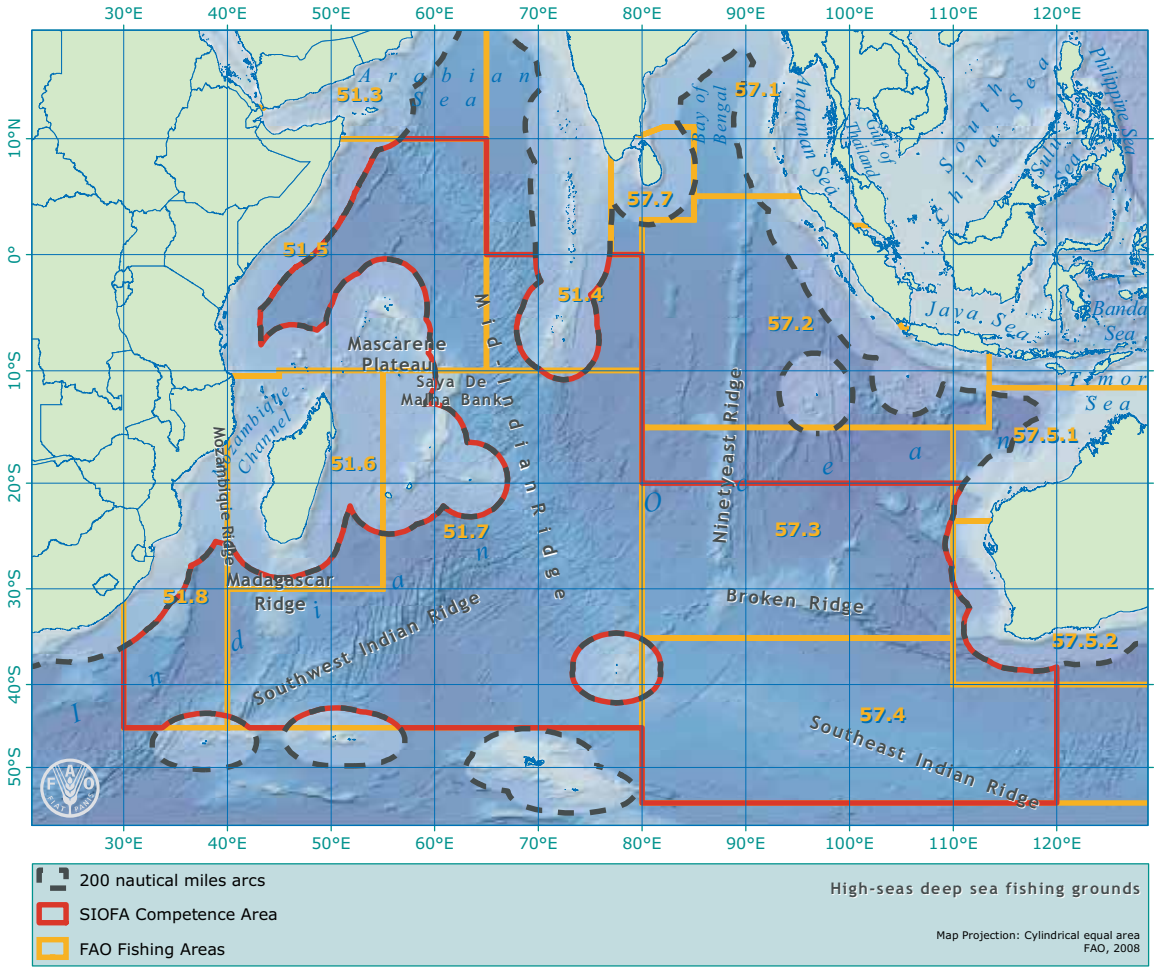
THE INDIAN OCEAN



MAP 1

Main high seas deep-sea fishing grounds in the Indian Ocean and area of competence of the Southern Indian Ocean Fisheries Agreement (SIOFA)

Indian Ocean

FAO Statistical Areas 51 and 57

GEOGRAPHIC DESCRIPTION OF THE REGION

The Indian Ocean is the third largest of the earth's five oceans. It is bounded to the west by Africa, to the north by Asia, to the east by Australia and the Australasian islands and to the south by the Southern Ocean. No natural boundary separates the Indian Ocean from the Southern Atlantic Ocean, but the 20°E meridian that connects Cape Agulhas at the southern end of Africa with Antarctica, 4 000 km distant, is generally considered to be the boundary.

The topography of the sea bed on the high seas of the Indian Ocean is characterized by large areas of abyssal plane with extensive ridge systems and numerous seamounts, banks, plateaus and other underwater features. Major deep-sea ridge systems, with peaks at fishable depths, include the South West Indian Ridge, Madagascar Ridge, Mid-Indian Ridge, Ninety East Ridge and Broken Ridge (Shotton, 2006). The Mascarene Ridge includes the Saya de Malha Bank, which in some areas is less than 20 metres (m) deep and is mostly in international waters between Mauritius and Seychelles (Goreau, 2002).

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

Regional Fisheries Management Organization/Arrangement

The Southern Indian Ocean Fisheries Agreement (SIOFA) – a regime for the management of non-highly migratory species – covers most high seas areas in the Indian Ocean, as indicated in Map 1. The southern boundary of SIOFA borders the Convention Area covered by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR); the eastern boundary borders the South Pacific Regional Fisheries Management Organisation (RFMO) Convention Area currently under negotiation; and the western boundary borders the South East Atlantic Fisheries Organisation (SEAFO) Convention Area. The northern boundary is more complex as can be seen in Map 1. High seas areas of the Indian Ocean not covered by SIOFA or by any other agreement, include the high seas areas of the northern portion of the North Indian Ocean, the Bay of Bengal and west of Indonesia (FAO Statistical Subareas 51.3, northern part of 51.4 and 57.1, 57.2, and the northern part of 57.3). No deep-sea bottom fishing in these areas is at present known to occur.

SIOFA was concluded and opened for signature in July 2006. Signatories to the agreement are Australia, the Comoros, France, Kenya, Madagascar, Mozambique, Mauritius, New Zealand, Seychelles and the European Community. However, the agreement has not yet entered into force. As of October 2008, Seychelles (by ratification), the Cook Islands (by accession) and European Community (by approval) are parties to the agreement (FAO, 2007a).

The Resolution on Data Collection concerning the High Seas in the Southern Indian Ocean was adopted by the Fourth Intergovernmental Consultation on the Southern Indian Ocean Fisheries Agreement in 2004. While the resolution was only voluntary at that stage, the Conference on the Southern Indian Ocean Fisheries Agreement in July 2006 called on all states concerned to implement the resolution as a matter of urgency (FAO, 2007b). No data have yet been reported as requested by the resolution.

DESCRIPTION OF DEEP-SEA BOTTOM FISHERIES IN THE HIGH SEAS

History of fisheries

Deep-sea trawl fishing has taken place over the past several decades in the high seas of the South West Indian Ocean region, with exploratory surveys conducted by vessels from the former Union of Soviet Socialist Republics (USSR) beginning in the 1970s. Former USSR vessels conducted periodic deep-sea trawl research cruises on a commercial scale throughout the 1980s and 1990s with catches ranging from a high of over 6 000 tonnes of deep-sea species in 1980 to a low of only 10 tonnes in 1990. Throughout the 1990s, one to three Ukrainian deep-sea trawl vessels operated on the high seas each year, with each vessel fishing only part of the year. (Romanov, 2003; Clark *et al.*, 2007)

Deep-sea trawlers from both New Zealand and Australia were reportedly fishing in the region several years prior to 1999; however, in the period 1999–2001 there was a major increase in deep-sea trawling on the high seas with the discovery of orange roughy (*Hoplostethus atlanticus*) stocks by vessels from New Zealand (Japp and James, 2005). The combined catch of all deep-sea species in 2000 was estimated at approximately 40 000 tonnes, involving up to 50 vessels from over a dozen countries, although accurate catch data are unavailable, given the unreported and unregulated nature of the fishery. In 2001, only eight vessels reportedly participated in the fishery, although more were thought to have been involved and, in 2002, fishing activity declined even further (FAO, 2002).

In addition to the high seas trawl fisheries, there has been a high seas fishery for demersal species since at least the 1970s. This involves motherships and dories using handlines, which operate on the shallower portions of the Mascarene Ridge and the Saya de Malha Bank, between Mauritius and Seychelles in the Western Indian Ocean. The principal target species in this fishery is sky emperor (dame berri) (*Lethrinus mahsena*), with stocks straddling the Mauritian exclusive economic zone (EEZ) and the high seas (Christy and Greboval, 1985; Sanders, Sparre and Venema, 1988; Maguire *et al.*, 2006).

TABLE 1
Main species targeted by deep-sea fisheries in the Indian Ocean

Common name	Scientific name
Main target species – trawl fishery	
Alfonsino	*Beryx* spp.(mainly *Beryx splendens)*
Orange roughy	*Hoplostethus atlanticus*
Main target species – longline fishery	
Deepwater longtail red snapper (ruby snapper)	*Etelis coruscans*
Other deep-sea species	
Black oreo	*Allocyttus niger*
Bluenose warehou (blue-eye trevalla)	*Hyperoglyphe antarctica*
Pelagic armourhead (boarfish)	*Pseudopentaceros richardsoni*
Boarfishes nei	Caproidae
Cape bonnethmouth	*Emmelichthys nitidus*
Black cardinal fish	*Epigonus telescopus*
Rubyfish	*Plagiogeneion rubiginosum*
Rudderfish	*Centrolophus niger*
Smooth oreo dory	*Pseudocyttus maculatus*
Spiky oreo	*Neocyttus rhomboidalis*
Violet warehou (black butterfish)	*Schedophilus velaini (Schedophilus labyrinthica)*
Wreckfish	*Polyprion americanus*
Deep-sea sharks	
Other species	
Sky emperor (dame berri)	*Lethrinus mahsena*
Deep-sea lobster	*Palinurus barbarae*

Note: the accuracy of attributions to fishes in the family Centrolophidae in the Southern Indian Ocean is uncertain (R. Shotton, personal communication, 2008).

Current fisheries

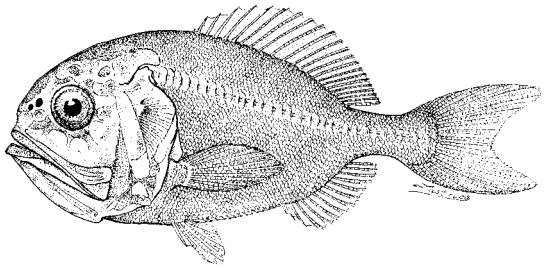
The dominant bottom fishery in the high seas of the South West Indian Ocean over the past several years has been the mid-water and bottom trawl fishery on or around seamounts for alfonsino (*Beryx splendens*) and orange roughy. Other deep-sea species caught in this fishery include black oreo (*Allocyttus niger*), spiky oreo (*Neocyttus rhomboidalis)*, smooth oreo dory (*Pseudocyttus maculatus*), black cardinal fish (*Epigonus telescopus*), bluenose warehou (blue-eye trevalla) (*Hyperoglyphe antarctica)*, boarfishes nei (Caproidae) and pelagic armourhead (*Pseudopentaceros richardsoni)*. For

an overview of the main species targeted, see Table 1 and Figure 1. Deep-sea trawlers primarily target orange roughy or alfonsino and take other species, including deep-sea sharks, as bycatch. These fisheries are a mixture of bottom trawl and mid-water trawl fisheries on deep-sea seamounts, ridge systems and other underwater features (e.g. shoals, escarpments) in the international waters of the South West Indian Ocean (Shotton, 2006). (Clark *et al.*, 2007; Sissenwine and Mace, 2007)

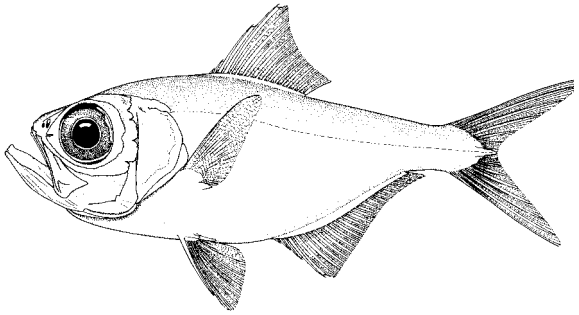
In addition to the trawl fishery, a deep-sea longline fishery on the high seas developed over the past several years targeting primarily deepwater longtail red snapper (ruby snapper) (*Etelis coruscans)*. Anecdotal evidence, including observation of vessels, indicates that there are directed deep-sea gillnet and longline fisheries on the high seas for sharks, but none were reported to FAO.

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

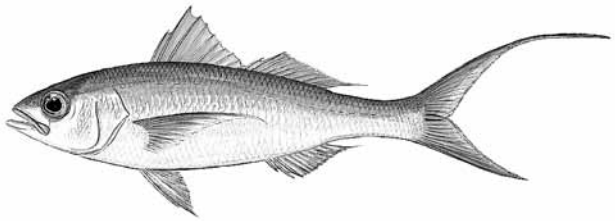
Orange roughy (*Hoplostethus atlanticus*)



Splendid alfonsino (*Beryx splendens*)



Deepwater longtail red snapper (ruby snapper) (*Etelis coruscans*)



Source: FAO.

Bottom and mid-water trawl fishery for alfonsino and orange roughy

Orange roughy are generally most abundant between 750 and 1 100 m where they often form large aggregations in association with seamounts and other underwater features. Bycatch species of commercial value in the orange roughy fishery includes oreo. Deep-sea sharks are also caught as bycatch.

The fishery for alfonsino generally operates at shallower depths – between 300 and 600 m. However, alfonsino school in mid-water and are usually caught with mid-water trawlnets. Commercial species caught with alfonsino include pelagic armourhead, black cardinal fish and bluenose warehou (FAO, 2002).

The Southern Indian Ocean Deepsea Fishers Association (SIODFA)[1] is an association of four fishing companies with vessels engaged in deep-sea trawl fisheries on the high seas. SIODFA indicated in a report published by FAO in 2006 that four deep-sea trawl vessels have regularly fished the high seas of the Southern Indian Ocean for orange roughy and alfonsino since 2003. The four vessels were flagged to Namibia, Australia and the Cook Islands. Not all of the vessels fish all year round. Fishing effort consists of approximately 1 500–2 000 tows a year for the four vessels combined. Of

[1] SIODFA is comprised of Austral Fisheries Pty Ltd, Perth, Australia; Bel Ocean II Ltd, Port Louis, Mauritius; Sealord Group, Nelson, New Zealand; and TransNamibia Fishing Pty Ltd, Walvis Bay, Namibia. SIODFA members have currently restricted the number of vessels fishing in the South Indian Ocean to four vessels (G. Patchell, SIODFA, personal communication, 2007).

these, approximately 50–60 percent are mid-water tows, largely targeting alfonsino, and 40–50 percent are bottom trawl tows targeting orange roughy (Shotton, 2006).

The Cook Islands report that one deep-sea trawler has also conducted fishing operations in the South West Indian Ocean (FAO Statistical Area 51) although they provide no information on the catch.[2] In response to the 2007 FAO Questionnaire on High Seas Deep-sea Fisheries (hereinafter referred to as the FAO Questionnaire – see Appendix A), Australia reported that two trawlers fished on the high seas in the South West Indian Ocean (FAO Statistical Area 51) and three trawlers operated in the South East Indian Ocean (FAO Statistical Area 57) in 2004, 2005 and 2006. However, it is not clear whether one or more of these vessels fished in both areas and thus are counted twice. Australia did not provide information on the high seas bottom catch in the Indian Ocean.[3] The main fishing areas appear to be the South West Indian Ocean Ridge, Madagascar Rise (in particular Walters Shoal), the Mid-Indian Ridge, Ninety East Ridge and East Broken Ridge (Shotton, 2006).

No precise information on catch and effort has been reported for the bottom and mid-water trawl fisheries. The only information available on catch and effort in the high seas bottom fisheries in the Indian Ocean is that provided by China in aggregate form on catch and effort in the Chinese longline fishery (see following section).

Bottom longline fishery for deepwater longtail red snapper

In addition to the trawl fisheries, China reported that several longliners – four in 2005 and seven in 2006 – have begun operating in the North West Indian Ocean (FAO Statistical Area 51) targeting deepwater longtail red snapper (see Table 2).

It is not clear whether these vessels are fishing within or to the north of the boundary of the Southern Indian Ocean Fisheries Agreement. Altogether, these longline vessels caught a total of 970 tonnes during 150 fishing days in 2005/2006.[4] The Cook Islands report one longline vessel targeting deep-sea species operating in the South East Indian Ocean (FAO Statistical Area 57). Australia reports that five longliners and one multipurpose vessel have been bottom fishing on the high seas of the Indian Ocean in FAO Statistical Area 57 (South East Indian Ocean). Australia indicated that information on the catch of this fleet is confidential.[5]

TABLE 2
Catch in the Chinese longline fishery, North West Indian Ocean, 2005/2006

Species name	Catches (tonnes)
Deepwater longtail red snapper	756
Other	214

Other bottom fisheries

As indicated in the section on History of fisheries, there are high seas fisheries for demersal species operating on the shallower portions of the Mascarene Ridge and the Saya de Malha Bank between Mauritius and Seychelles, primarily involving vessels from Mauritius. However, this has been changing in recent years. These fisheries remain important for the Mauritian fishing industry. In 2006, a total of ten vessels fished on the shallow water banks of Saya de Malha, Nazareth and Albatross and in the Chagos Archipelago with a total of 2 612 tonnes of catch landed (frozen fish), which was mainly comprised of Lethrinidae (88.2 percent) and snappers/groupers (10.1 percent). However, only the Saya de Malha Bank lies largely in the high seas but the catch in 2006 from this area represented 62.9 percent of the total catch from the banks. It was also reported that an increase in the number of vessels and trips was observed in 2006. (Ministry of Agro Industry & Fisheries [Fisheries Division], Mauritius, 2006)

[2] Response from the Cook Islands to FAO Questionnaire.
[3] Response from Australia to FAO Questionnaire.
[4] Response from China to FAO Questionnaire.
[5] Response from Australia to FAO Questionnaire.

In 2006, a Spanish vessel offloaded deep-sea lobsters in Durban, South Africa, reportedly caught while fishing in the high seas on Walters Shoal on the Madagascar Ridge. The lobsters were identified as a new species, *Palinurus barbarae*. The fishing gear used by the vessel was not reported. (UCT, 2006)

As indicated earlier, anecdotal information suggests that several vessels may be fishing with deep-sea gillnets on the high seas of the South Indian Ocean, primarily for deep-sea sharks (G. Patchell, SIODFA, personal communication, 2007; Hareide *et al.*, 2006).

Catch and effort summary

Table 3 presents a summary of catch and effort by fishery and flag state.

TABLE 3
High seas deep-sea fisheries in the Indian Ocean – yearly catch and effort indicators by fishery for the period 2005/06

Flag state	No. of vessels	Catch (tonnes)	Effort
Trawl (mid- and bottom trawl) fishery targeting orange roughy and alfonsino			
Australia	3–5	4 000–5 000+ (overall estimate)	1 500–2 000+ (overall tows per year)
Cook Islands	1		
Mauritius	1		
Namibia	1		
Bottom longline fishery targeting deepwater longtail red snapper			
Australia	6*	/	/
China	7	970	150 days
Cook Islands	1	/	/

/ = Unknown.
* Five and one "other".

Illegal, Unreported and Unregulated (IUU) fishing

Very little information is known about IUU bottom fishing activities in the Indian Ocean. These fisheries are currently unregulated by a multi-lateral mechanism.

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

Status of target stocks

The number of distinct target stocks and the status of these stocks are unknown. In the case of orange roughy, an FAO report states that the fishery targets "possibly a moderately large number of separate spawning stocks" and that possibly the only way to obtain accurate information on the catch since 1999 would be in a "confidential context", i.e. provided that the information would not be made publicly available (Shotton, 2006).

In terms of changes in catch in the fishery, after the increase in vessel numbers in 2001, average catch per vessel for the season is estimated to have dropped from 1 600 tonnes to under 300 tonnes per vessel. The following years saw reduced numbers of vessels and a shift from orange roughy to alfonsino and rubyfish targets on the Madagascar Plateau, Mozambique Ridge and Mid-Indian Ridge (Clark *et al.*, 2007).

Status of bycatch stocks

The stock structure and status of bycatch species are unknown. According to trawl industry sources, bycatch by weight in the current aimed-trawl fisheries is low (Shotton, 2006). However, in terms of numbers of species taken as bycatch, detailed information on the former USSR and Ukrainian deep-sea trawl fishery between 1972 and 2000 indicated that well over 100 species or species groups were recorded taken as bycatch in the deep-sea trawl fisheries for alfonsino and orange roughy in the region (although some of the species recorded as bycatch were pelagic species) (Romanov, 2003). This suggests that the impact on associated and dependent deep-sea species, in particular in non-aimed trawl fisheries, could be significant.

Impacts on Vulnerable Marine Ecosystems (VMEs)

The member companies of SIODFA have conducted extensive mapping of much of the deep-sea topography of the high seas of the South Indian Ocean where commercially valuable species of fish are likely to occur. SIODFA has probably produced the best information currently available on the locations of corals in association with

seamounts, ridge systems and other underwater features in the region. Shotton (2006) gives relatively detailed information provided by the industry on the topography and location of corals, particularly in the areas that SIODFA members have voluntarily agreed to set aside as areas closed to bottom fishing (further information can be found in SIODFA, 2007). Nonetheless, a comprehensive assessment of deep-sea areas affected by bottom fishing has not been carried out and the extent of the impacts is currently unknown (Shotton, 2006).

The fisheries for alfonsino and orange roughy are conducted on seamount and ridge systems across a wide area of the Southern Indian Ocean. SIODFA member companies note that coral bycatch (brain coral, black coral and branch coral) occurs in some areas, with little or no bycatch in other areas, and that skippers of the four vessels in this fleet try to avoid bottom areas where corals are present to prevent damage to their trawlnets (Shotton, 2006; SIODFA, 2007).

Based on the biogeography of the region, stony corals are likely to occur in association with seamount peaks throughout the Southern Indian Ocean between 20° and 60°S latitude, at depths where fishing currently takes place (Clark *et al.*, 2006). Corals have been reportedly taken in bottom trawl fishing operations in the region and, while the impact of the SIODFA fleet may be minimal, the impact of past bottom trawl fishing on seamount and ridge systems in the region, particularly in the 1999–2001 period, may have been significant (Butler *et al.*, 2001).

CONSERVATION AND MANAGEMENT MEASURES

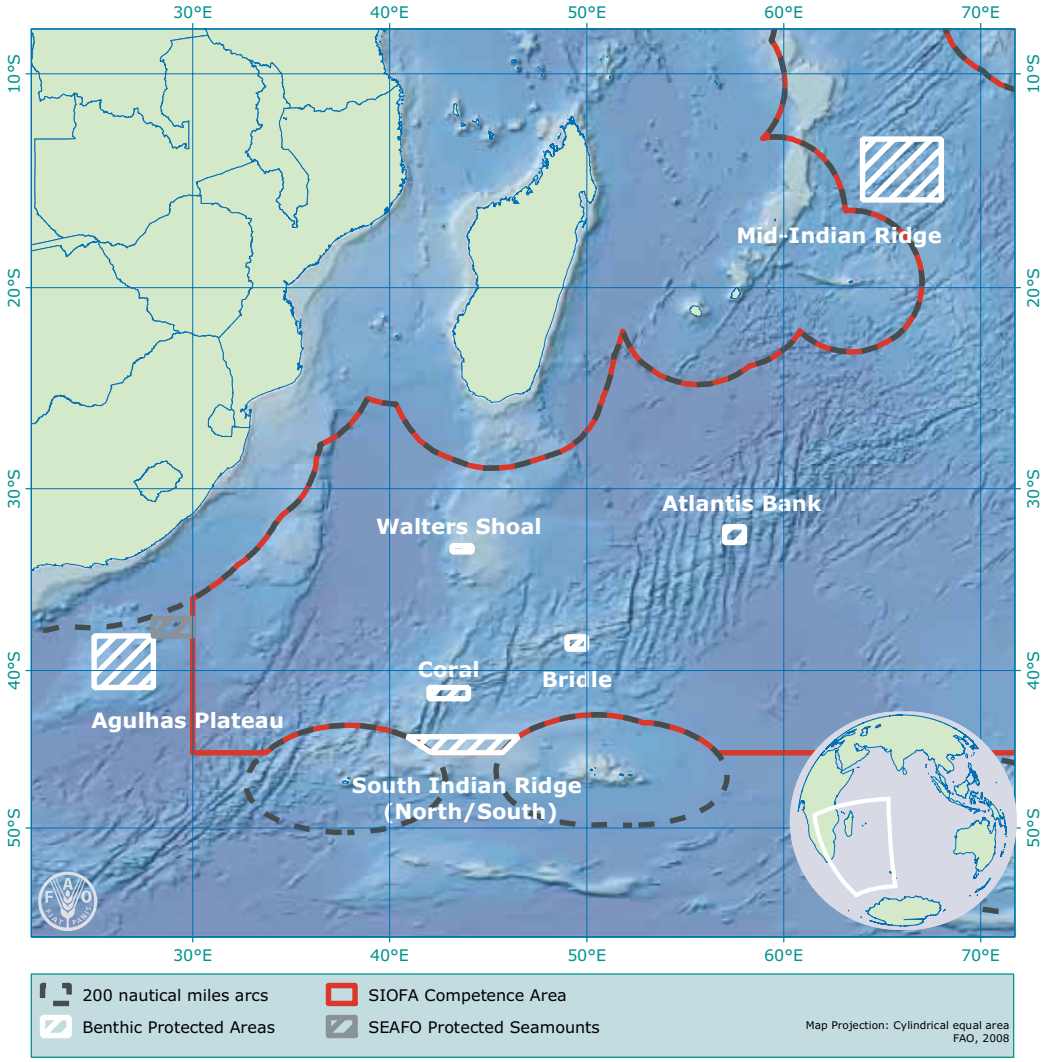
There are currently no conservation and management measures put in place by a regional fisheries body for the management of the high seas bottom fisheries in the Indian Ocean. However, in July 2006, SIODFA decided to refrain voluntarily from bottom trawl fishing in 11 deep-sea areas (Maps 2 and 3) in order to protect cold-water corals (IUCN and SIODFA, 2006). Two of the four vessels fishing for SIODFA member companies carry observers full time and all vessels, as of 2008, will carry video for visual observation of bottom fauna along trawl tow lines (G. Patchell, SIODFA, personal communication, 2008). In addition, the member companies of SIODFA have established a data collection and biological sampling programme for the vessels involved.

A number of national regulations also apply to high seas bottom trawl fisheries. For example, Australia reports that, since 1999, the Government requires Australian-flagged fishing vessels to be authorized to fish in waters outside the Australian Fishing Zone (AFZ). Australian-flagged vessels deep-sea fishing on the high seas are also required to accept the presence of observers, complete catch and effort logbooks and operate a vessel monitoring system (VMS), as well as operate in a manner that does not contravene Australia's obligations under international agreements and other arrangements to which Australia is a party.[6] Australia further reports that observer coverage occurs on an ad hoc basis on high seas bottom fishing vessels; observers collect data on catch, effort, discards, bycatch and wildlife interactions.[7] Vessels flagged in Nambia and the Cook Islands must use VMS and both countries have observer requirements.

INFORMATION AND REPORTING GAPS

There is a need for further information and reporting of catch, bycatch and areas fished in relation to potential impacts on VMEs. At the moment, little information is publicly available – no catch of deep-sea species has been reported to FAO for Areas 51 and 57 other than the catch reported by China (with regard to longline vessels fishing for deepwater longtail red snapper) and Australia (orange roughy in Area 57). However, it is not clear whether the figures represent the catch taken from within

[6] Response from Australia to FAO Questionnaire.
[7] Ibid.



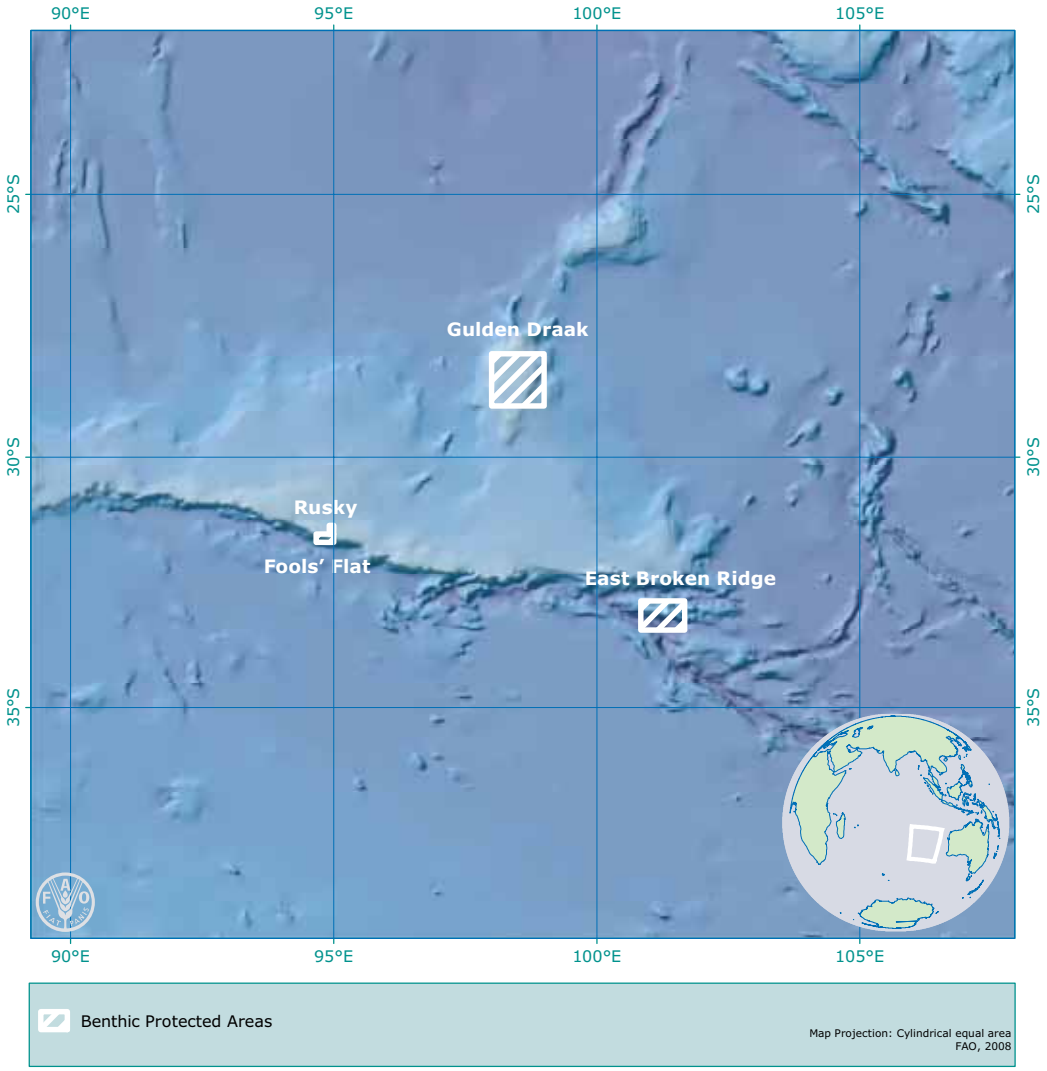
MAP 2
SIODFA benthic protected areas in the South West Indian Ocean

the EEZ, on the high seas, or both (FAO, 2008). Furthermore, no stock assessments have been conducted, or at least not been made publicly available, and there have been no systematic assessments of the impact of the fishery on non-target, associated and dependent species or vulnerable benthic ecosystems.

The data and information collected by the trawl fishing vessels operating in the region involved in SIODFA are likely to be of high quality, valuable and more comprehensive than information collected from or by deep-sea commercial fishing vessels in any other high seas region. A considerable amount of this information has been published in the FAO Report on the *Management of demersal fisheries resources of the Southern Indian Ocean* (Shotton, 2006). Once a management regime has been established for this region, including confidentiality arrangements, it will be important to ensure that the data generated by the fisheries are reported and effectively utilized.

SOURCES OF INFORMATION

The FAO Questionnaire was sent to states known as having a high seas deep-sea fishing fleet. Three countries – Australia, the Cook Islands and China – officially replied with some information regarding deep-sea fishing in the high seas of the Indian Ocean. Namibia also replied to the FAO Questionnaire and reported deep-sea fishing activity in the high seas, but did not indicate specific areas. In addition, reports from FAO, the Commonwealth Scientific and Research Organization (CSIRO) Australia, the United



MAP 3
SIODFA benthic protected areas in the South East Indian Ocean

Nations Environment Programme (UNEP)/Census of Marine Life, the International Union for the Conservation of Nature (IUCN), SIODFA and other sources have been used.

SUMMARY TABLE FOR 2006

Main flag states involved in fisheries	Australia, China, Cook Islands, Mauritius and Namibia
Estimated total number of vessels	20–22
Total reported catch (tonnes)	5 000–6 000

Main fisheries			
Gear	**Target species**	**Fishing grounds**	**Regional Area**
Mid-water trawl	Alfonsino	Madagascar Ridge, Walters Shoal, Southwest Indian Ocean Ridge, Mid-Indian Ridge, Ninety East Ridge and East Broken Ridge	FAO Areas 51 and 57
Bottom trawl	Orange roughy		
Longline	Deepwater longtail red snapper	Unknown	FAO Area 51 – North West Indian Ocean

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