fishable stocks.

Surveys of lobster abundance have been carried out since 1989. These annual surveys now sample the Torres Strait lobster population at 82 sites, providing an annual index of the relative abundance of the two year-classes, the strength of the recruiting year-class, and estimates of growth and mortality.

The Islander catch is also monitored in the middle of each year around Mabuiag and Badu Islands in central Torres Strait to measure lobster catch, diver effort and the size-composition of the catch. In 1997 catch-log recording by freezer vessels became compulsory, and the data from these logs are now used by the Australian Fisheries Management Authority (AFMA) in conjunction with records collected from processors to estimate the total quantity of lobster shipped from Torres Strait.

Commercial-catch data are combined with annual fishery-independent surveys of lobster abundance and age composition for stock assessments of the tropical rock lobster fishery. In 1989, the first year the lobster stock in Torres Strait was sampled, the diver catch was 249 t of tails, while the survey, based on 572 sites, estimated the fishable stock to be 2200–3350 t tail weight. This indicated that only about 10% was taken by fishers, leaving 90% of the population to emigrate to the breeding grounds. Based on that low level of exploitation compared with other lobster fisheries, it was estimated that fishing mortality that year could have safely increased at least four-fold to yield around 800 t of tails.

Since then, annual surveys of lobster abundance and age-composition have continued to provide fishery-independent estimates of the fishable stock and of the relative abundance of recruits that would become the target of the fishery in the following year. Until recently, the reference indicator was the fishing mortality rate that would allow 75% of the stock to emigrate and breed. With this reference indicator, the long-term potential average yield for the combined Australian and Papua New Guinea components was estimated to be 250 t of tails. Estimates of long-term sustainable yield were revised annually as more data on recruitment and stock parameters accumulated.

Since the peak Australian dive catch of 349 t tail weight in 1986, annual catches by the Australian dive sector have been around 200 t. In the 1990s they were generally higher than those before 1986 and close to the overall average. The 1999 and 2000 catches were exceptions, dropping to the low levels of the early 1990s. Fishing effort and mortality appear to have increased over the last 5–10 years and, taking annual variation into account, the catch rate has declined since 1988. Size-composition data show a trend of increased exploitation of one-year-olds since 1989. This may reflect the high availability of two-year olds in 1989—the reference year—as it is only when two-year-olds are unusually abundant that little effort is targeted at one-year-old lobsters. Bimodal size distributions are typical of most years for which size composition records are available.

It was concluded in 2000 that the stock is probably biologically overfished. It was recommended that management action should be taken to ensure that fishing mortality does not increase unless further research indicates that an increase is defensible.

Mackerel trolling

Available evidence suggests there are two genetically distinct northern and eastern stocks of Spanish mackerel in Australia. The former, in Torres Strait and the Gulf of Carpentaria, is part of a northern stock distributed from the southern Gulf of Papua to Western Australia. The eastern stock occurs off eastern Queensland and New South Wales.

Catches average around 100 t of fillets annually, almost all taken from northeastern Torres Strait. While there is wide monthly variation, with catch rates generally higher in the second half of each year, the annual rate has remained stable between 1988 and 2000.

Bêche-de-Mer

Bêche-de-mer are easily overfished because they are large, easily seen and collected, and do not require sophisticated fishing techniques. As a result, the Torres Strait Bêche-de-mer Fishery is subject to a suite of input and output controls aimed at preventing overfishing but also allowing Islanders to benefit from the use of bêche-de-mer stocks.

Sandfish was very heavily fished in the early 1990s, and in 1995 in particular. It is a high-value species living in shallow waters, so is particularly vulnerable. Following concerns of serious resource depletion and overfishing of sandfish stocks on Warrior Reef, two fishery-independent surveys — in November 1995 – January 1996 and in January 1998—were conducted to assess sandfish abundance.

The surveys showed that the sandfish stock was declining, with progressively smaller breeding populations leading to smaller and smaller recruitments. Strong management measures were brought in, but further fishing pressure on sandfish, even within the catch limits, may have led to a collapse of the stock. A continued closure was recognised as the only feasible strategy for rehabilitation.

A third survey of the sandfish population on Warrior Reef in January 2000 found that sandfish stocks were still severely depleted, with only a very slight recovery since the extremely low abundance of 1998. Estimates suggested that the standing stock of adult animals remaining on Warrior Reef was unlikely to be more than 100 t; the estimates of virgin biomass are over 1600 t.

The findings from the most recent survey resulted in a continued closure for sandfish. Experience elsewhere in the Pacific is that overfished bêche-de-mer stocks may take years to recover. This is because holothurians, like many other invertebrates, are broadcast spawners, so fertilisation success is highly dependent on population density. Consequently, reduction of population densities may result in too few eggs to rebuild the population.

Hatchery-propagation of sandfish has been developed by the International Center for Living Aquatic Resources Management (ICLARM) in the Solomon Islands.

Reseeding sandfish stocks with hatchery-produced juveniles is now being considered as a way to assist stock recovery on Warrior Reef.

The status of black and white teatfish, surf redfish and other lower-value species remains unknown at present. These species may become the target of increased fishing pressure in future, as the export market for quality bêche-de-mer is growing. Regulations in the fishery include: limiting the method of taking bêche-de-mer to either gathering by hand, or gathering by hand-held, non-mechanical implements; banning the use of hookah gear; limiting dinghy size to 7 m; having a competitive Total Allowable Catch (TAC) for commercial species; and imposing a limit on the minimum size of animals in the catch.

Management performance

- **mandate for management**

The Torres Strait Treaty gives a very clear mandate for management and sets out very clear objectives of management and the main beneficiaries.

- **political will of national authorities and regional organisations to promote cooperative management**

The Protected Zone Joint Authority is mandated to regard to the rights and obligations conferred on Australia by the Torres Strait Treaty,

- **institutional arrangements and the capacity of national authorities and regional organisations to promote management.**

The Protected Zone Joint Authority works effectively to promote the objectives laid out in the Torres Strait Treaty. There are now formal institutional arrangements for PNG/Australian cooperative management but regular meetings are held to implement the catch sharing arrangements specified in the Treaty.

- **use of decision making procedures and criteria for the allocation of shared resources based on transparent and equitable criteria**

Under Articles 22 and 23 of the Treaty, arrangements have been put in place to allow for sharing of the catch on both sides of the border. Arrangements are negotiated based on the degree of interest by both participating countries.

- **access provisions for new entrants**

When the management arrangements for PZJA fisheries first came into effect in 1985, transferable licences were issued to persons who were not traditional inhabitants if they could demonstrate the required prior history and commitment to fishing in Torres Strait. Since then, new licences have only been issued to traditional inhabitants. In different fisheries a number of provisions have also reduced licence holdings by non-traditional inhabitants over time.

People who are not traditional inhabitants and wish to obtain a licence for a fishery in Torres Strait must buy one of the transferable licences from an existing operator. These licences are subject to strict boat replacement regulations limiting vessel size. Traditional inhabitants can enter any commercial fishery by obtaining, at a nominal

cost, the appropriate fishing licence or by belonging to a community, which has authority for the desired fisheries

- **membership and participation rights that are based, inter alia, on harvesting interests as well as environmental interests (e.g. eco-system and biodiversity interests)**

The Torres Strait Treaty requires each party to take legislative and other measures to protect and preserve the marine environment in and in the vicinity of the Torres Strait Protected Zone. In formulating these measures each party must take into account internationally agreed rules, standards and recommended practices, which have been adopted by diplomatic conferences or by relevant international organizations.

- **mechanisms for the sharing of fisheries management functions and responsibilities as well as the sharing of management costs; and**

Australia and PNG have a diplomatically appointed Joint Advisory Council that addresses many Treaty issues including fisheries monitoring, catch sharing, fisheries management and community-based management of traditionally utilised resources

- **prevention and elimination of IUU fishing activities.**

The Surveillance and Enforcement Program undertaken by the Australian Fisheries Management Authority concentrates on four major activities:

- Education/Extension;
- Promotion/Development;
- Information/Intelligence gathering; and
- Enforcement/Policing

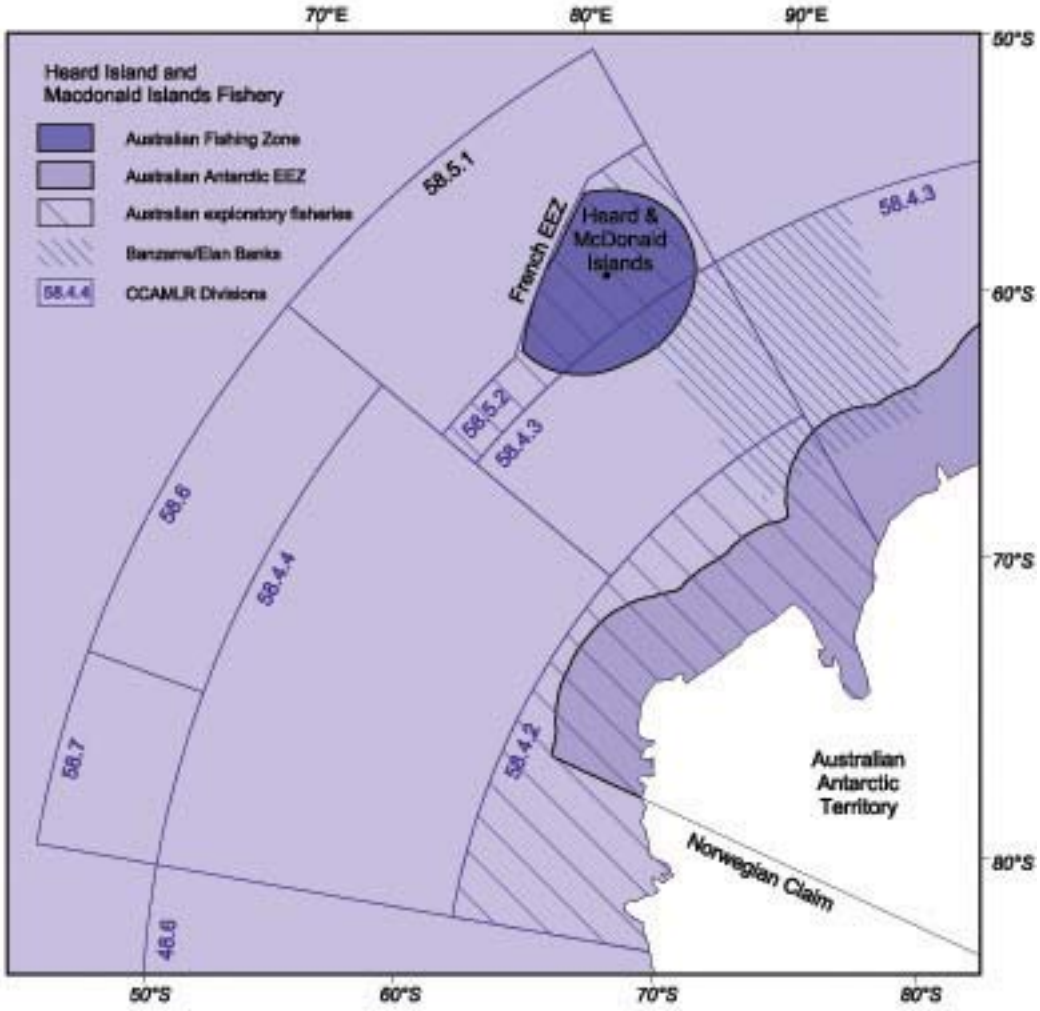
The objectives of the Program are as follows:

- To carry out surveillance and enforcement duties to support the legislation and the policies of the PZJA;
- To provide an education and extension service for both traditional and commercial fishers to enhance the development and management of the fisheries within the TSPZ; and
- To undertake such duties as required by the PZJA to protect the resources of the TSPZ and to promote their exploitation by persons permitted to utilise those resources in keeping with the spirit of the Treaty between Australia and PNG.

HEARD ISLAND AND MCDONALD ISLANDS FISHERY

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 Management 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 fall under the jurisdiction of the Australian Fisheries Management Authority (AFMA). The AFZ abuts directly to the French EEZ.



The two Australian vessels operating in 2000–2001 made seven trips to the region. The total catch of toothfish was 2988 t and that of icefish from the fishery were at their highest recorded level, with 1149 t being taken.

FAO catch data suggest a very large catch (9469 t) from FAO Statistical Area 51 in the Indian Ocean and where previous reported toothfish catches were insignificant. Detailed scientific and other scrutiny has concluded that most of these catches were

probably taken illegally from within the EEZs of France and Australia, and were fraudulently misreported.

Development of the fishery.

Although substantial catches of nototheniid (Antarctic cod) and channichthyid (icefish) fish have been taken since the early 1970s by Soviet, French and Ukrainian vessels on the adjacent Kerguelen plateau, there was very little fishing around Heard Island and the McDonald Islands until quite recently. Some Soviet fishing probably took place in the early 1970s and there was some Polish exploratory fishing in 1975.

Following a joint Soviet–Australian exploratory fishing expedition in 1987, Australia mounted a series of exploratory cruises between 1990 and 1993 on the Australian Antarctic Division's research vessel *Aurora Australis*. The cruises assessed the abundance and distribution of fish stocks in the AFZ, finding commercial quantities of Patagonian toothfish (*Dissostichus eleginoides*) and mackerel icefish (*Champsocephalus gunnari*). However, the biomasses for these species, estimated by a swept area approach, were much lower than those calculated for the neighbouring Kerguelen plateau and, in the case of icefish, were seasonally and spatially variable.

Management arrangements

As the islands lie to the south of the Polar Front (Antarctic Convergence), they also fall under the jurisdiction of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). The Commission, comprising 23 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 Fishery refers to the portion of the AFZ that falls within the CCAMLR Division 58.5.2. In addition, the area to which the *Fisheries Management Act 1991* applies has been extended to give AFMA responsibility for managing fishing by Australian vessels in the high seas area of Division 58.5.2.

AFMA released the *Heard Island and McDonald Islands Fishery Management Policy 1998–2000* in February 1998 allowing for a maximum of two permits. The Management Policy is amended each year to incorporate the decisions of the annual meeting of CCAMLR, particularly with regard to TACs and bycatch provisions. It is envisaged that a formal Management Plan will be implemented in 2002. Under the proposed plan, management would be by way of a system of transferable quotas, issued as statutory fishing rights, and with the specification of a minimum quota holding (25.5% of the total) before an operator may fish. Amongst other conditions, retention of quota in the fishery would require completion of a specified amount of research annually.

The remainder of the AFZ around Heard and McDonald Islands (the southern segment) falls within the CCAMLR Division 58.4.3 and is managed by AFMA under separate arrangements. 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 in this area.

Illegal fishing in CCAMLR Divisions has been a serious problem. The Commission estimated that 10 000 t to 18 000 t of toothfish were taken illegally in Division 58.5.2 in 1997 and a further 520 t to 3500 t in 1998. At least some of this illegal catch was likely to have been taken in the AFZ. The reduction between 1997 and 1998 may have been due in part to surveillance and enforcement action taken by Australia and other countries, but also reflected a drop in price resulting from oversupply. Despite the reduction in the size of the illegal catch, CCAMLR was still concerned about the threat it posed to toothfish stocks and seabirds. It agreed to a number of counter-measures, in particular the mandatory use of automated, satellite-based vessel monitoring systems. In addition, the October 1999 meeting of CCAMLR agreed to introduce a certification scheme so that only certified catches of toothfish could be imported to the markets of CCAMLR parties.

Boats must carry two observers on every trip. In addition to monitoring compliance with permit conditions, the observers 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 also imposes specific data provision requirements on the fishery, including the reporting of catch and effort information every 10 days.

Knowledge of the fushery

Patagonian toothfish live around most sub-Antarctic islands and submarine plateaus. As these areas are separated by large expanses of abyssal basins these may tend to inhibit interchange of fish. Preliminary results from genetic studies combined with tagging information suggest there is little interchange of fish between fishing grounds. 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 now 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 in the diet 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. The maximum length ranges between 45 cm and 66 cm and maximum ages between 5 and 15 years, depending on the location. Fecundity is high. A separate population of icefish (characterised by a different breeding season and length distribution) occurs on Shell Bank on the eastern edge of the Heard Island Plateau. Owing to the small size of this population, no commercial exploitation of it is allowed.

Yearly stock assessments are carried out by the Australian Antarctic Division that feed into the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) stock assessment process that prescribes TACs for Division 58.5.2.

Since 1991, CCAMLR has adopted objectives for the maintenance of exploited fish stocks in terms of their abundance relative to their pre-exploitation abundance.

CCAMLR requires that abundance remain sufficiently high to avoid the likelihood of declining recruitment and to meet the needs of dependent species (usually predators). Criteria initially developed for krill have been applied to toothfish and icefish. For toothfish, the catch limit must be chosen so that over a 20-year period:

- the probability of the spawning biomass dropping below 20% of its pre-exploitation median level is less than 10%; and
- the median spawning biomass remains at or above 50% of its pre-exploitation median level.

For icefish, the second criterion is set at 75% of its pre-exploitation median level because icefish have been found in the diet of a number of predator species in the area.

A stock projection model is used to determine TACs that satisfy the CCAMLR criteria. To generate stock trajectories over the required period, the model uses basic biological information on the species together with estimates (derived from trawl surveys) of recruitment and its variability. Uncertainty in the input data can be taken into account explicitly. This generalised yield model was initially developed for krill, but has been adapted for use with toothfish, icefish and other Heard Island and McDonald Islands stocks.

A precautionary TAC of 311 t was set for icefish in Division 58.5.2 in 1995 in response to Australia's request to CCAMLR for a new trawl fishery. The TAC for icefish was re-evaluated after the 1997 pre-recruit survey. Because there is evidence of at least two separate stocks, based on differences in spawning time and size structure, their status was assessed separately. The TAC for the Heard Island Plateau was set at 900 t. Despite the Scientific Committee of CCAMLR recommending that directed fishing for icefish be avoided in the other known area, Shell Bank, because of low abundance, CCAMLR did not explicitly restrict fishing in this area. Australia chose to close this area to fishing.

Potential yields of toothfish in Division 58.5.2 were derived in 1994 and 1995. The 1996 assessment used an improved version of the generalised yield model and new recruitment estimates to obtain a TAC of 3800 t. This was considerably higher than the previous TAC of 297 t. CCAMLR's second criterion (the one designed to maintain dependent species) is the limiting criterion for toothfish. A catch of 3800 t easily satisfies the first criterion, with a probability of 4% of falling below 20% of the pre-exploitation median. The 1997 TAC was set at 3700 t after taking into account the estimated catches from illegal as well as legal fishing.

The toothfish assessment was updated in 1998 using the latest version of the generalised yield model, a revised estimate of the 1997 illegal catch, the upper estimate of the 1998 illegal catch and an assumption that high illegal catches do not continue. The long-term annual yield was calculated as 3690 t. A short-term annual yield was calculated for mackerel icefish by the same method as in 1997 and the results of the 1998 pre-recruit survey. Although the estimate of biomass on the Heard Island Plateau was lower than in 1997, the calculated yield increased to 1160 t because of a reduction in uncertainty.
A random, stratified survey of toothfish was undertaken on the Heard Island Plateau in March–April 1999. This survey collected comparable data to the early 1990s

surveys. The dataset, along with commercial fishing data, was used to update population parameters including recruitment, growth, biomass and stock structure. The results indicated much greater year-to-year variability in recruitment than previously thought and a slower-growing, longer-lived population on the Heard Plateau than in South Georgia. The results were used in the generalised yield model, producing a revised long-term yield estimate of 3585 t.

Regular surveys of the fishery continue to be undertaken by commercial vessels under the direction of the Australian Antarctic Division. This research has lead to further refinements to the stock assessment models and 2000–01 season TACs of 2995 t for toothfish and 1150 t for icefish.

Management performance

- **Mandate for management.**

The Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) provides a sound mandate for management. This along with Australian Fisheries management Authority's legislation and management plans provides a sound basis for the management of legal catches. The Commission, comprising 23 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.

- **Political will of national authorities and regional organisations to promote cooperative management.**

As demonstrated by the very strict control placed on the development and operation of the Australian fishery, along with their active participation in CCAMLR there is a strong political will from Australia to manage the fishery sustainably.

- **Institutional arrangements and the capacity of national authorities and regional organisations to promote management.**

CCAMLR provides a strong institutional basis on which to manage cooperative parties.

- **Use of decision making procedures and criteria for the allocation of shared resources based on transparent and equitable criteria.**

It is believed that the stocks between the adjacent French and Australian fishing zones that this is not an issue. Because these are fully utilized by the sovereign state, no further allocations have been made.

- **Membership and participation rights that are based, inter alia, on harvesting interests as well as environmental interests (e.g. eco-system and biodiversity interests).**

Environmental interests drive the management of the fishery, both through CCAMLR's ecosystem approach and through the Register of the National Estate and the World Heritage Listing.

- **Mechanisms for the sharing of fisheries management functions and responsibilities as well as the sharing of management costs; and**

Not applicable because of stock segregation.

- **Prevention and elimination of IUU fishing activities.**

CCAMLR agreed to a number of measures to mitigate IUU fishing. In particular the mandatory use of automated, satellite-based vessel monitoring systems and the introduction of a certification scheme so that only certified catches of toothfish could be imported to the markets of CCAMLR parties.