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Southern Indian Ocean Deepwater Fisheries Association (SIODFA) Benthic Protected Areas in the Southern Indian Ocean

Relates to agenda item: 12 Working paper ☐ info paper ☒

Delegation of SIODFA

Abstract

This paper has been submitted by the Southern Indian Ocean Deep Sea Fishers Association.

SIODFA

Southern Indian Ocean Deepwater Fisheries Association (SIODFA)
Benthic Protected Areas in the Southern Indian Ocean[1]

SIODFA Secretariat
February 2016

1. BACKGROUND

In February 2006 then current operators of bottom trawlers in the Southwest Indian Ocean met in Pretoria, South Africa in anticipation of the meeting of the UN General Assembly in November 2006 to discuss issues related to high-seas fishing, reflecting their concern that there was no effective RFMO in the South West Indian Ocean. An unequivocal message from the Pretoria meeting was that operators must continue to expand their scientific knowledge base, and all operators agreed to participate in an acoustic survey programme and the collection of detailed biological data during the austral winter of 2006. It was also recognized that special efforts were needed to fully protect areas from possible effects of bottom contact of fishing gear by prohibiting bottom trawling. It was expected that international agreements for the high seas would include similar measures. Such measures were proposed for bottom trawl fisheries in the South Pacific but the first meeting to establishment this RFMO failed to reach agreement on any benthic protected areas. There was no agreement to close any areas, such as the South Tasman Rise. A number of countries indicated that they would support a proposal at the UN General Assembly to ban high seas bottom trawling if a consensus developed, "New Zealand will push for urgent interim measures to address the effects of bottom trawling on the high seas, Fisheries Minister Jim Anderton will tell parties to a future Regional Fisheries Management Organization (RFMO) meeting in Wellington today"

The South West Indian Ridge is a slow spreading ridge system separating the African, Australia and Antarctic Plates, and has a relatively unique geological structure. Rising from depths of 6000 m, many of the ridges and seamounts on this chain have massive slips and faults which make bottom trawling difficult if not impossible. Only limited areas can be, or have been fished, using bottom trawls. Here, it must be determined whether such impacts would constitute adverse effects.

While it was considered unlikely that bottom trawling on the South West Indian Ocean Region and the central Southern Indian Ocean (including 90 East Ridge and Broken Ridge) had adversely affected the aquatic environment it was recognized that localised impacts may occur to the epifauna on hard substrates in some regions. It was believed that less than one per cent of the region within the depth range of 500-1600 m that will come under the Southern Indian Ocean Fisheries Agreement had been bottom trawled. However, there was substantial negative international publicity about the extent of bottom trawling and of the risk of new technologies developing that would allow more areas to be harvested. The South West Indian Ocean was being described by many supporting the development of a South Pacific RFMO as an example of a disaster in high-seas fisheries management. The fishery has been criticised as a boom and bust fishery in the international media but most operators in the fishery failed economically because of poor fishing skills and lack of technical expertise in deepwater fishing.

The meeting proposed to make use of their knowledge base of habitat in the region to identify candidate bottom trawl protected areas (BPAs), similar to that recently done in New Zealand. These areas would have to be specified in the absence of definitive research on sensitive habitats and, in particular, areas of coldwater corals, including shallow (100-400 m) and deepwater habitats. It was felt that the members

[1] Cite this paper as "SIODFA 2016. Southern Indian Ocean Deepwater Fisheries Association (SIODFA) Benthic Protected Areas in the Southern Indian Ocean. SIODFA Technical Report XVII 16/01. 40 pp."

skippers were the best people to help in identifying areas for protection, and the intention was to to propose (initially) four areas, across a wide range of the SWIO, to be closed as BPAs. These areas were to include Broken Ridge, two or three on the South West Indian Ridge and one on Walters Shoal. No area is proposedfor 90 East, as this is almost exclusively a midwater trawl fishery, but there was no substantial reason not to proceed there.

After these areas had been identified and then agreed upon, all vessels operated by SIODFA members were to abide by a total closure of these areas to bottom trawling and it was proposed that this ban be made general to include all boats whether their owners are members of SIODFA or not. There had been extensive bathymetric surveying of the region prior to fishing and areas of sensitive habitat were well known to skippers some of these had been traditionally avoided. Because of concerns that were mid-water trawling to be permitted there would be difficulty in demonstrating compliance, it was agreed that no trawl fishing of any form would be permitted in the BPAs that were agreed upon.To ensure that these areas are fully protected in the future from any real or perceived adverse impacts of trawling, and to ensure that there is visible protection of biodiversity, industry has used its knowledge of habitats and under water features in the region (derived from its own swathe mapping and bathymetric data collection on vessels), to develop a set of Benthic Protected Areas (BPA's), similar to those recently recommended in New Zealand.

One issue that was considered when establishing these BPA's was the possibility of their ultimately becoming Marine Protected Areas. In future, all mining/oil and even many types of research work, could be prevented in an MPA. If it is ever proposed that the BPAs listed here be converted into full MPAs it was recognized that many parties may want to be involved in such discussions. Hence, for example, some large areas of sediment covered bottom between 1000-1400 m along Broken Ridge, have not been included in that BPA as they will potentially be targets areas for other extractive purposes in the future. In general, instead of large areas being set aside where trawling is not possible, localised areas of known value and representative benthic biodiversity have been chosen.

Benthic Protected Areas, in which no trawling will be allowed (either bottom or midwater), are mainly proposed in areas that could be trawled and little abyssal plain has been included in the proposed BPAs. Instead, specific locations have been selected for protection from trawling that encompasses complex bathymetric features either likely to contain or known to contain a high diversity of benthic flora and fauna.

2. SELECTION OF BENTHIC PROTECTED AREAS

2.1 Sources of **Information**

SIODFA members have collected substantial bathymetric databases on a major part of the Indian Ocean. Large areas have been swathe mapped using an 11 KHz frequency sidescan sonar system Sidescan sonar is a low frequency acoustic system with multiple transducers that map seafloor habitat. The system used for this programme was able to map with a wide swath and cover large bottom areas. The advantage of this type of system is that it can provide accurate bathymetry, but also detect soft and hard sediments. Additional bathymetric databases have been built up from commercial vessel echo-sounders using the commercial logging systems Seaplot ™ and Piscatus ™.

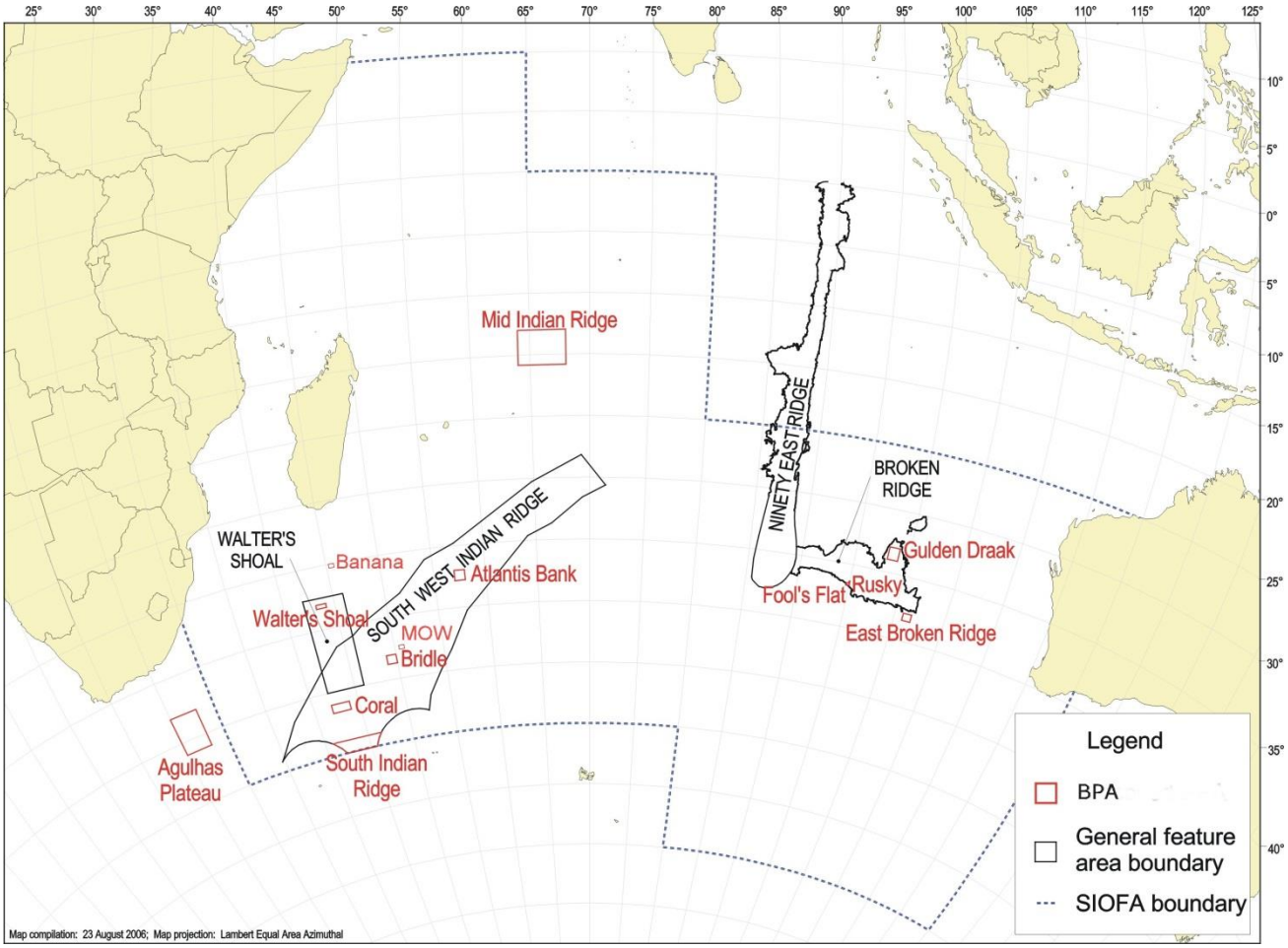
Highly detailed bathymetric information is available for most of the fishable depths on the region. Using bathymetric, inferred habitat, and biodiversity information collected from operating in the area, 11 regions were selected as Benthic Protected Areas. These are shown in **Error! Reference source not found.**. These were selected to give a wide representative coverage to cover the large diversity in the geological structures, sediment overlays, bottom types and benthic habitat types in the Indian Ocean. While many features have hard substrates (which are suitable for attachment by sponges, corals, tunicates and the like), many are covered with unstable sediments or are composed of muds or clays and are relatively barren.

Skippers were asked to suggest areas to be closed, including at least one seamount (rising from 4000-5000 m to 100-200 m depth). Potential points of interest to be considered were to include:

- sightings of whales and other marine mammals
- observations from vessel echo sounders
- bycatch taken in the past
- knowledge of the seafloor, presence of coral, steepness of slopes, etc.
- unfishable areas on the proposed areas and why
- fishable areas and past catch success and
- presence of other boats in the area.

Other criteria that were attempted to be used in selecting the BPAs were:

Figure 1
Locations of the SIODFA BPAs in the Southern Indian Ocean



Type of feature (multiple choices possible – what habitats do the BPAs represent):

- Seamount
- Spreading ridge structure
- Canyons
- Slope edge
- Banks
- Abyssal plain

Structural complexity of seabed

Previous knowledge

- New feature – only known to and explored by Industry
- Already charted – Industry knowledge has improved understanding Known but unexplored

Extent of Bathymetry Data:

- Swathe mapping
- Fishing vessel track-line data

Has the Feature been trawled?

- Yes – extensively
- Yes – limited
- Yes – very limited
- No

Availability of biological data?

- Fisheries data – catch composition.
- Bycatch from trawling (benthic organisms).
- Acoustic images of corals and other biota.
- Anecdotal statements on observations.

And, any other available and relevant sources of information.

Table 1 shows the extent as to how some of the above criteria were satisfied. Table 2 lists estimated areas associated with the respective areas. Table 3. Figure 1 shows the locations of the SIODFA BPAs in the Southern Indian Ocean.

3. DESCRIPTION OF INDIVIDUAL BENTHIC PROTECTED AREAS

3.1 Gulden Draak[2]

Gulden Draak is a large broken ridge and plateau north of Broken Ridge (Figure 2). It covers an area in excess of 10 000 km^2 in depths between 1800 and 1000 m; the feature runs in a north-south direction. The seamount rises from 4000 to 1100/1000 m. Although the area is considered suitable for trawl fishing, because the region's distance from other fishing zones in the Indian Ocean it would have only rarely been visited over the past decade. Despite this some information may be available from a range of fishing vessels that trialled fishing here in the past. These vessels included the *F.Vs. Will Watch*, *Nikko Maru*, *Southern Champion* and *Austral Leader*.

Commercial fishes found in this area include several oreo species. Bottom water temperatures are low. Some commercial log book information and acoustic records are available for this region and future work should be directed at documenting relevant fisheries information for this BPA. Despite this, it is believed that the benthic area of this area should be relatively pristine.

Some geological research has been done on the Broken Ridge area, e.g. Frey *et al.* 2000.

[2] The relation between the name of this Indian Ocean seafloor feature and the Belgian dark ale of the same name remains unknown – to us.

Table 1
List of SIODFA Benthic Protected Area Criterion and Characteristics

BPA	**Physical characteristics**				**Known to have been trawled**	**Believed to be unfished**[1]	**Oceano-grahic data exists**	**Biological data exists**	**USSR/ Ukrainian fishing data exists**	**Other fishing data exists**
	Plateau	Canyons	Corals	Knoll or seamount						
Gülden Draak	✓	×				✓	✓?	✓	✓	
Rusky	×	×	✓	✓	✓		✓	✓	✓	
Fools' Flat	✓	×	✓		✓		✓	✓	✓	✓
East Broken Ridge	×	✓		✓		✓	✓	✓?	✓	
Mid-Indian Ridge	×			✓						✓
Atlantis Bank		×	✓	✓	✓		✓	✓	✓	
Bridle		×		✓	✓		✓	✓	✓	✓
Walters Shoal	✓	✓			✓		✓	✓	✓	✓
Coral		×	✓	✓	✓		✓?	✓	✓	✓
South Indian Ridge		×		✓		✓				
Agulhas Plateau	✓			✓		✓	✓	✓	✓	
Banana					✓	×				✓
Middle of What			✓		✓	×	✓	✓		✓

Table 2

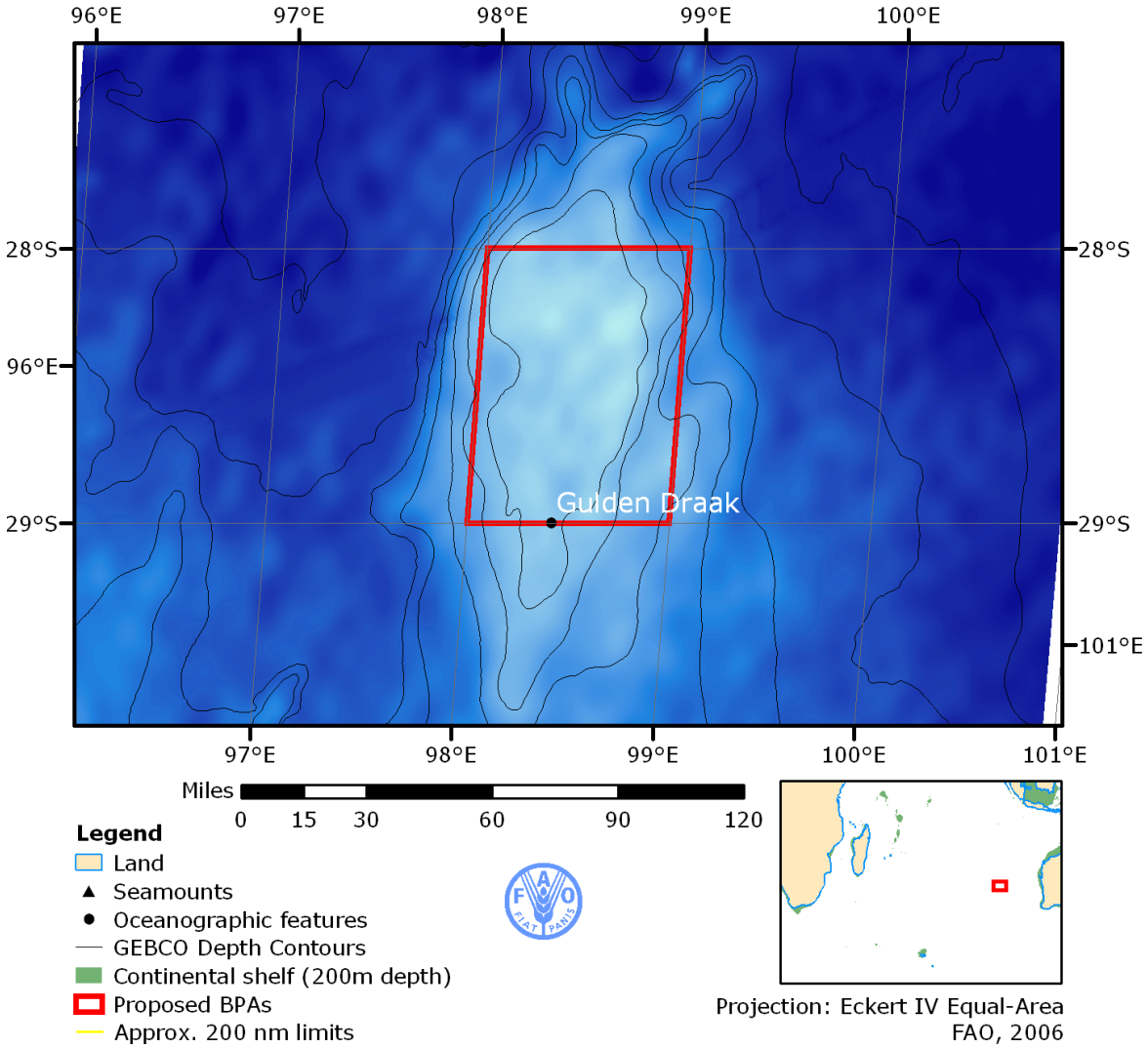
All area calculations using Lambert Equal Area Azimuthal with central meridian and reference latitude roughly the mid point of each box

	BPA	0-100 m	100-300 m	300-700 m	700-1000 m	1000-1500 m	> 1500 m	Total BPA area Km^2
1	Gulden Draak	0	0	0	4	9,290	1,573	10,867
2	Rusky	0	0	1	2	143	0	147
3	Fool's Flat	0	0	0	2	300	284	585
4	East Broken Ridge	0	0	0	0	98	4,937	5,034
5	Mid Indian Ridge	0	0	0	0	6	135,682	135,688
6	Altantis Bank	0	0	1	36	82	8,575	8,694
7	Bridle	0	0	0	0	130	6,658	6,788
8	Walter's Shoal	88	104	557	1,980	673	42	3,443
9	Coral	0	8	34	50	510	11,775	12,376
10	South Indian Ridge	0	0	28	53	5,776	75,583	81,439
11	Agulhas Plateau	0	0	0	8	54	85,766	85,828
12	Banana							
13	MOU						33,843	
	Total							350,889
	Major fishing areas		87.6	112.4	592.5	2,073.5	11,224.9	
	Bathymetric feature	0-100 m	100-300 m	300-700 m	700-1000 m	1000-1500 m	> 1500 m	Total feature area
	Ninety East Ridge	0	0	70.1	351.0	14,113.4	896,414.8	910,949.3
	Broken Ridge	0	0	156.4	1,565.8	21,590.9	355,986.3	379,299.4
	South West Indian Ridge + Walters Shoal	87.6	173.2	1,177.4	17,562.8	34,357.7	2,195,074.2	2,248,433
	Total area of major fishery (km^2)	87.6	173.2	1,403.9	19,479.6	70,062.0	3,447,475.3	
	% closed	100%	65%	42%	11%	16%	1%	

Table 3
BPA Coordinates, Area and Area Feature Summaries
All latitudes are south, i.e. 'S' and all longitudes are east, i.e. 'E'.

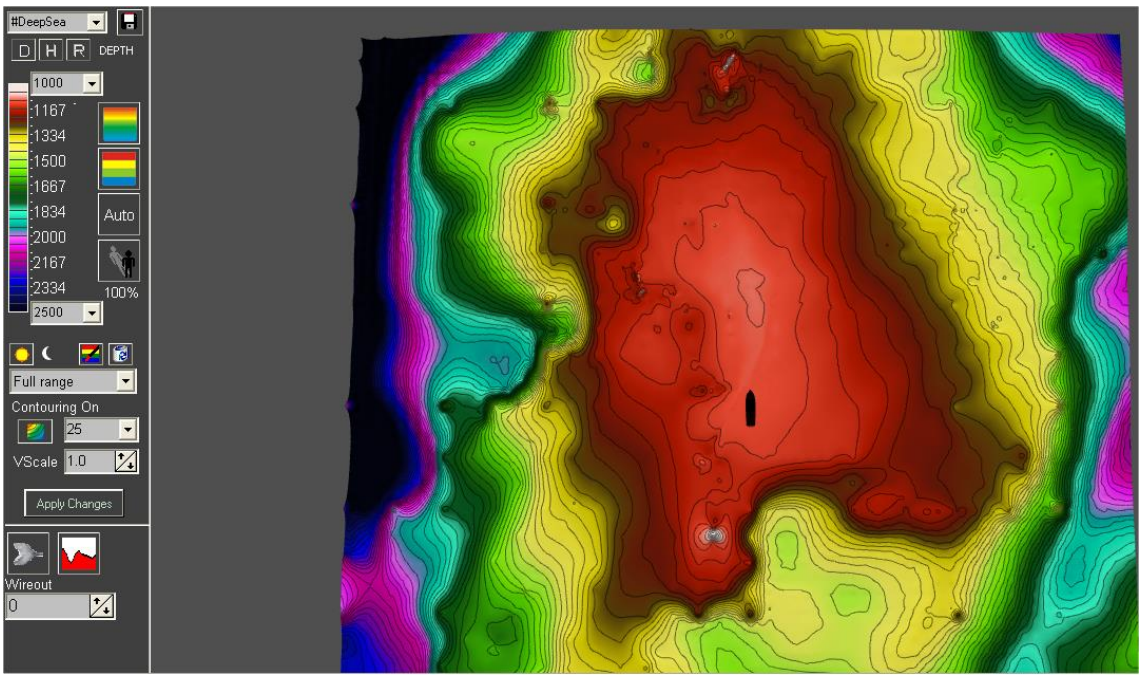
SIODFA Benthic Protected Areas						
Area	**Coordinates**				**Area (km^2)**	**Area Features**
	Lat (N)	**Long (W)**	**Lat (S)**	**Long (E)**		
Gülden Draak	28˚ 00′	98˚ 00′	29˚ 00′	99˚ 00′	10 867	A massive mid-ocean seamount in pristine biological condition.
Rusky	31˚ 20′	94˚ 55′	31˚ 30′	95˚ 00′	147	A productive knoll located on extensive ridge; extensive black coral exists with the benthos in an almost pristine state.
Fools' Flat	31˚ 30′	94˚ 40′	31˚ 40′	95˚ 00′	585	A deep-sea bank with numerous canyons incising its slopes; strong upwelling currents sustain extensive coral beds; in pristine condition, this is a previously unmapped area of the seabed.
East Broken Ridge	32˚ 50′	100˚ 50′	33˚ 25′	101˚ 40′	5 037	A seamount rising to 1000 m, biologically pristine; its benthos and topography previously undescribed.
Mid-Indian Ridge	13˚ 00′	64˚ 00′	15˚ 50′	68˚ 00′	135 688	An area of seamounts rising to 650 m; a tropical region in pristine biological condition.
Atlantis Bank	32˚ 00′	57˚ 00′	32˚ 50′	58˚ 00′	8 694	This seamount was formed from an ancient island; extensive research has been conducted on this BPA by a number of agencies; it is the location of a productive fishery
Bridle	38˚ 03′	49˚ 00′	38˚ 45′	50˚ 00′	6788	An area of knolls and ridges in almost pristine condition; previously unmapped and undescribed.
Walters Shoal	33˚ 00′	43˚ 10′	33˚ 20′	44˚ 10′	3 443	This area, which rises from 4000 to within 10 m of the surface provides a habitat for a variety of whale species; the area is characterized by high biodiversity
Coral	41˚ 00′	42˚ 00′	41˚ 40′	44˚ 00′	12 376	A spreading centre with seamounts and ridges with depths from 4500 m to 180 m. Extensive coral beds, a near pristine area.
South Indian Ridge (North)	44˚ 00′	40.878°	44 00′	46.544° E		An area of seamounts adjacent to the CCAMLR region to the south; in pristine biological condition. This area is bounded to the east and west by the EEZs of South Africa and France.
(South)	45 00′	42.124°	45° 00′	45.711°		
Agulhas Plateau	38˚ 00′	25˚ 00′	41˚ 00′	28˚ 00′	85 828	Region of seamounts north of the proposed South African Antarctic MPA; contiguous with the South African EEZ to the west.
Banana						
MOW						

Figure 1
Gulden Draak Benthic Protected Area



Coordinates		Areas at Depth	
North-west		Depth (m)	Area (km^2)
Lat	Long	≤ 100	0
		101- 300	0
		301 – 700	0
South-east		701 – 1000	3.6
Lat	Long	1001 – 1500	9290
		>1500	1573.4
		Total	10 867

Figure 2
Bathymetry of the Gulden Draak Seafloor Feature



3.2 Rusky Benthic Protected Area

This area has rocky extrusions and is characterized by extensive black coral (Antipatharia) coverage. Fishing on the Rusky benthic protected area is restricted to one, possibly two tracks on the feature in the depth range 400 – 500 m. Hence, most of the feature should not have been affected by demersal trawling. It is reported that there has been past fishing by Soviet/Ukrainian vessels across the flats about the Broken Ridge area.

Figure 4
Swath Sidescan Image of Rusky Knoll

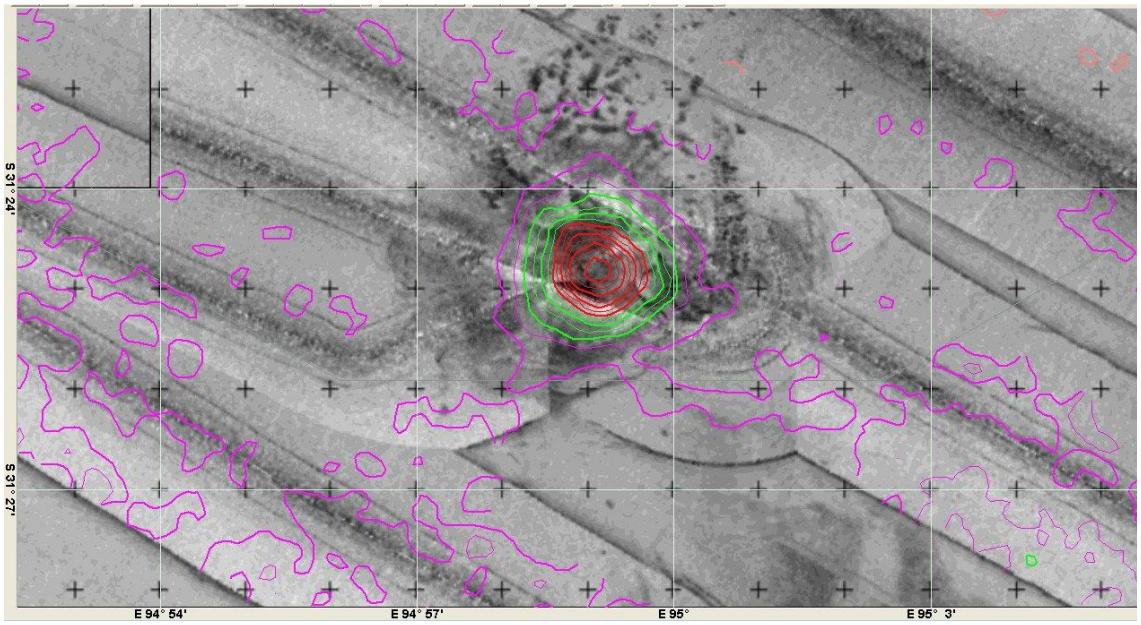
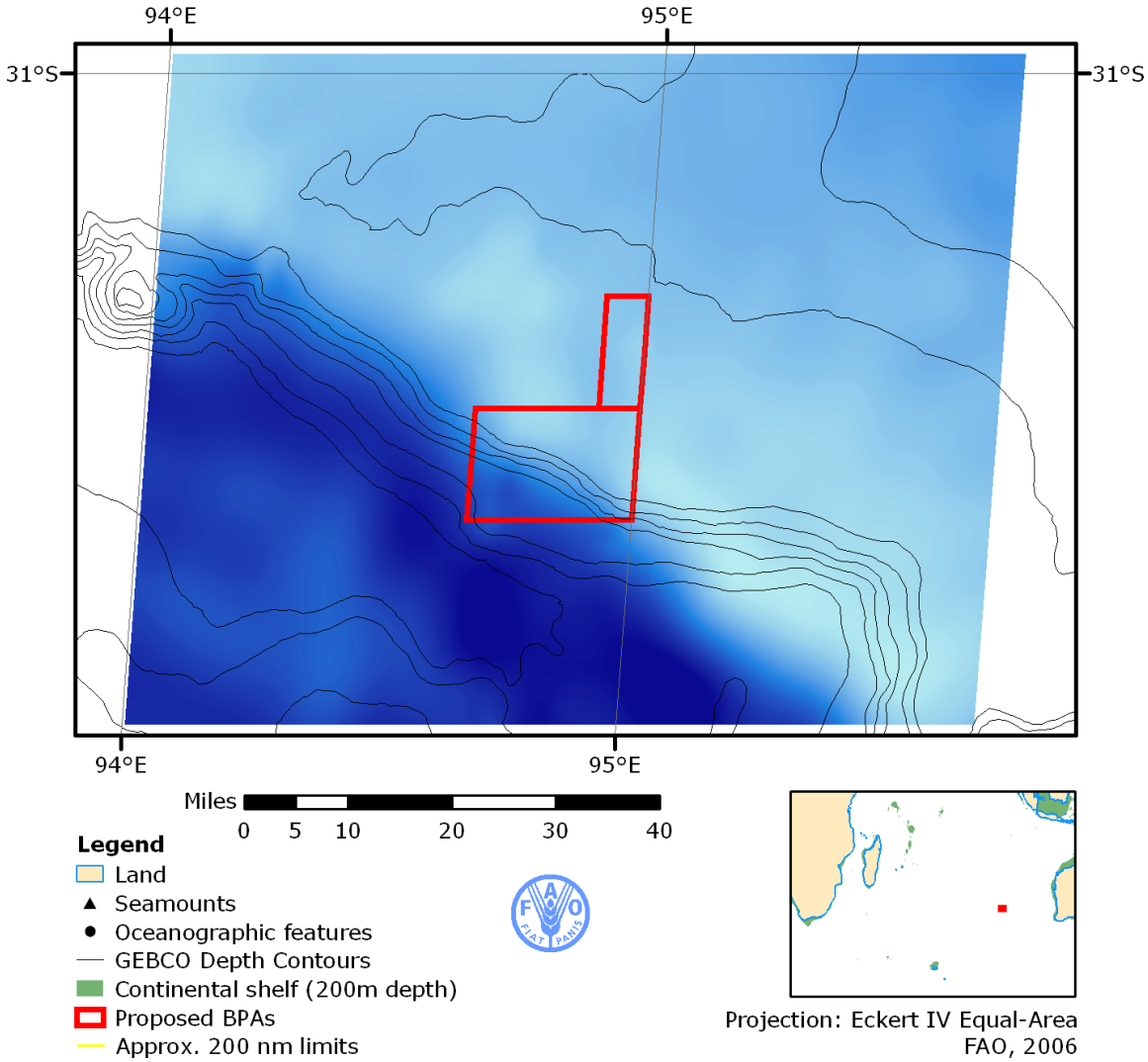


Figure 5
Regional Bathmetry, Rusky Knoll Benthic Protected Area



Areas at Depth

Depth (m)	Area (km^2)
≤ 100	0
101- 300	0
301 – 700	0.5
701 – 1000	2.4
1001 – 1500	143.4
>1500	0.3
Total	146.6

Figure 6
Bathymetry of Rusky BPA

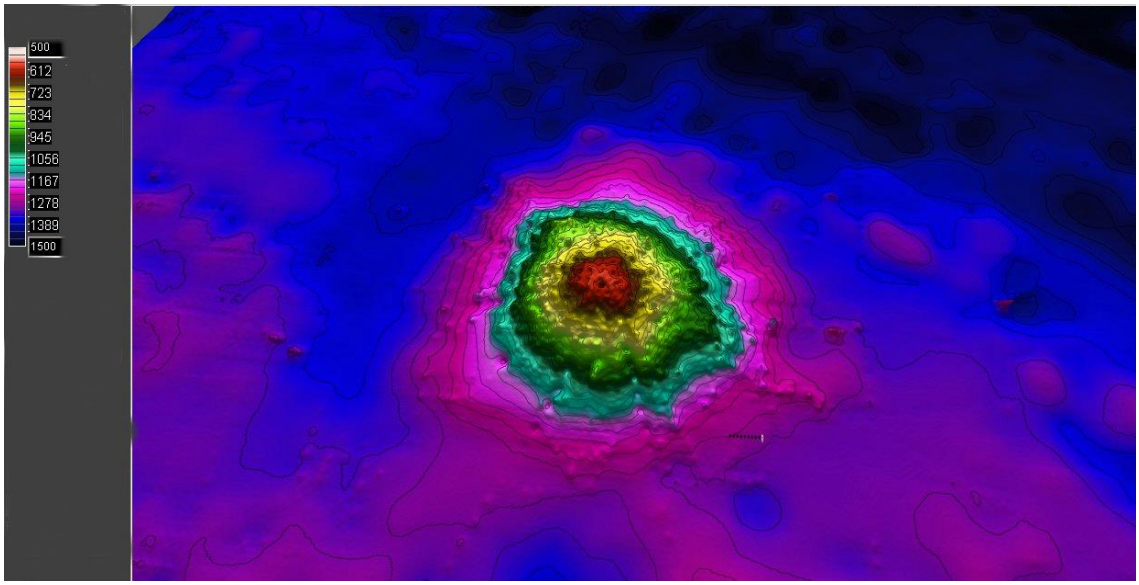
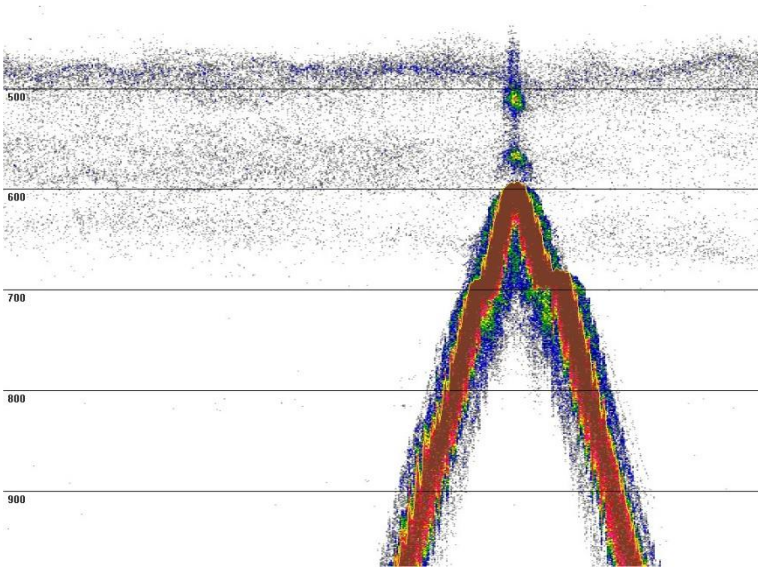


Figure 6

Small alfonsino (*Berys* slendens) and boarfish (*Pseudopentaceros* spp.) schools on the top and the ledges around Rusky knoll. (Credit, G. Patchell, Sealord Group).



3.3 Fool's Flat

This region is found on the southern side of Broken Ridge Plateau to the south of the Rusky Knoll BPA. This site was chosen because of the wide range of benthic habitat it provides. The seamount shoals to around 990 m; its southern side (the edge of Broken Ridge) drops steeply down to over 4000 metres. There are significant stands of brain and black coral on the southern rim of the ridge, which have elevations of 20 – 30 m and can be seen with sidescan sonar (Figure 7). When these have been observed on vessel echo sounders they look like aggregations of fish (but they do not move) – hence the term "Fool's Flat". There appears to be strong upwelling over the south-west boundary and this no doubt has resulted in favourable conditions for the growth of deepwater corals.

The only trawl shots undertaken here have been on the flat sedimented bottom at around 1000m. At least two fishing vessels are believed to have data collected in the past and knowledge of the presence of fish fauna on this benthic protected area that will help in defining the ecology of this feature.

Areas at Depth

Depth (m)	Area (km^2)
≤ 100	0
101- 300	0
301 – 700	0
701 – 1000	1.7
1001 – 1500	299.7
>1500	283.9
Total	585.3

Figure 7
Swath Sidescan Image of Fools Flat

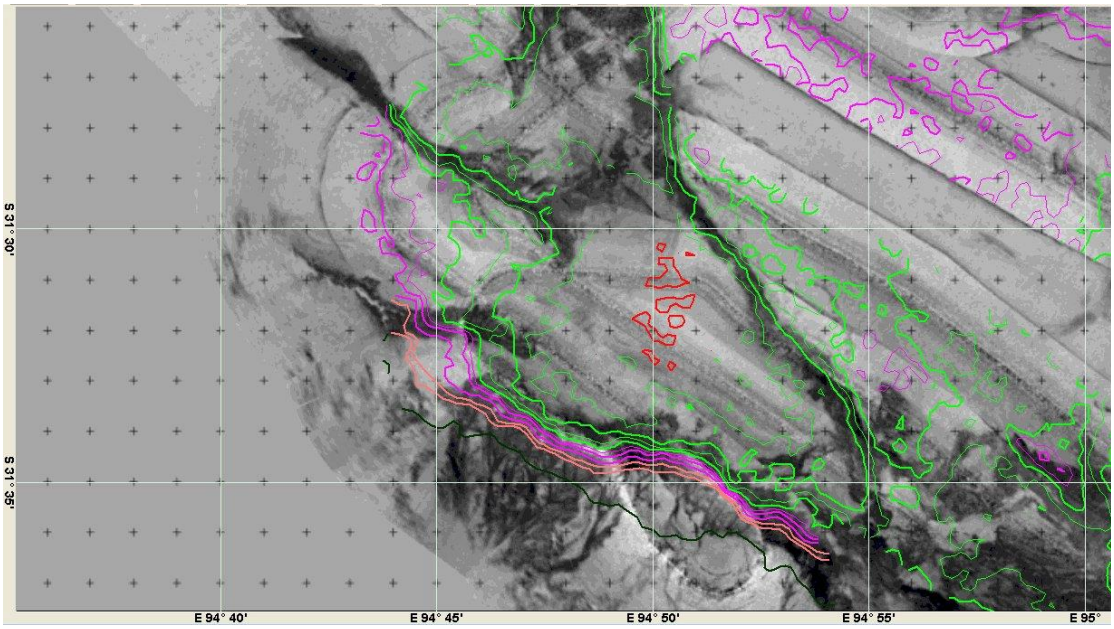


Figure 8
Bathymetry of Fools Flat

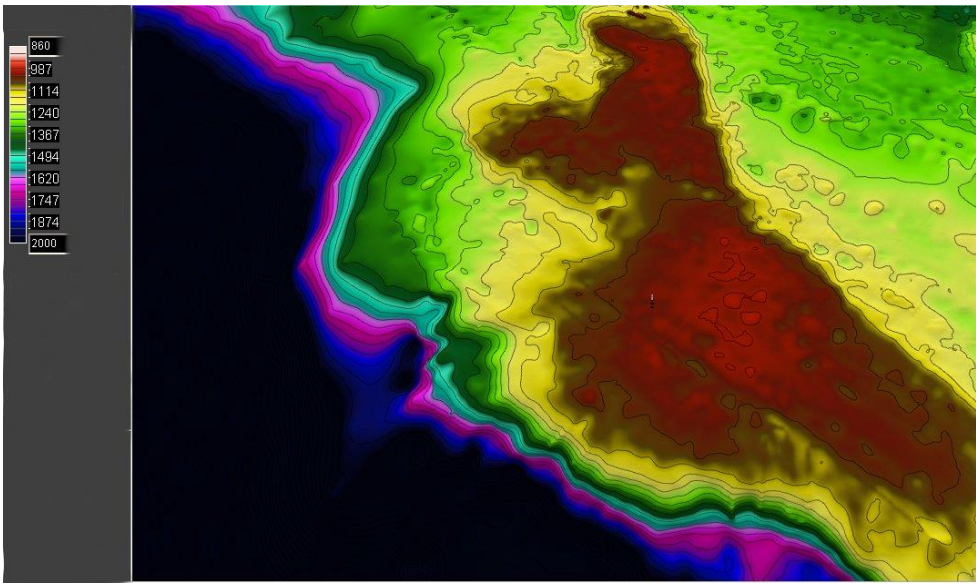


Figure 9
Sidescan Image showing coral beds on Fools' Flat

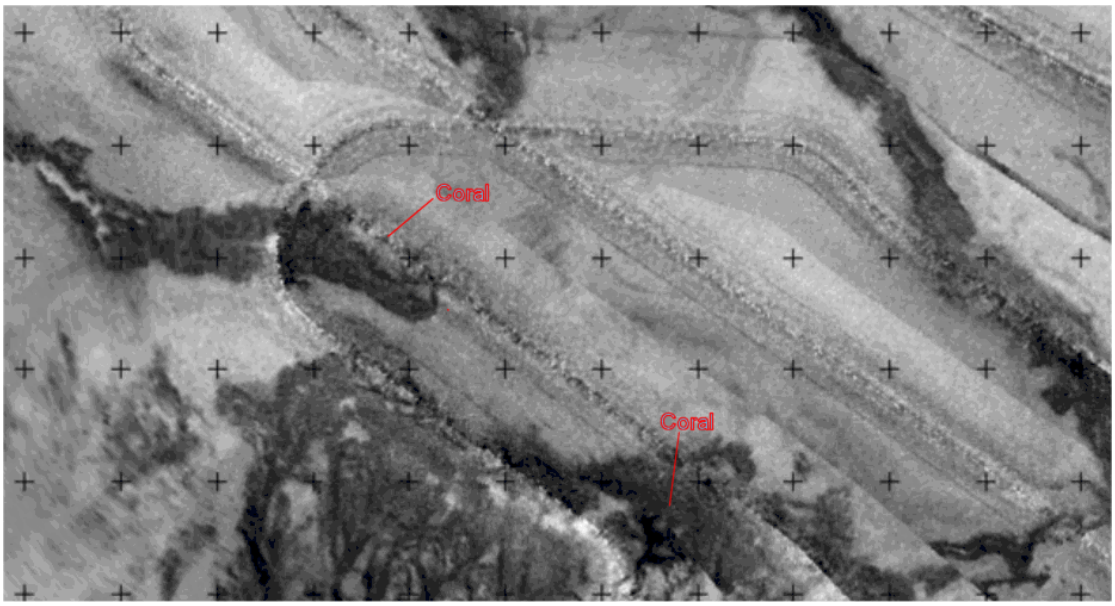
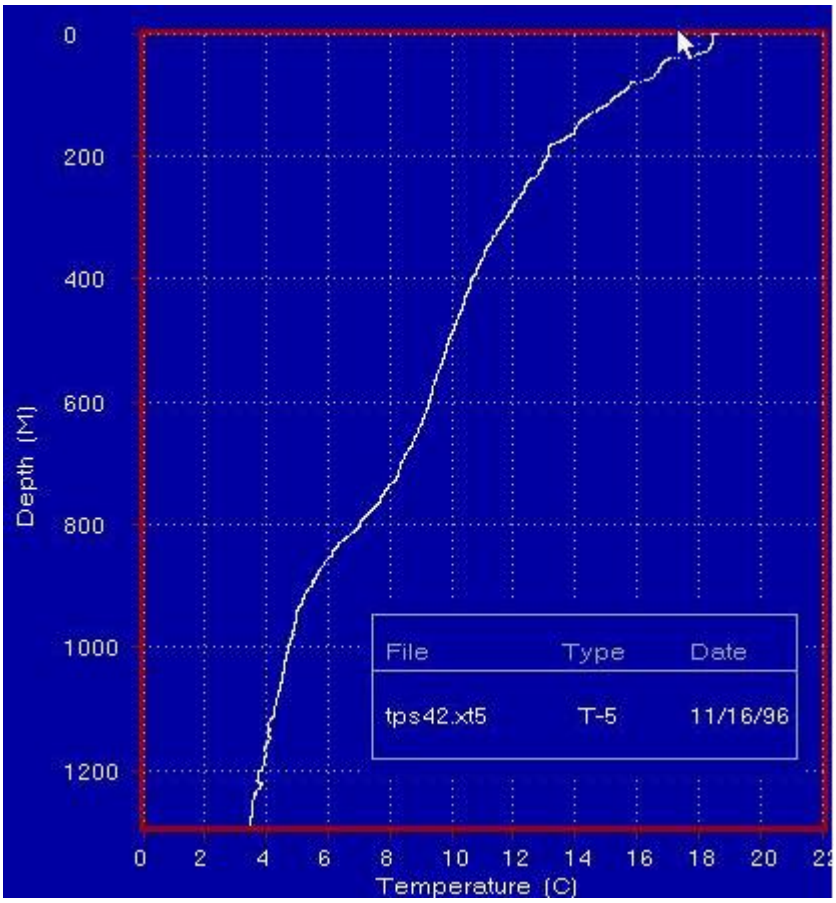


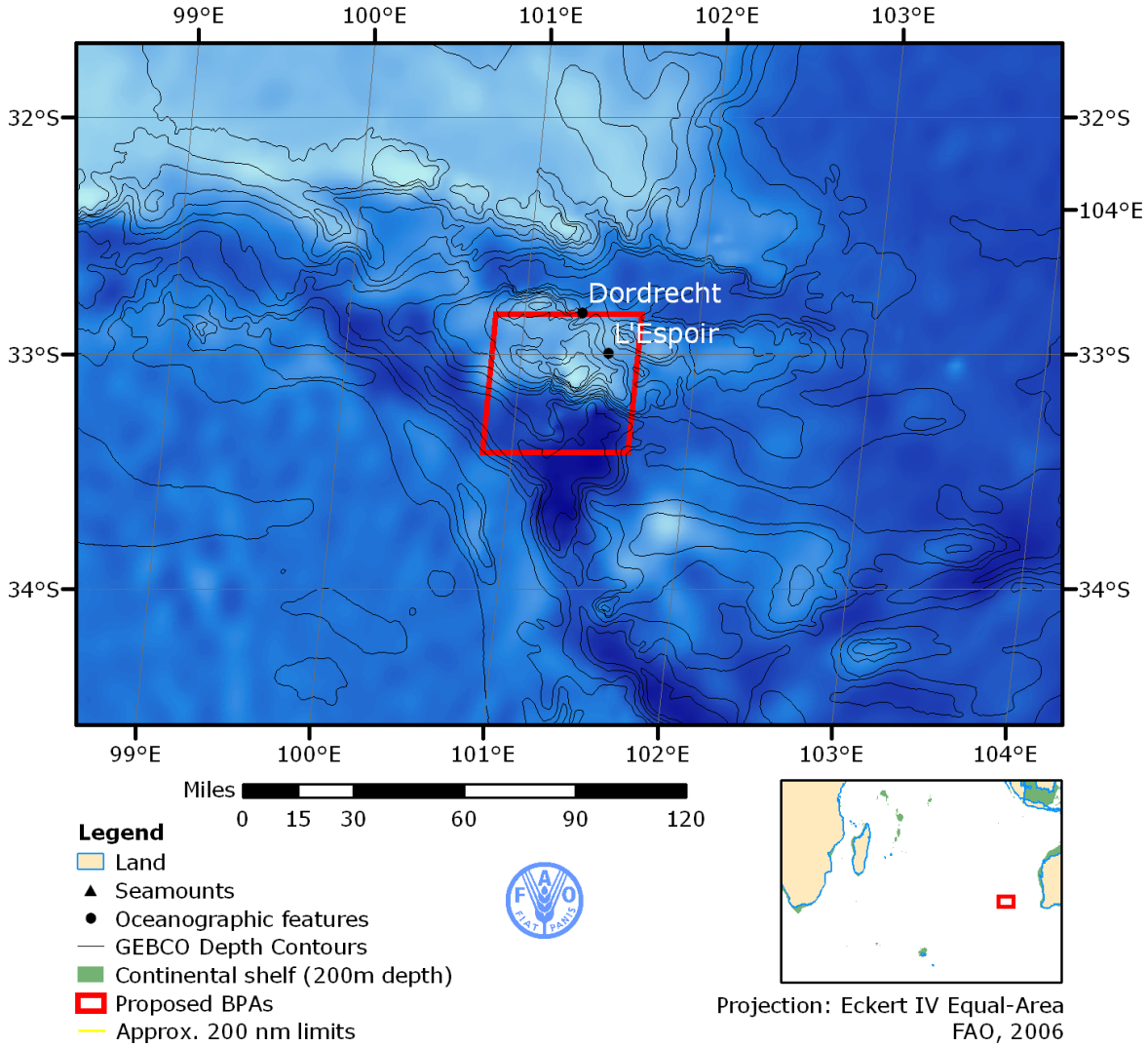
Figure 10

Bathythermograph Temperature Profile, Fools' Flat, November 1996. Zero to 12 500 m.



3.4 East Broken Ridge

Figure 11
Regional Bathymetry of East Broken Ridge



Areas at Depth

Depth (m)	Area (km^2)
≤ 100	0
101- 300	0
301 – 700	0
701 – 1000	0
1001 – 1500	97.50
>1500	4 936.6
Total	5 034.1

This guyot[3] is located on the eastern end of Broken Ridge and is characterised by numerous slips and canyons extending down the sides (Figure). It rises from 3000 m to a depth of 1060 m (Figure 1). As far as is known it has not been previously described and has not been trawled on. Searches for fish aggregations have has been undertaken, but only for one day. The seamount appears to have suitable environmental conditions for the deepwater species of fish that typically occur in the area (

Figure 1). It is believed to be biologically pristine and its benthos and topography, which is fractured and, in the view of many skippers, makes demersal trawling impossible. There are some indications that this feature may have been above sea level at some time in the past. Figure 15 shows a temperature profile for this sea floor.

Figure 12
Swathe sidescan image of the guyot east of Broken Ridge

[3] A guyot is a flat topped seamount. Guyots show evidence of having been above the surface with gradual subsidence through stages from fringed reefed mountain, coral atoll, and finally a flat topped submerged mountain.

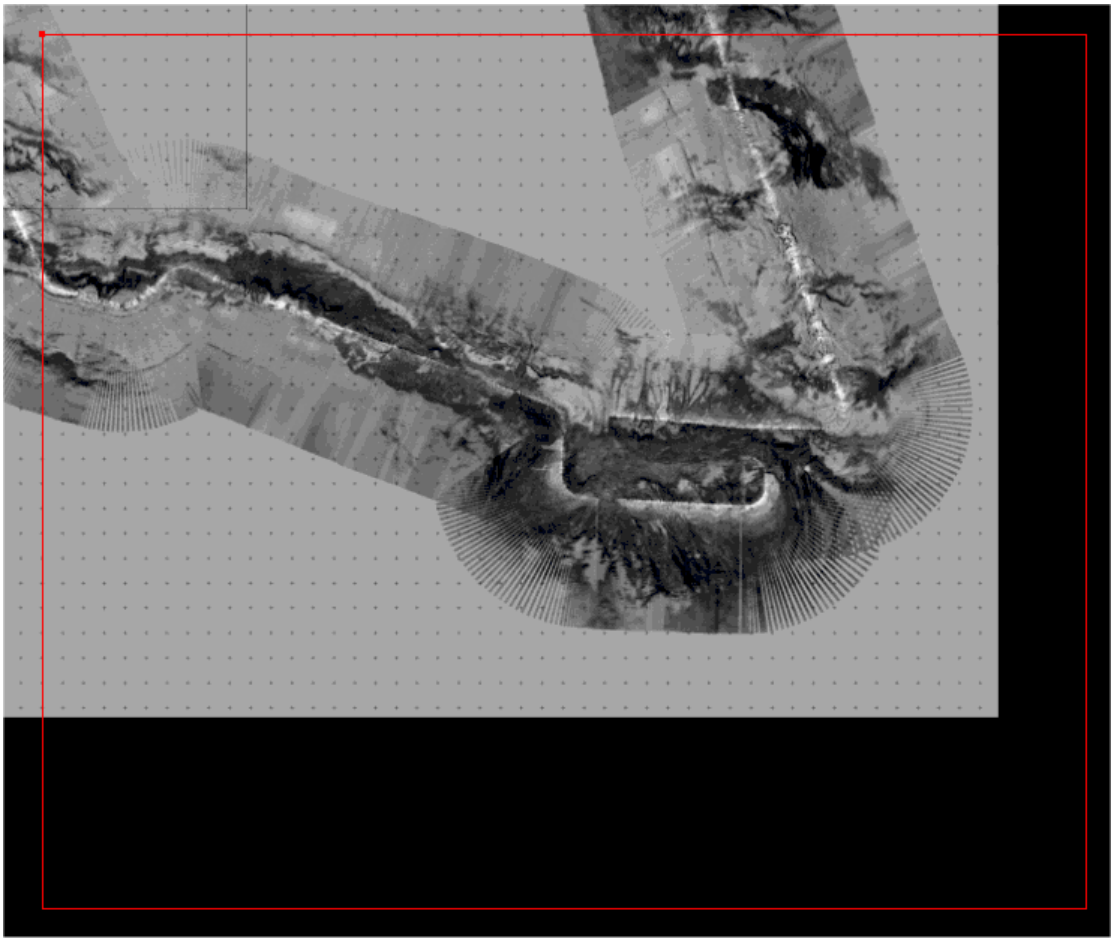


Figure 13
Bathymetry of Seamount to the east of Broken Ridge (60 mile view)

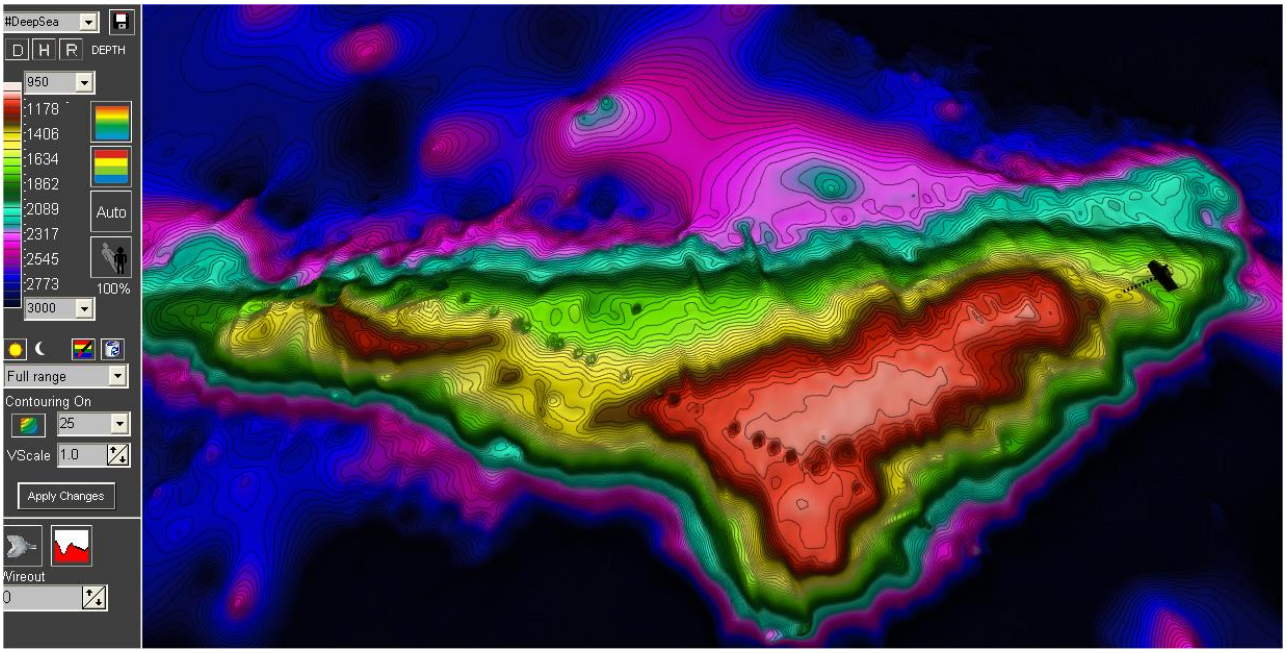
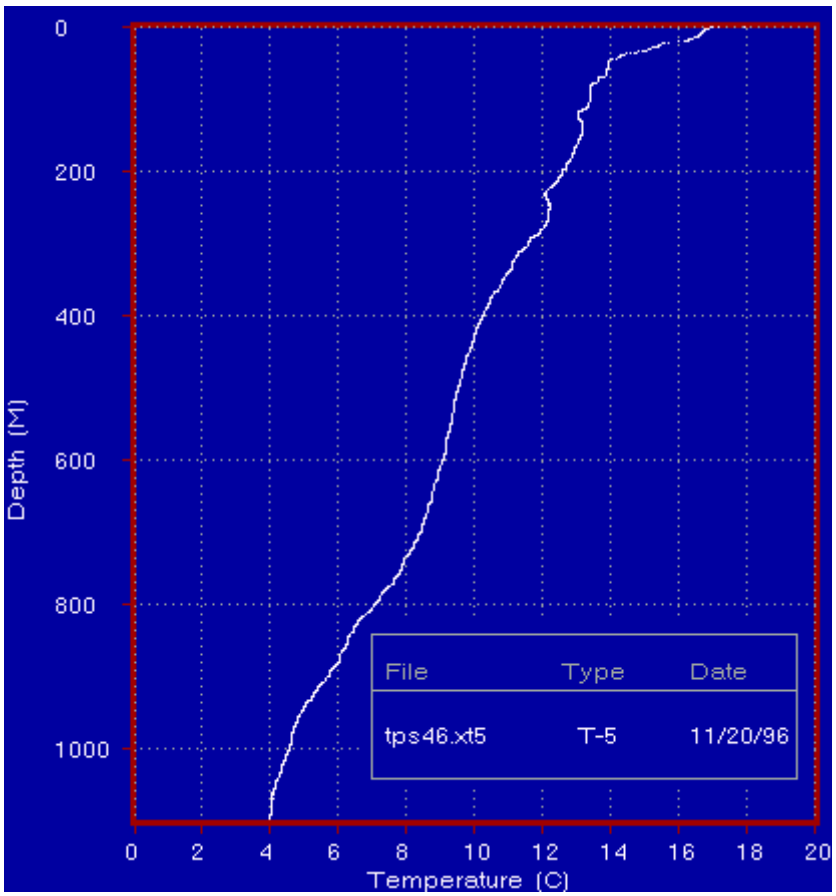


Figure 14

Temperature Profile in spring near the Broken Ridge Eastern Seamount

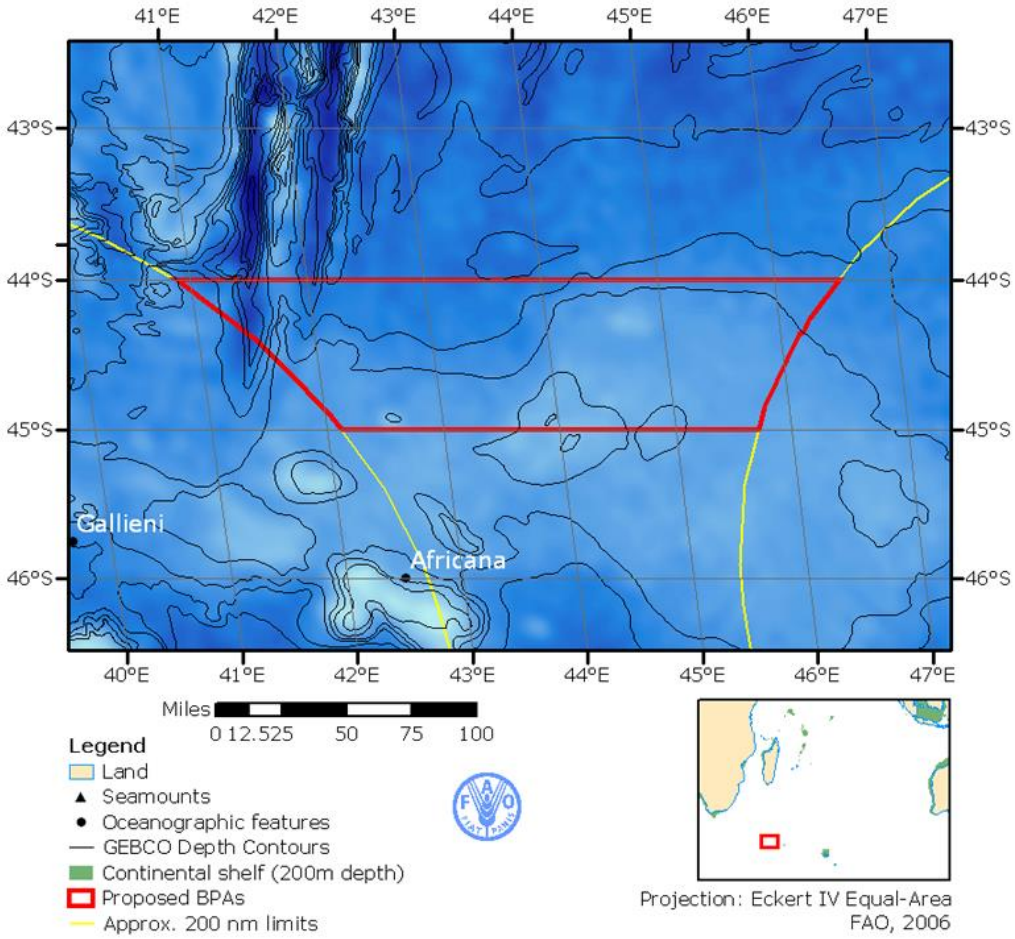


3.5 Southern Indian Ridge Benthic Protected Area

This is an area of seamounts (Figure 15) adjacent to the CCAMLR

region and is believed to be in pristine biological condition with little trawling in the past. The zone comprises the northern flank of the west-east orientated Del Caño Rise such that the southern limit, around 45º S is along the ridge of this rise. The southern boundary abuts the CCAMLR-managed zone to the south and lies between the South African EEZ around Prince Edward and Marion Islands to the west and the French EEZ surrounding Crozet Island to the east. The estimated points of contact with the EEZ areas are: 44 °S, 40.878 °E; 44 °S; 46.544 °E; 45 °S, 42.124 °E; 45 °S, 45.711°E.

Figure 15
Southern Indian Ridge Benthic Protected Area



Lombard *et al.* (2004) have prepared habitat maps for this area. The relevant zones are:

i.	shelf of mounts and rises	200 – 500m
ii.	upper slope	500 – 1800m
iii.	lower slope	1800 – 3500m

Lombard *et al.* show the BPA as an area as generally one of thick to very thick sediment.

Coordinates	Areas at depth

North-west		Depth (m)	Area (km^2)
Lat	Long	≤ 100	0
NW corner: 44 ° 00'S SW corner: 45 ° 00' S	40.878 ° E 42.124 ° E	101 – 300	0
		301 – 700	
South-east		701 – 1 000	
Lat	Long	1 001 – 1 500	
NE corner: 44 ° 00' S SE corner: 45 ° 00' S	46.544 ° E 45.711 ° E	>1500	
		Total	39 702.3

The Del Cano Rise has diverse and complex bathymetry and may be a major factor in affecting productivity of this region of the Southwest Indian Ocean. The 2000 m Rise lies between the plateaus that ascend to the Prince Edward to the west and the Crozet Island groups to the east and is just southeast of the Southwest Indian Ridge, a seafloor feature that includes a series of transform faults and associated fracture zones that may host hydrothermal vent communities.

The region lies directly between two fronts of the Antarctic Circumpolar Current, with the Sub-antarctic Front to the north and the Antarctic Polar Front to the south. The currents interact with the rugged underwater features and would be expected to form eddies that entrain nutrient rich water, especially over the Del Cano Rise. Upwelling of these eddies drives annual phytoplankton blooms attracting fish and squid, which in turn feed local populations of seabirds and mammals – including the grey-headed and wandering albatrosses. Indeed, these production zones over the Del Cano Rise region may enable globally significant population of seabirds and seals to breed at the neighbouring islands, including king, macaroni and southern rockhopper penguins, northern and southern giant petrels, white chinned petrels, wandering, sooty and light mantled albatross. Fur seals and elephant seals, historically hunted almost to extinction and only recently having recovered, also heavily use these feeding grounds.

Bottom water is reported to be cold, ≈ 1 °C. Lutjeharms (1985) reports that the Sub-Antarctic Front lies to the north of the Prince Edward Islands in this area and would run approximately along the southern boundary of this benthic protected area. The Southern Sub-Antarctic Front lies somewhat to the south of this front, around 50º S. (Ansorge & Lutjeharms 2002).

Lombard *et al.* (2006) imply that the area of the Del Caño Rise will be subject to the Antarctic Circumpolar Current flowing form west to east. Further, as this current crosses the Southwest Indian Ridge it creates meso-scale eddies. These authors also note that increased chlorophyll concentrations are periodically observed downstream of the region of the islands delineated by the 1800m isobath, i.e. the upper-lower slope division resulting in an area of high zooplankton biomass.

Fish Fauna

Gon & Heemstra (1990) provide distribution data for sevenfishes that can be expected to inhabit this area. (Table 4). It is reported that Patagonian toothfish (*Dissostichus eleginoides*) may be available to trawl in this benthic protected area.

Seabirds and Marine Mammals

Lombard *et al.* (2006) note that the southern region of this BPA, along the ridge of the Del Caño Rise provides a a movement and foraging axis for seabirds, specifically white-chinned petrels (*Procellaria aequinoctialis*), wandering albatrosses and sooty *Phoebetria fiscal* and note the importance of co-management of such areas. They also note the importance of nesting the proposed Prince Edward Island marine protected area within a broader management framework in the wider region. These authors also map the Del Caño ridge as a foraging area for southern elephant seals

Table 4
Fishes expected to be encountered in the Del Canso Rise Area

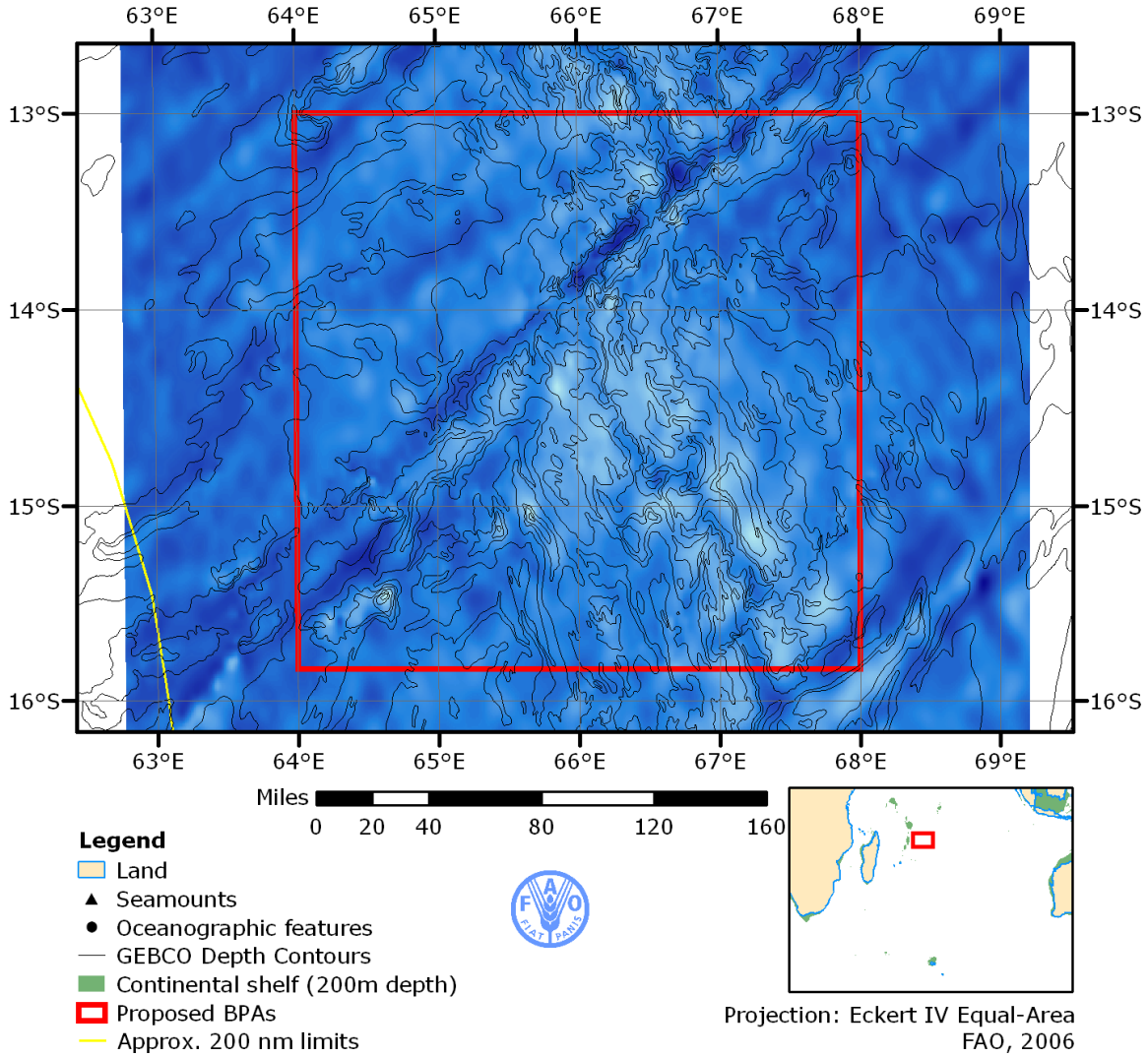
Family	Species	Habitat
Halosauridae	*Halosaurus macrochir*	Benthic
Synaphobranchidae	*Diastobranchis capensis*	Benthic
Muraenolepididae	*Muraenolepsis marmoratus*	Benthic
	Muraenolepsis orangiensis	Benthic
Moridae	*Guttigadus kongi*	Benthopelagic
Macrouidae	*Coryphaenoides carinatus*	Benthic
	Macrourus carinatus	Benthic
Congiopodidae	*Zanclorhnchus spinifer*	Benthic
Zoarcidae	*Lycodapus antarcticus*	Meso- to bathypelagic
Nototheniidae	*Dissostichus eleginoides*	Benthic to benthopelagic
	Gobionotothen marionensis	Benthic
	Lepidonotothen larseni	Benthic
	Lepidonotothen squamifrons	Benthic
	Notothenia coriiceps	Benthic
	Notothenia rossii	Benthic
	Paranotothenia magellanica	Benthic
Harpagiferidae	*Harpagifer georgianus*	
Channichthyidae	*Channichthys rhinoceratus*	
Achiropsettidae	*Mancopsetta milfordi*	

Conservation

Currently the Prince Edward and Crozet Islands are protected as a nature reserve to safeguard the millions of birds and mammals that breed there every year. The Prince Edward Islands alone support almost half of the global population of wandering albatross201. However, the waters around the islands, including the highly productive Del Cano Rise region and the waters overlying the Southwest Indian Ridge, provide essential feeding grounds for these animals. It is reported that there has been collaboration between South African and French governments, NGOs and scientists to protect the waters around the Prince Edward and Crozet Islands.

3.6 Mid-Indian Ridge

Figure 16
Bathymetry of the Mid-Indian Ridge Bio-region



Areas at Depth

Depth (m)	Area (km^2)
≤ 100	0
101- 300	0
301 – 700	0
701 – 1000	0
1001 – 1500	5.8
>1500	135,682.0
Total	135,687.8

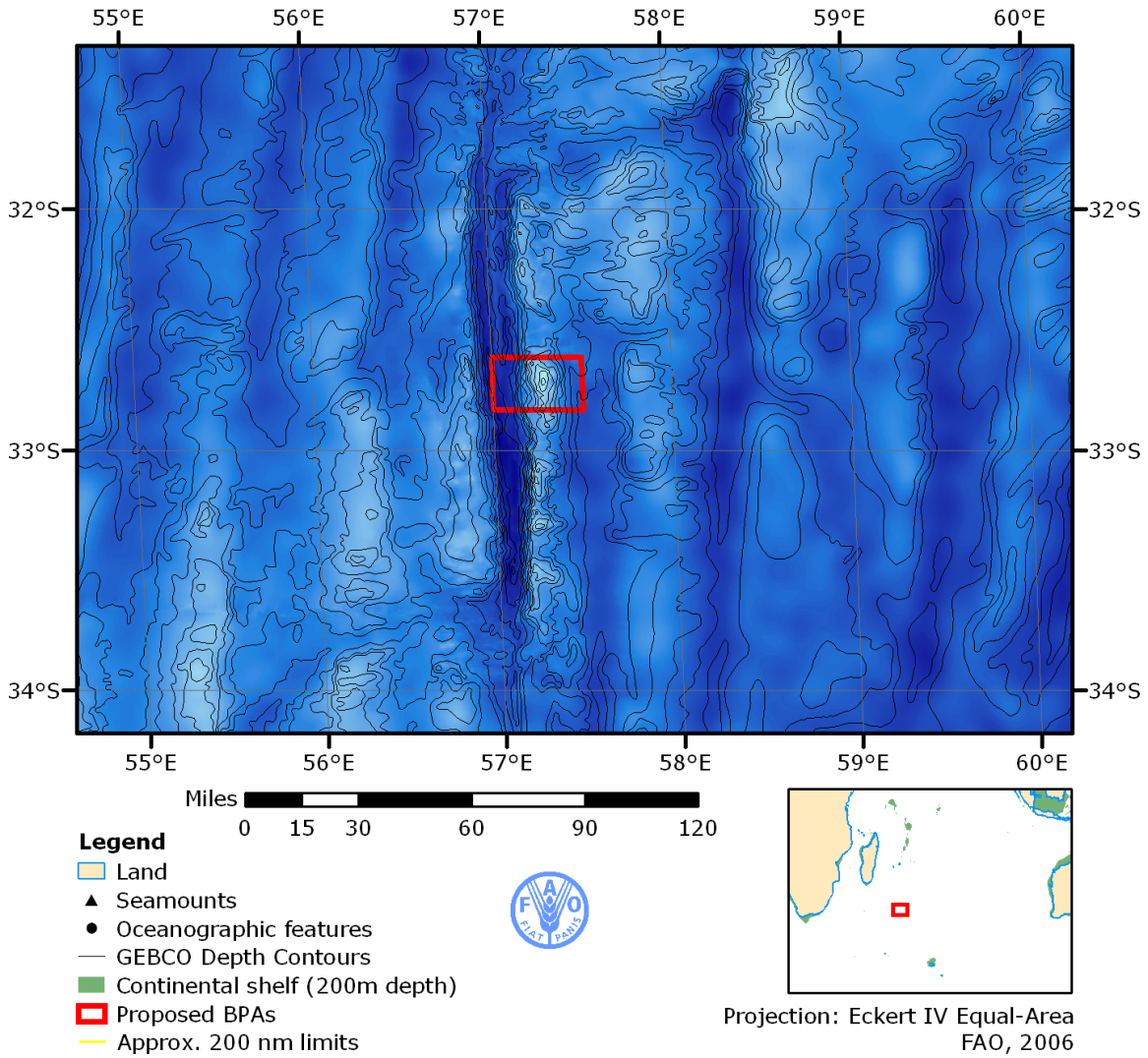
The mid-Indian Ridge lies to the northeast of Mauritius and has been described as 'Triple Junction' as the Australian, African and Indian tectonic plates meet in this area. The benthic protected area was defined here to provide a closed zone in the northern part of the 'southern' Indian Ocean. There are a number of seamounts on this ridge which provide trawling opportunities. This is an area of seamounts rising to 650

m in a tropical region. It is believed to be in pristine biological condition. Water conditions are described as 'warm'. Specific hills occur in the region of 15° 39' S, 64° 14'E.

It was considered that this large BPA would provide an appropriate geographical complement to the South African Prince Edward Island MPA, the Australian Heard and MacDonald Island World Heritage Property and possible future areas of conservation in the CCAMLR convention area.

3.7 Atlantis Bank

Figure 17
Bathymetry of Atlantic Bank Benthic Protected Area

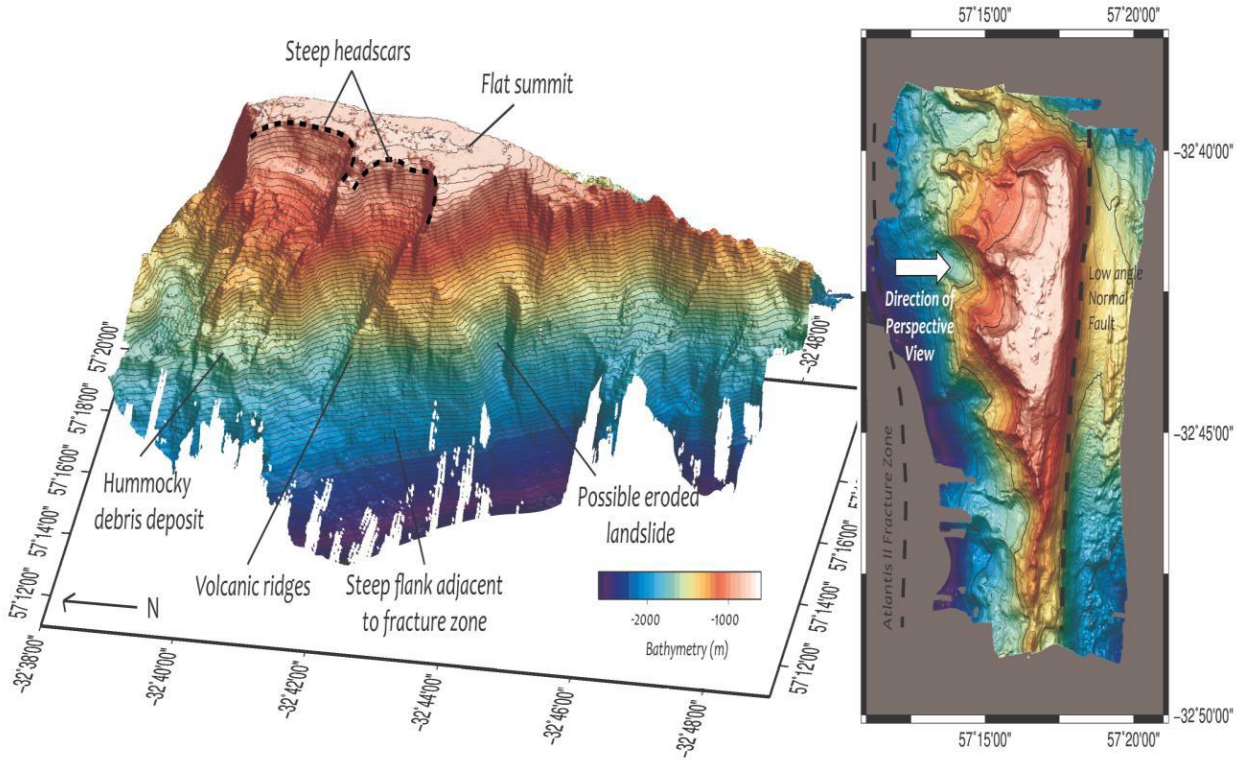


Areas at Depth

Depth (m)	Area (km^2)
≤ 100	0
101- 300	0
301 – 700	1.4
701 – 1000	36.0
1001 – 1500	81.5
>1500	8,574.6
Total	8,693.5

Atlantis seamount (Figure 18) is located within sub-tropical waters and is a fossil island, with two fossil beaches and lagoons and a submerged headland. Precipitous 'sea cliffs' occur on either side of the feature and the bottom has areas of fossilized corals. About two-thirds of the bank is covered by limestone, with ripple marks, identical to those in the sand at modern beaches. However, these were "frozen" or lithified as rock millions of years ago, as this island sank. There are little pot holes ground into gabbro rock that are still partially filled with pebbles and sand. Headlands and fossil sea-stacks (isolated eroded remnants of the island) occur across the upper most surface. This 'tectonic' island, which has an area of at least 25 km^2, has slowly subsided beneath the surface to a depth of 700m and is considered to be remarkable for its modern biological community.[4]

Figure 18
Map of Atlantis Seamount (Lily Muller, University of Oxford)



Geology

Atlantis Bank is of special scientific significance in that it is a site where work pivotal to understanding being the first tectonic guyot ever studied in research on the geology of ultraslow-spreading ridges. The seamount is an oceanic core complex flanking the Atlantis II fracture zone on the Southwest Indian Ridge and is a tectonic seamount and a guyot, the summit being largely flat. This guyot rises from 4000 to 700 m and is on the Atlantis Fracture Zone of the Southwest Indian Ridge. It has a unique paleontological record and has been the drilling site within the **Ocean Drilling Programme** (ODP) – see <*http://www-odp.tamu.edu/publications/prelim/176_PREL/176OBJT.HTML*>; it has been a major focus of research activity, including submersible dives and as such is the most intensively studied of the SIODFA benthic protected areas. Baines *et al.* (2003) report on the mechanisms that have given rise to the 120-km long ridge of which Atlantis Bank is part.

[4] see www.wshoi.edu/oceanus/viewArticle.do?id=2389&archives=true>

Fauna

The benthic habitats documented on the seamounts include a high diversity of species, especially corals and coral associates. This diversity is currently being analysed in various laboratories in the UK, France, Australia and the USA. Preliminary results for, for example, ophiuroids, indicate 50% of the species are new to science. Atlantis seamount is particularly notable for large stylasterid and Paragorgia colonies and also *Euplectella* spp (c.f.) colonised by a new species of *Spongiacaris* (Rogers & Taylor 2012).

Submersible dives have observed lobsters, crabs, sharks, sea fans, siphonophores, sponges, and other benthic species on this Bank. There have been a number of bottom trawl shots on this Bank, but with limited success because of the rugged nature of the bottom. There are many ancient seastacks, boulders, rock slides, and gravel beds that make it difficult to bottom trawl. Figure shows the bathymetry and structure of the Bank with locations that have been trawled marked with black lines.

Jamstec (2000) has reported the results of observations on near-bottom and/or mesopelagic communities in depths from 750 to 5365 m. Among other results he reported on the vertical stratification of crow shark (*Etmopterus pusillus*), Gilchrist's orange roughy (*Hoplostethus gilchristi*) and the big-eye dory (*Allocytus verrucosus*).

Fisheries

Atlantis Bank has been subject to fishing and there is evidence of gear effects upon the bottom in some areas. The seamount includes cliff habitats characterised by large anemones, large sponges, and octocorals. Large *Paragorgia* colonies are particularly notable. This is also the only seamount on which large concentrations of armourhead[5] were observed during two recent cruises and also during Russian fishing on the South West Indian Ridge.

This bank has provided a significant mid-water trawl fishery for alfonsino and reportedly, catches of 1000 t have been taken; small catches of orange roughy have also been taken. There are areas that can be fished on Atlantis using bottom trawls and about 60 tows are known to have been made on this feature. Despite this, most of the sea floor appears to have been untouched by bottom trawling; indeed roughy 'marks' have been observed on unfishable areas. The Association has decided to establish this bank as a benthic protected area because of the historical and scientific interest.

[5] Prof. A.D. Rogers, Department of Zoology, University of Oxford, U.K., in a submission proposing this area as an *Ecologically or Biologically Significant Marine Area* notes **"**The seamount hosts populations of pelagic armourhead (*Pseudopentaceros wheeleri*) which do not occur elsewhere on the South West Indian Ridge as far as is known." While the common name "pelagic armourhead", which is *Pentaceros richardsoni*, is used, the commonname for *P. wheeleri* is slender armourhead. Armourhead is harvested from a fairly wide range of areas in the Southern Indian Ocean by SIODFA vessel operators.

Figure 19

Swathe Mapping Illustration of Atlantis Bank

Swathe mapping shows areas of submerged lagoons (north-east). Areas that have been fished are shown in the boxes to the south of the are

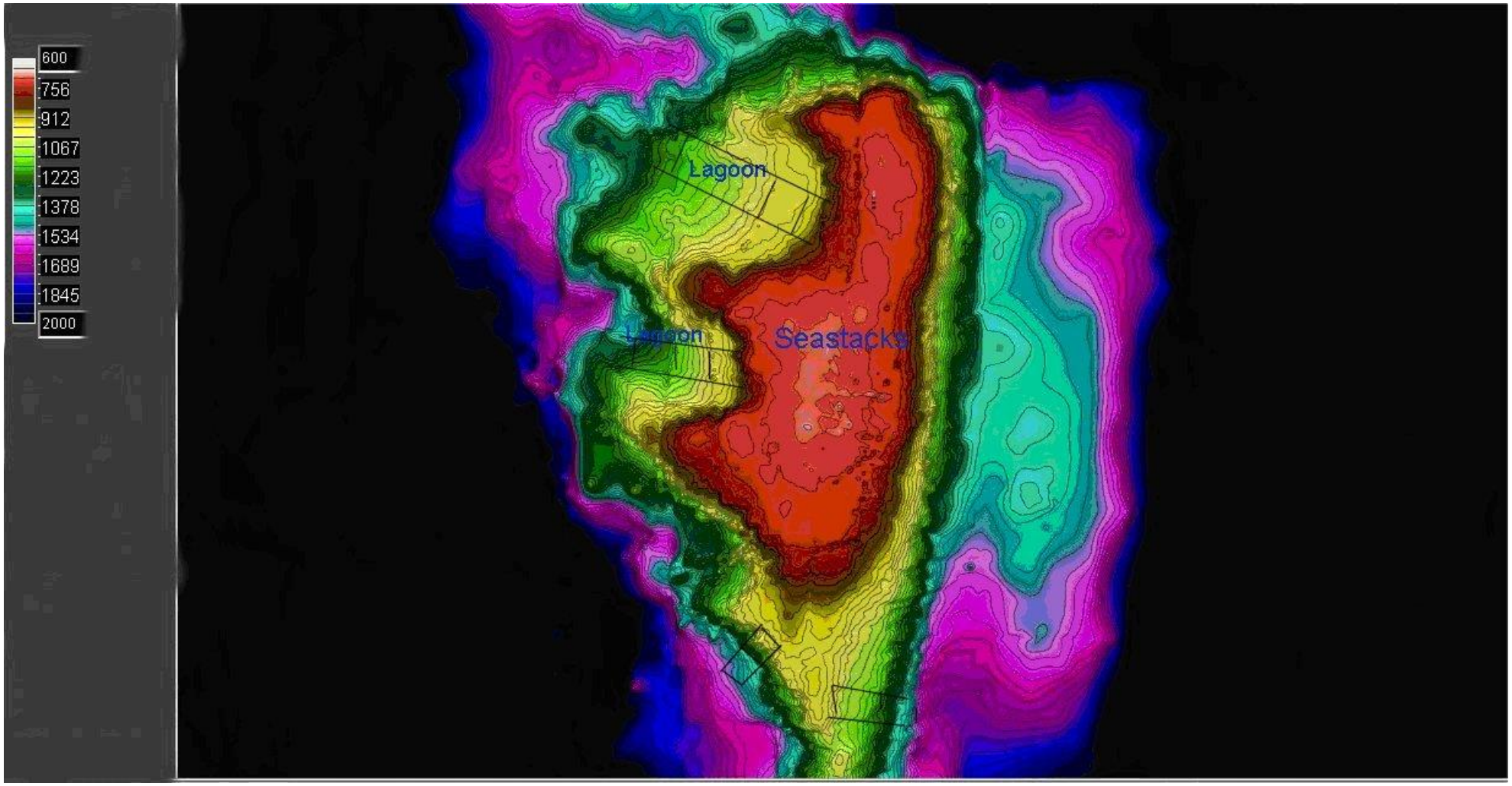


Figure 20
Second image of bathymetry of Atlantis Bank

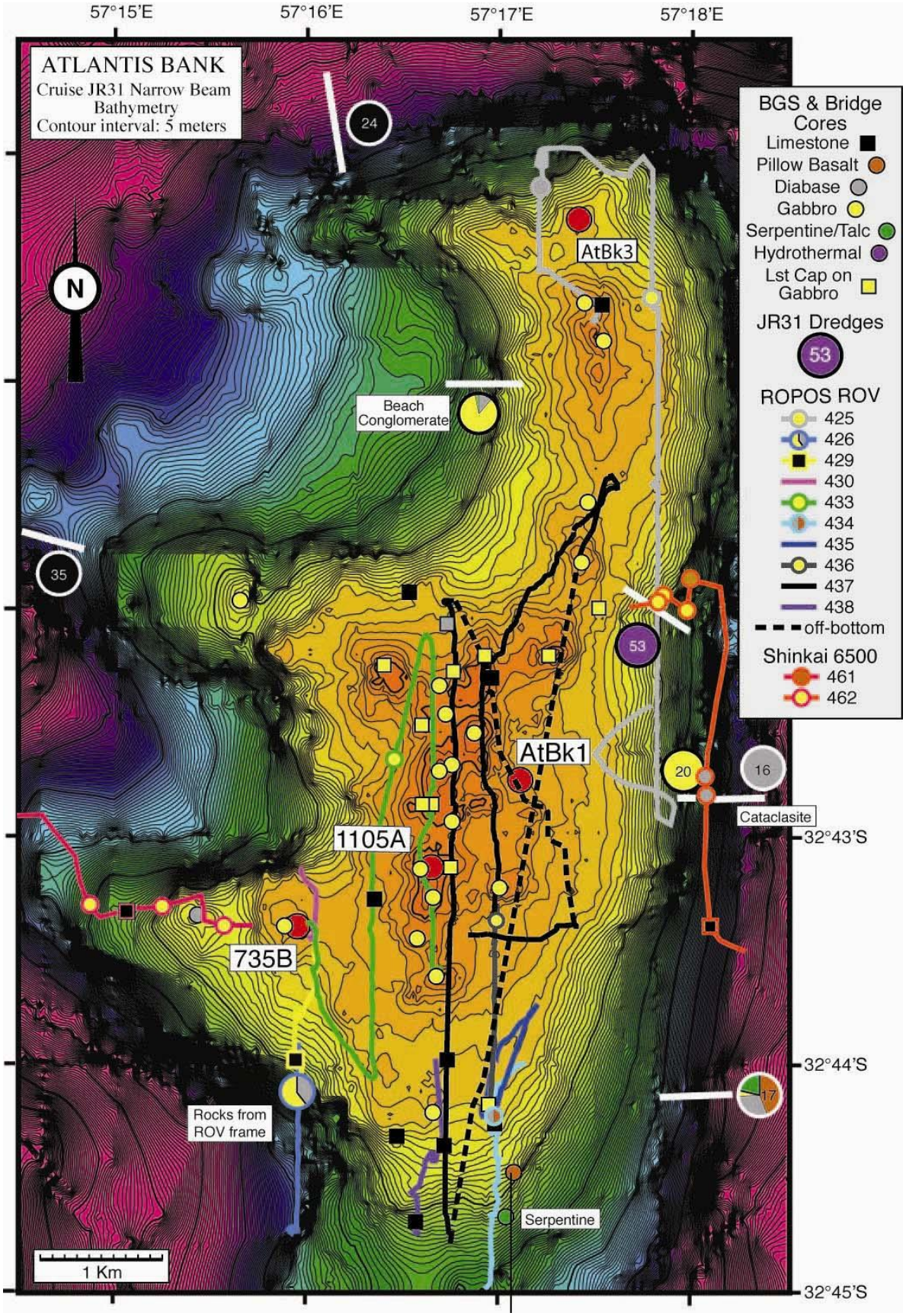
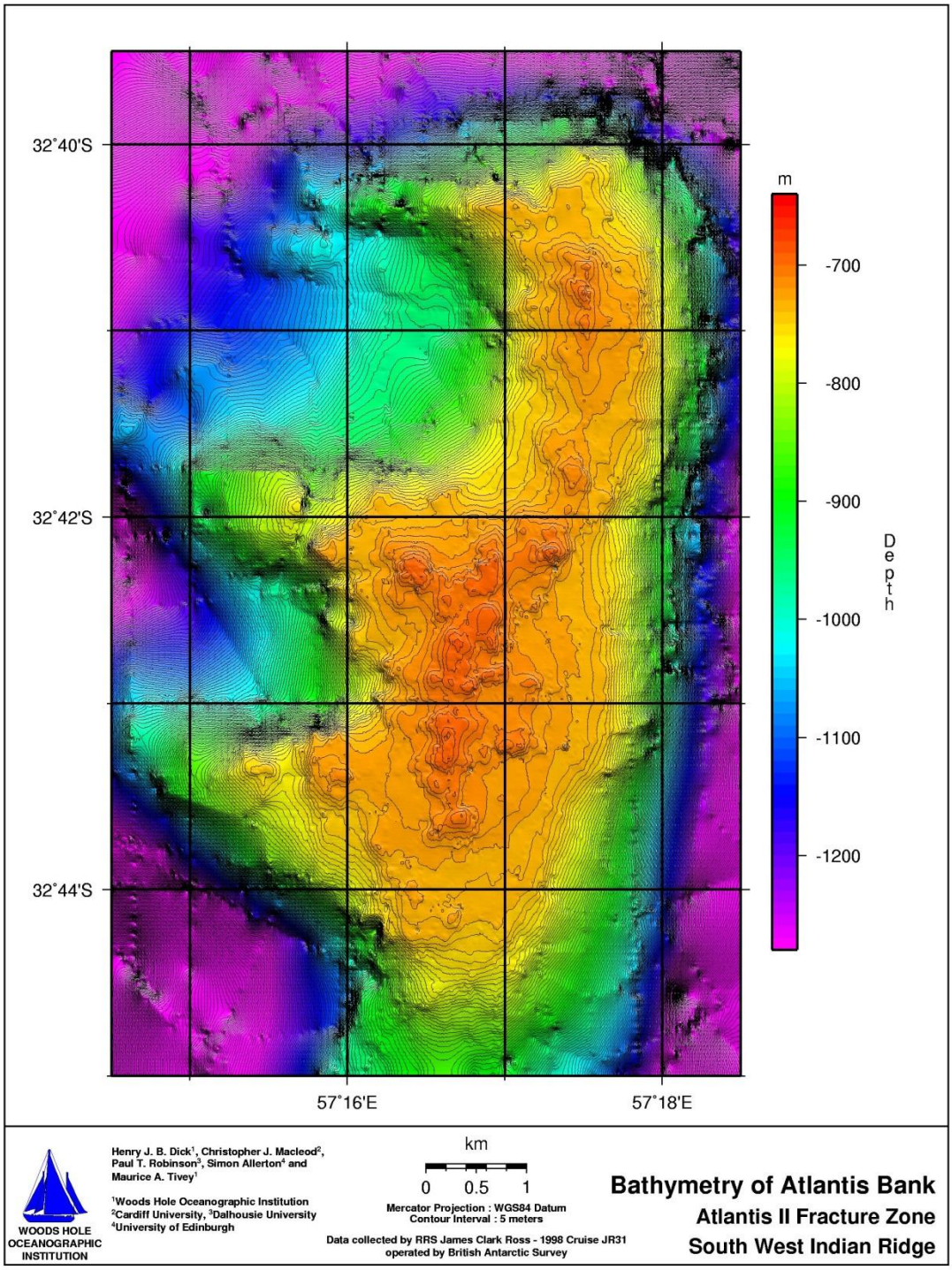


Figure 21
Bathymetry of Atlantis Bank



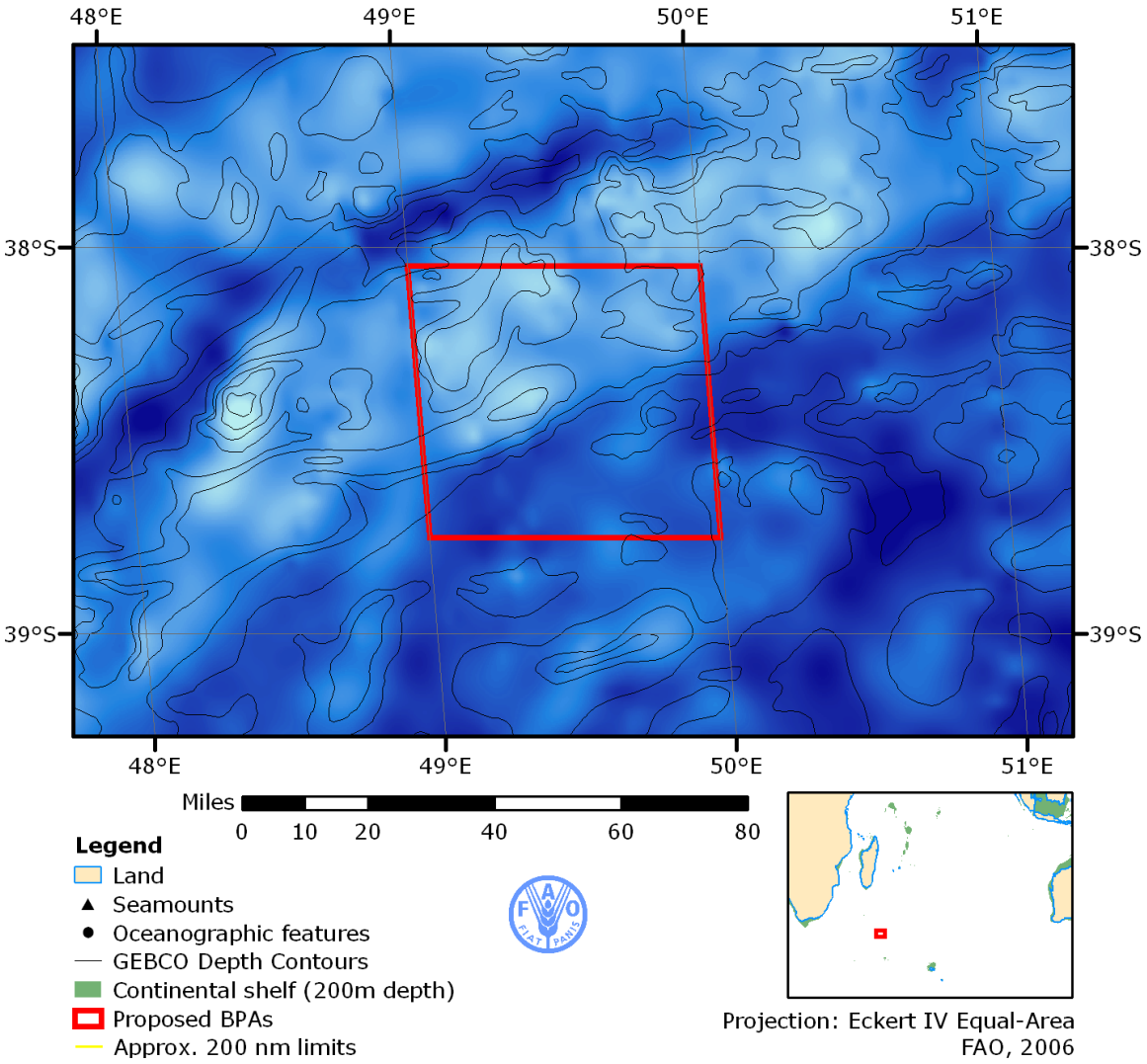
3.8 **Bridle Benthic Protected Area**

This region, in the central region of the Southwest Indian Ridge, contains a number of knolls and ridges between 900 and 1500 m in depth and is surrounded by a substantial area of sediment in the depth range 1500- 2500 m, shown as grey in the side-scan image (Figure 16). Most of these knolls have not been described before. There has been only limited trawl effort in the region with only

small catches of orange roughy and oreo dories. There are five historically significant spawning stocks of orange roughy within 50 miles of this BPA. The tops of this feature have been characterized by the populations of bluenose warehou (or Antarctic butterfish) (*Hyperoglyphe antaarctica*).

This area was heavily fished in the past with reports of 18 boats fishing the feature in one day and 36 boats fishing the feature of the fishing season in 2000. Commercial estimates of past catches from this feature are in the range of 5000 – 10 000 t with current biomass possibly 10% - 25% of the initial unfished biomass. This may be even lower (5%) on associated ridges in this region, e.g. *Saddle*, *Tonga* and *Electris*. The area developed a reputation for breaking trawl bridles, the wires that connect the trawl doors to the net, and hence the name. The bathymetry of the benthic protected area is shown in Figure 22.

Figure 22
General bathymetry of Bridle Benthic Protected Area region



Areas at Depth

Depth (m)	Area (km^2)
≤ 100	0
101- 300	0
301 – 700	0
701 – 1000	0.2
1001 – 1500	129.8
>1500	6,658.0
Total	6,788.0

The benthic substrate is reported characterized by many 'nasty' little ridges (and hence the name) and an abundance of brain corals, especially further south. There appears to be heavy sedimentation from surface productivity in many areas and the extent of sedimentation in the region highlights the productivity in the water column and potentially the benthos in this area.

Figure 23
Habitat assessment, Bridle Benthic Protected Area region

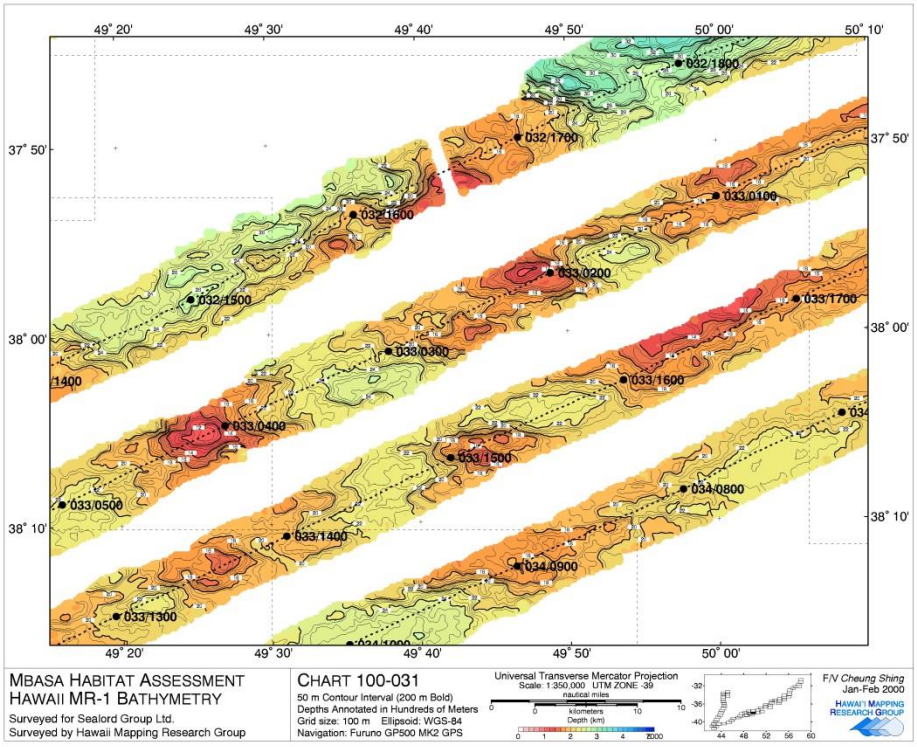


Figure 24
Habitat assessment bottom image, Bridle Benthic Protected Area region

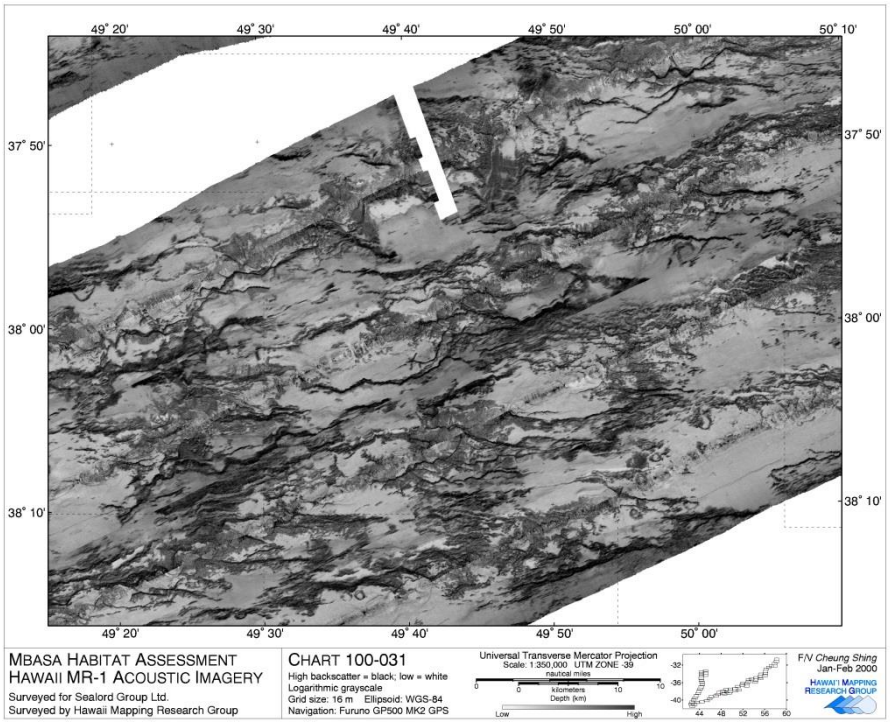
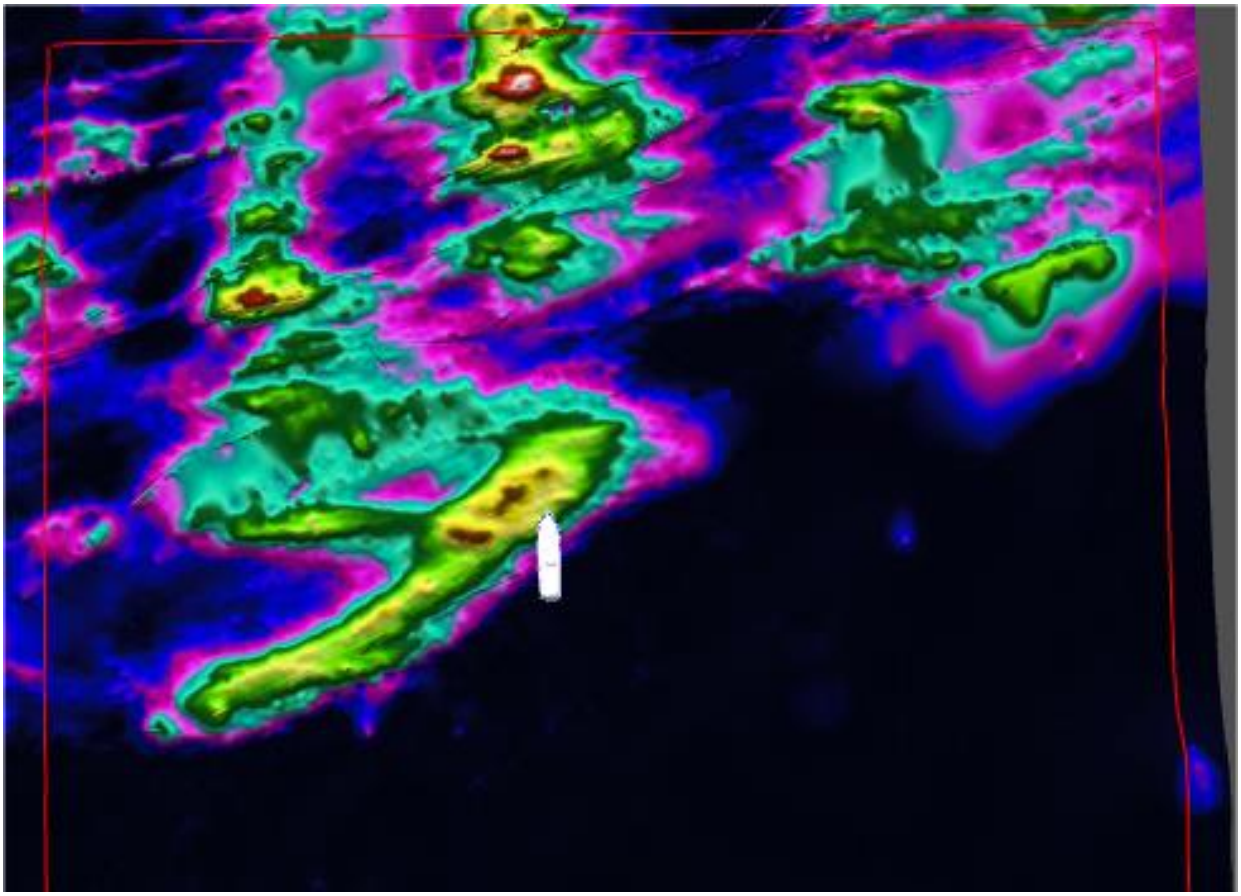


Figure 25
Bathymetry of the Bridle benthic protected area.



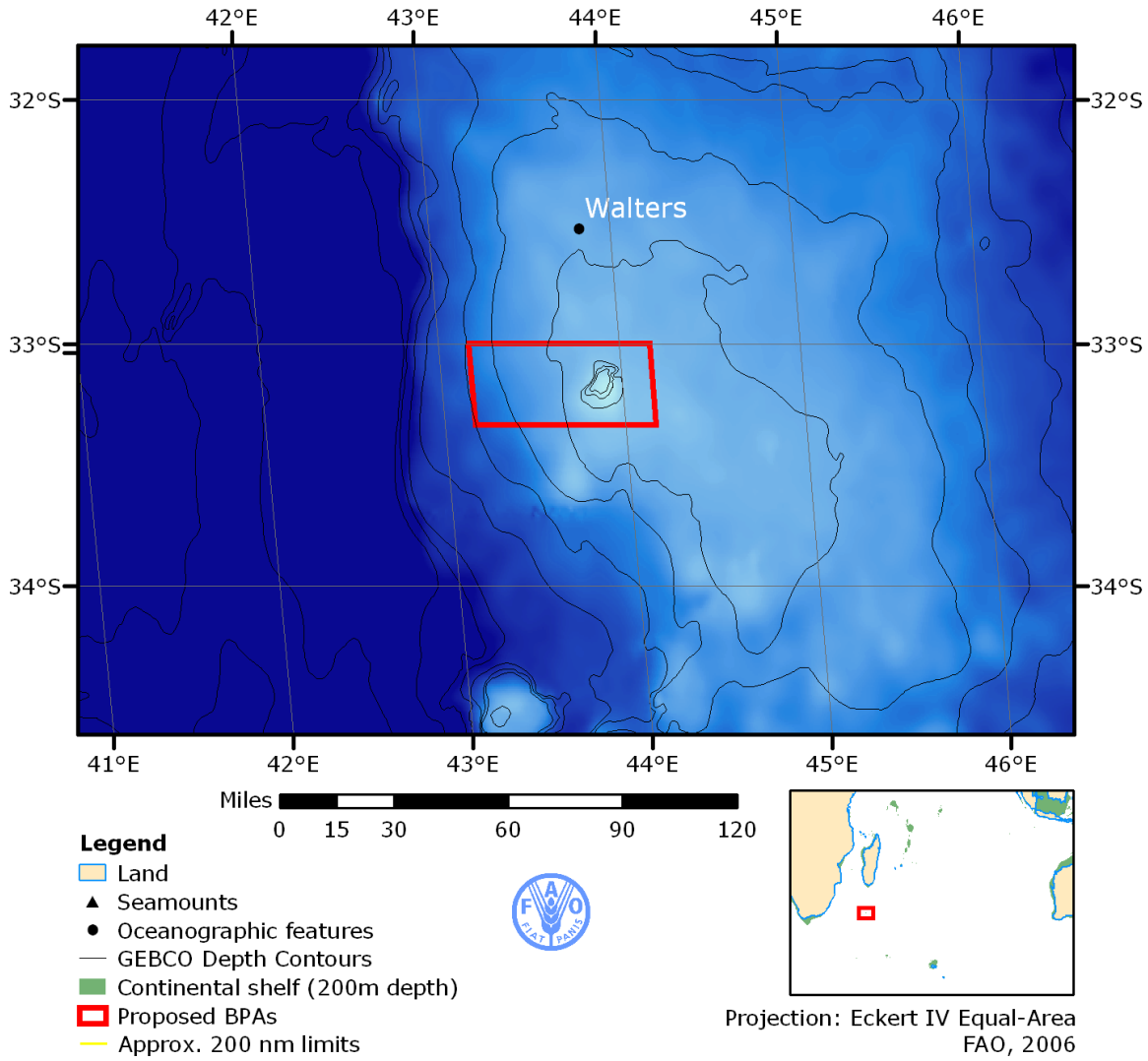
3.9 Walters Shoal Benthic Protected Area

This benthic protected area is located near the southern end of the Madagascar Ridge and consists of a spreading centre with seamounts and ridges with depths rising from 4500 m to 180 m. It contains extensive coral beds and is believed to be a near pristine area.

There has been some fishing on the western side of the BPA in the past. Other operators are reported to fish for lobster on this bank which shoals to 10 – 12 m areas of sandy bottom and can exhibit breaking waves. It is also reported to be an area of importance for whale sightings. Bottom fishing has been reported in the shallow areas in the past.

Some benthic and water-column faunal collections have been reported in this area, e.g. Parin, Nesis, Sagaidachny & Shcherbachev (1993) and Detinova& Sagaidachny (1994) based on work undertaken in the 1980s by three vessels that operated from Walters Shoal north to Socotra Is.; and that of Ledoyer (1994) and Geinrikh (1995).

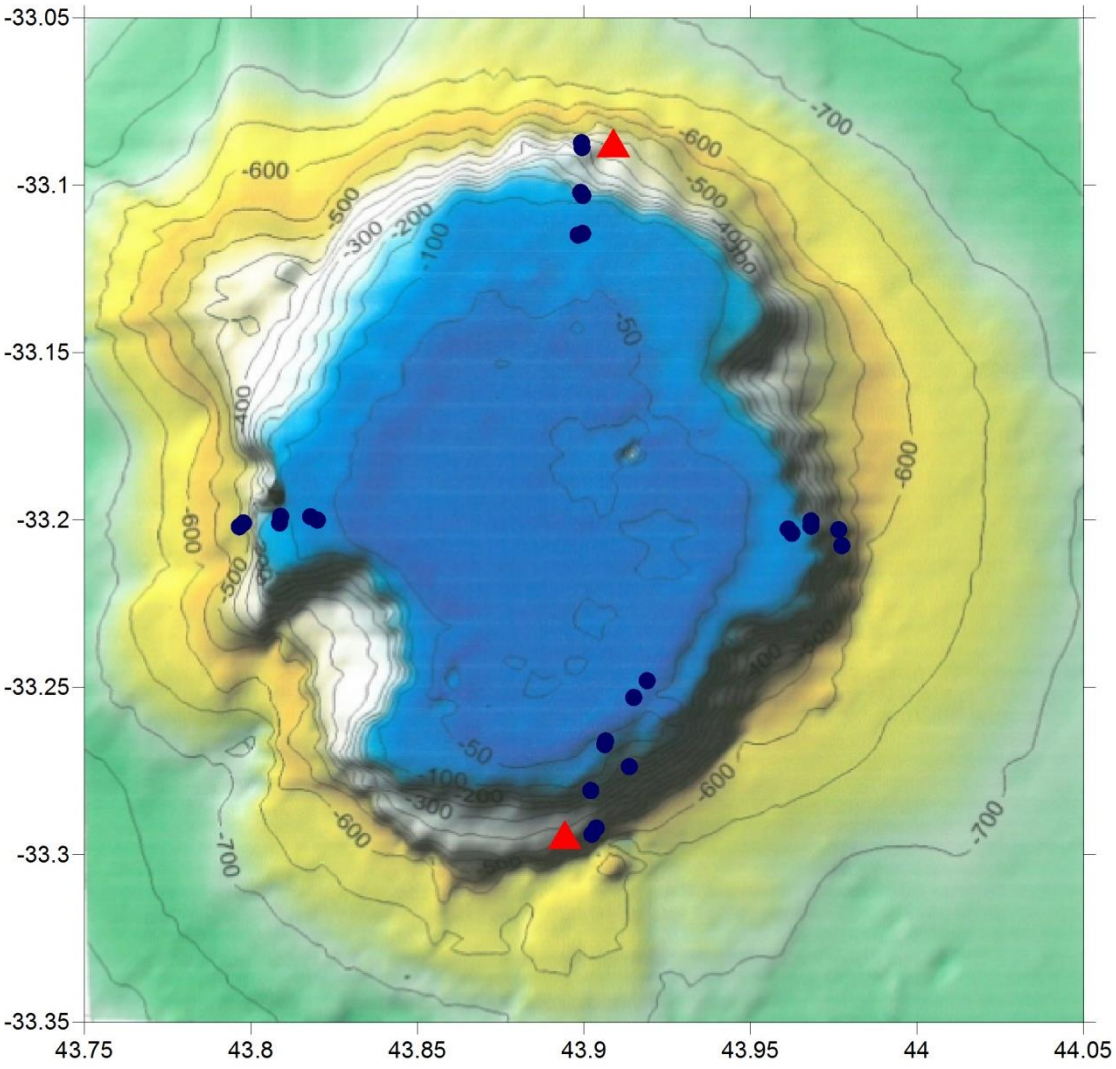
Figure 26
Bathymetry of general region of Walters Shoal



Areas at Depth

Depth (m)	Area (km^2)
≤ 100	87.6
101- 300	104.4
301 – 700	557.1
701 – 1000	1,979.9
1001 – 1500	672.9
>1500	41.5
Total	3,443.4

Figure 27
Bathymetry of Walters Shoal (Courtesy of IUCN)



This

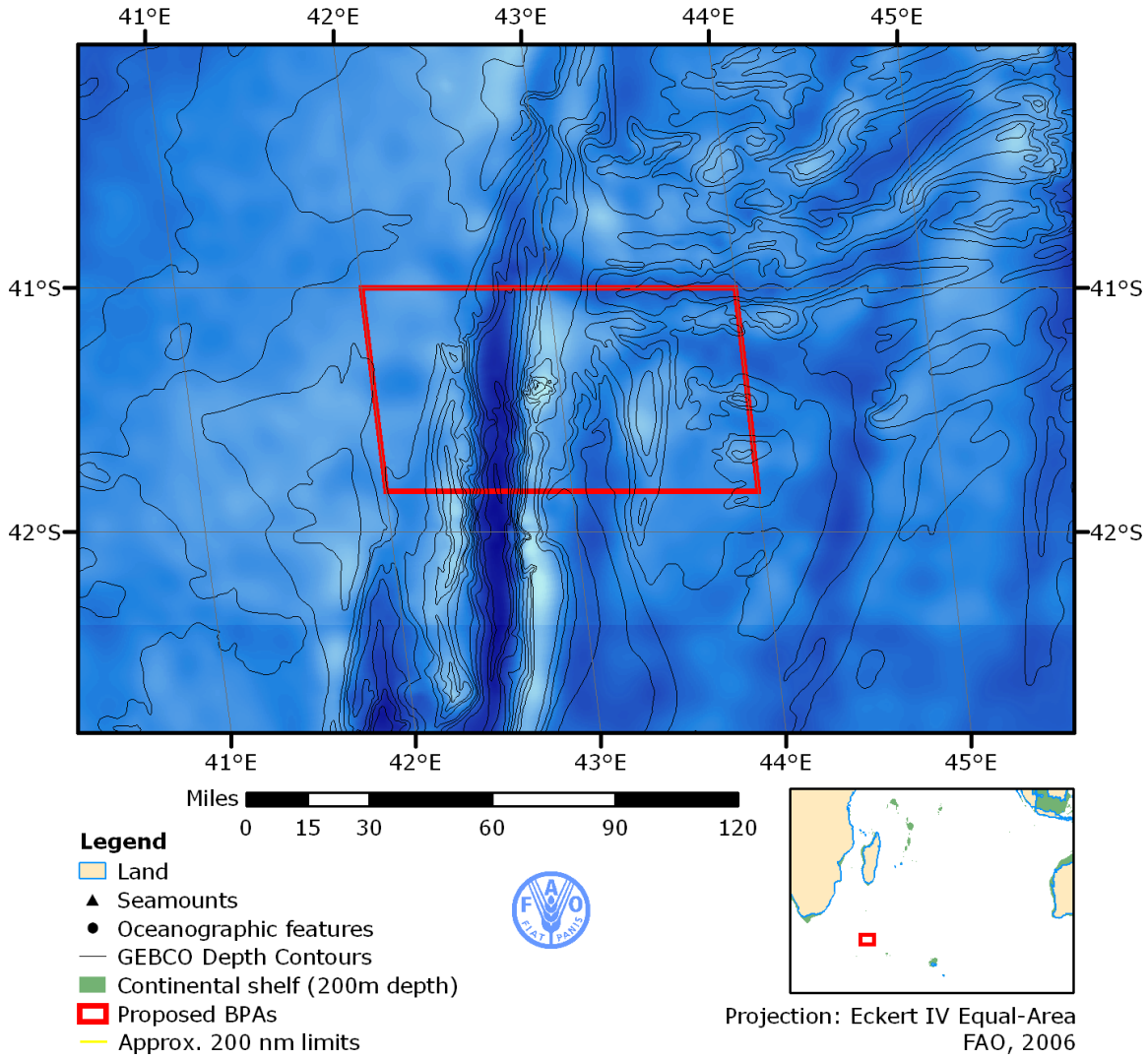
The IUCN is planning a research voyage to Walters Shoal in 2016 with the objective of improving the conservation of biodiversity and ecosystems. Research will be undertaken to inventory, characterize and describe benthic fauna and flora, and to extrapolate macro-ecological characteristics. In the pelagic environment the research will assess the hydrology and biogeochemistry of the Shoal and study the zooplankton communities. They will undertake video recording of pelagic fauna and male

seabirds and marine mammals observations. There will be an acoustic survey of micronekton and bathymetric survey by deploying moorings south of Madagascar.

3.10 Coral Benthic Protected Area

This benthic feature is characterizes by extensive presence of deepwater coral (and hence the name) along both sides of a spreading centre, which extends to 6000 m at its maximum.

Figure 28
General bathymetry of Coral Sea floor feature



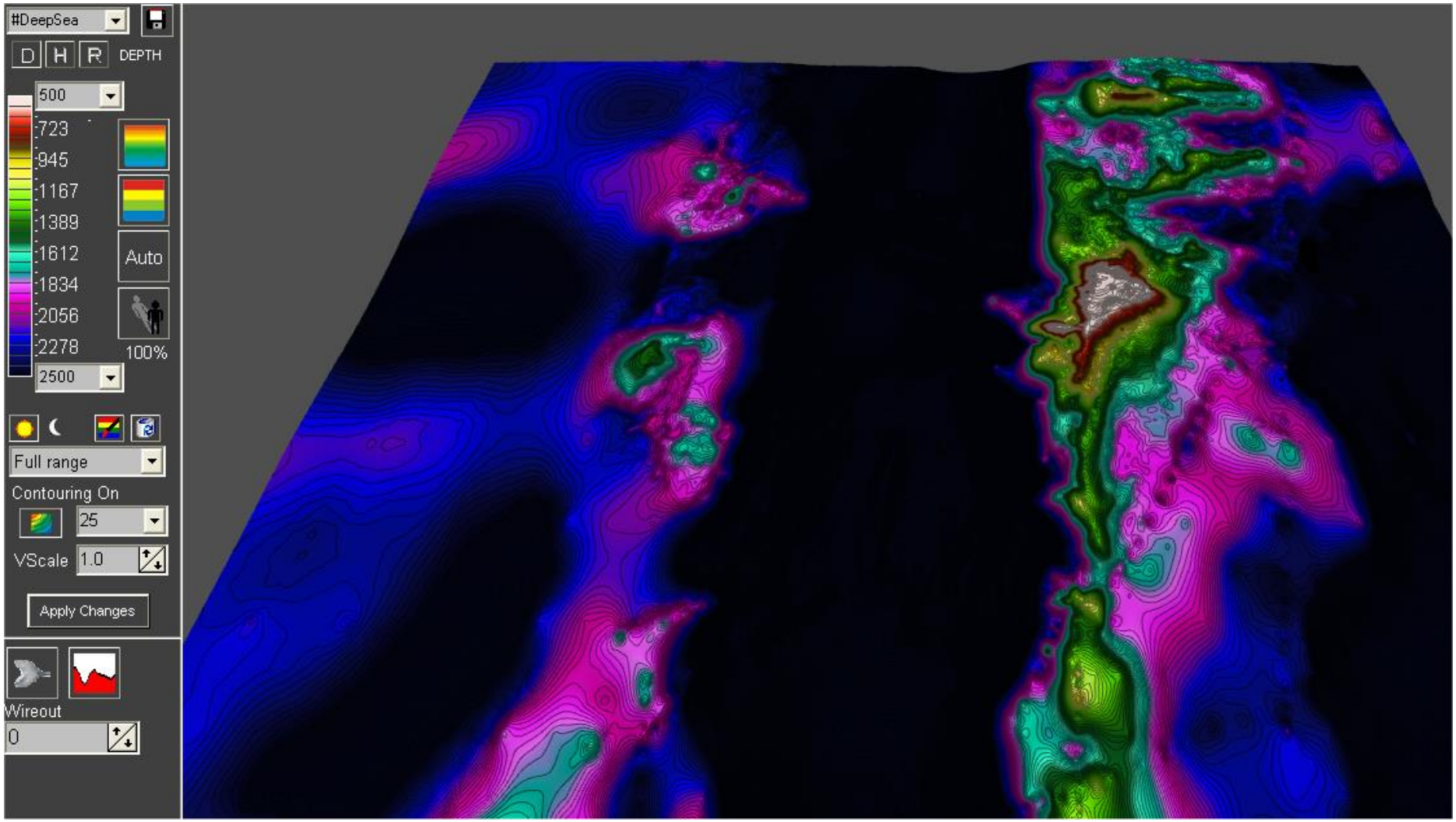
The seamount is located in sub-Antarctic waters. Observationis were made of this seamount using a remotely operated vehicle, *Kiel 6000*, on the *R.V. James Cook* cruise JC66 in November and December 2011. Depth range observed is from ~300 m to 1200 m. Intact cold-water corals were observed at ~1000 m, largely comprising dead coral framework with high densities of associated fauna including both sessile (corals, sponges) and mobile (squat lobsters, echinoderms) elements. In shallower waters, located on the upper flanks and summit of the seamount are coral gardens comprising Scleractinia and Octocorallia. The coral framework at 1000m largely comprised *Solenosmilia variabilis*. The identity of Scleractinia on seamount summit and upper flanks is uncertain but could possibly be *Lophelia pertusa*.

Seabirds
The pelagic ecosystem differs from those further north (north of the Sub-Antarctic Front) in having high concentrations of pelagic grenadiers. Seabirds are common over the seamount particularly wandering albatross and white-chinned petrels but also other species (Rogers *et al. 201?*).

Rogers (2014) notes that this is the only known example of a seamount with cold-water coral reef habitat lying in sub-Antarctic waters in the Southern Indian Ocean. The water mass overlying the seamount is Sub-Antarctic and hosts pelagic communities completely different to those further north (north of the Sub-Antarctic and Sub-Tropical Fronts). Pelagic species include Antarctic myctophids (*Electrona* spp) and also pelagic grenadiers. The benthic fauna varies depending on depth on the seamount and also the substratum slope and composition. Cold water coral reef is located on the eastern flanks of the seamount at 1,000m depth. The main framework building species appears to be *Solenosmilia variabilis*. The framework is largely comprised of dead coral but is largely intact with fissures and holes probably created through seismic activity. Live colonies of the framework-building species are also present. The coral reef hosts high densities of a range of other coral species, particularly zoanthids and octocorals. Glass sponges also occur at high density.

Mobile fauna include a variety of crustaceans, particularly squat lobsters, but also crinoids, sea stars and fish. Shark or ray eggs were also visible in areas attached to coral. Below the coral reef habitat lie dense sub-fossil beds of barnacle scutes. Other coral habitat is located on the upper slopes and summit of the seamount and comprises gardens and copses of coral including both octocorals and Scleractinia (possibly *Lophelia pertusa*). The western side of the seamount is much more rugged than the eastern side and in areas comprises vertical cliffs. These are colonised by dense communities of sponges, octocorals and brachiopods with mobile fauna including benthopelagic fish, sharks and also octopus.

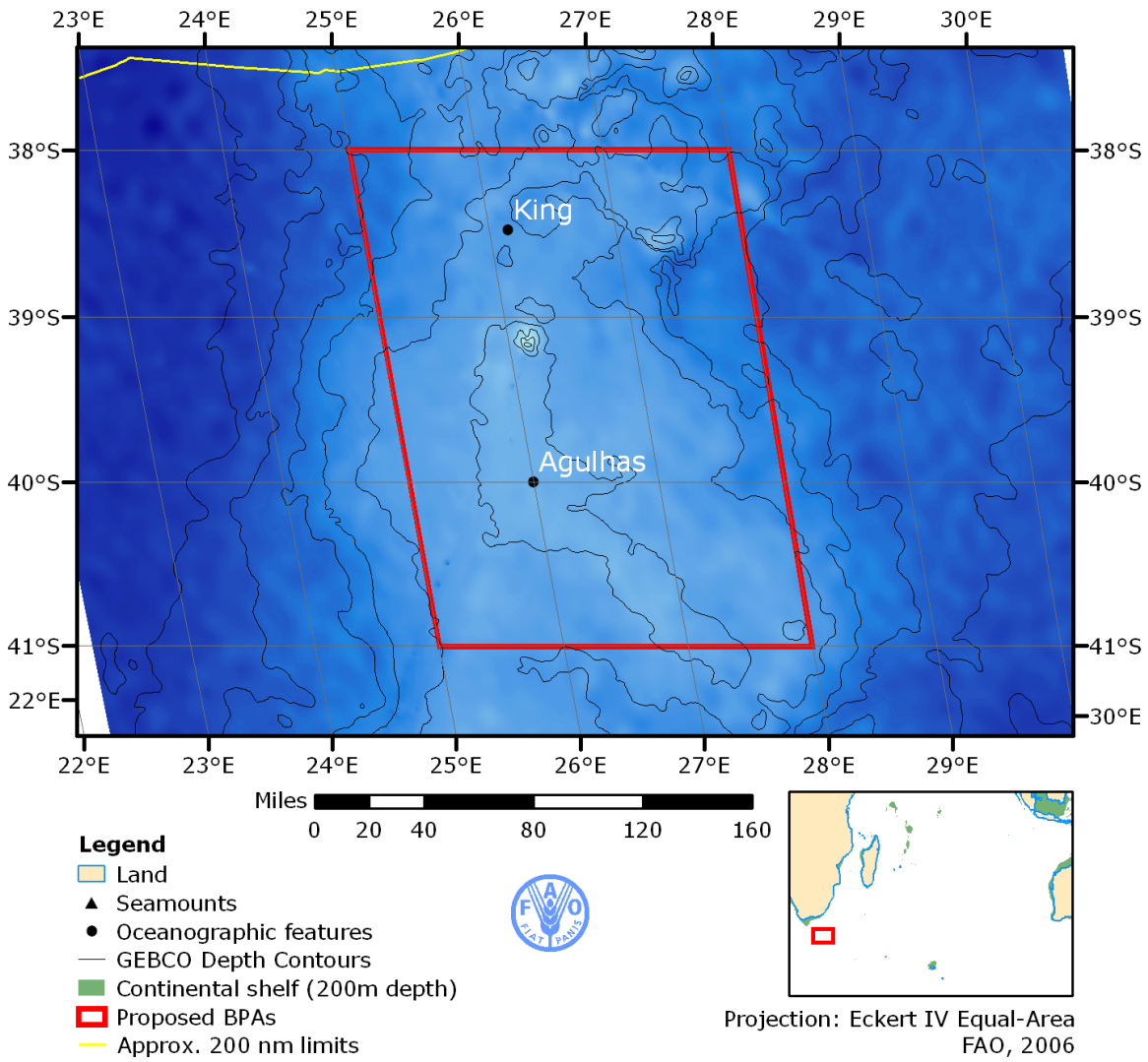
Figure 29
Swathe Sidescan Image Coral BPA



3.11 Agulhas Plateau

This is a region (Figure 30) of seamounts north of the proposed South African Antarctic MPA and is to the west of the Southern Indian Ocean Agreement convention area. This area has been the site of geophysical studies, e.g. that reported by Barrett (1977). Skippers report that there are abundant coral stands within this remote benthic protected area, which is several days steam distant from other fishing grounds to the east that are in the area.

Figure 30
Bathymetry of the Agulhas Plateau Region



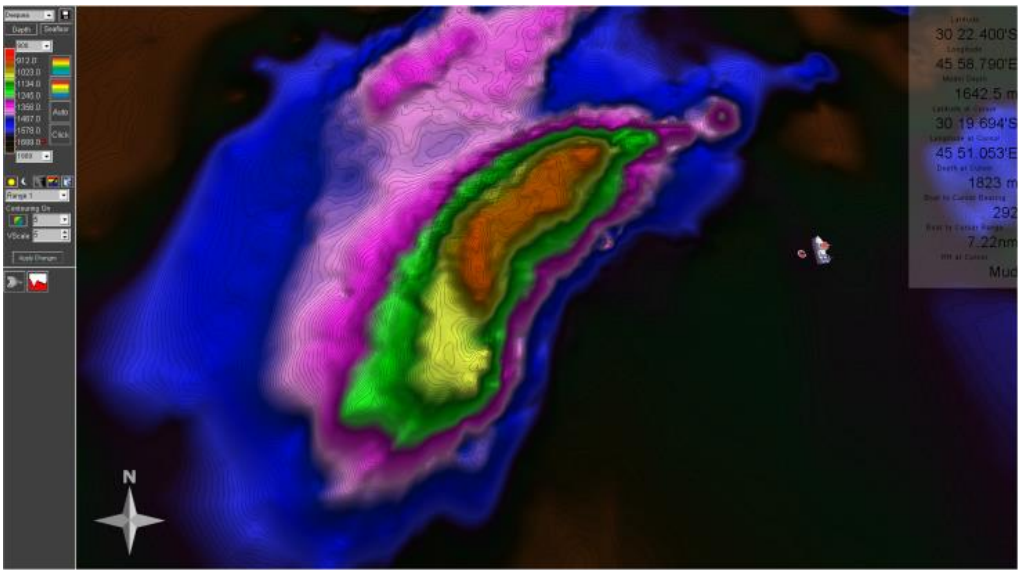
Areas at Depth

Depth (m)	Area (km^2)
≤ 100	0
101- 300	0
301 – 700	0
701 – 1000	8.0
1001 – 1500	53.6
>1500	85,766.2
Total	85,827.8

3.12 Banana Benthic Protected Area

Banana sea floor feature is an isolated elevation north of Walter's Bank. It has hard coral present, and is very rocky. Orange Roughy are present and in total 13 trawl shots have been attempted over the past decade, with most becoming fast. With new vessels arriving in the fishery it was thought important to indicate areas where they could have a significant adverse impact on vulnerable marine ecosystems: this is such a one. Its coordinates are 30° 20' S to 30° 30' S and 45° 40' E to 46° E.

Figure 31
Bathymetry of the Banada seafloor feature

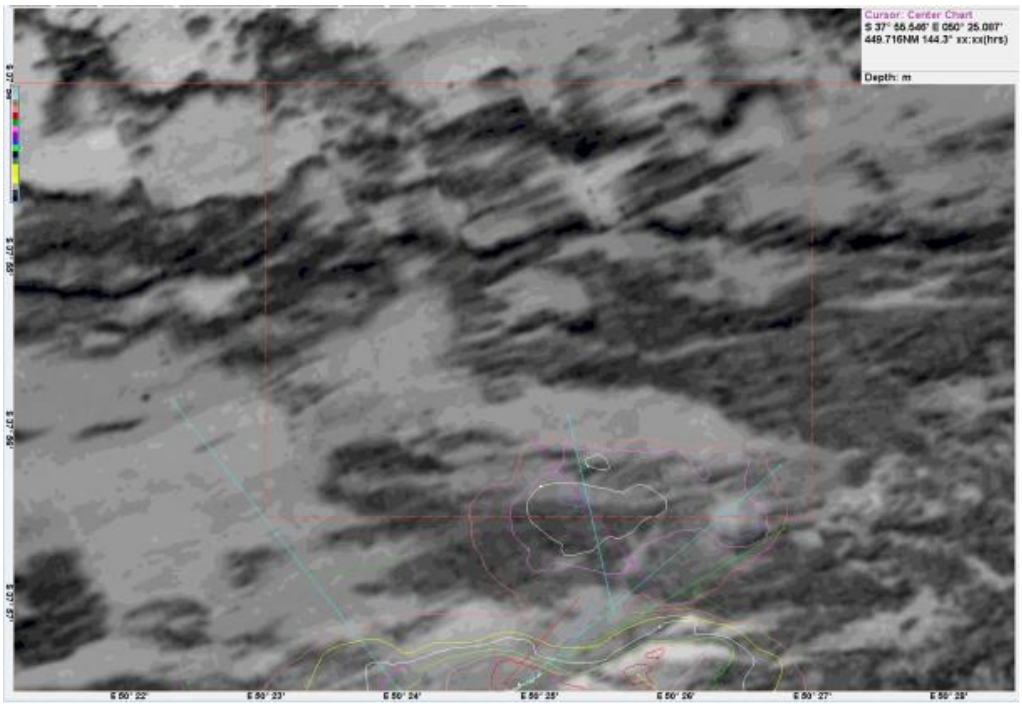


3.13 MOW Benthic Protected Area

This seamount (Figure XX) has cold-water corals and is located in the boundary zone between sub-tropical and sub-Antarctic waters. The MOW seamount has generally been an important area for fishing in the past and it is believed that this is a first instance where pristine areas of seafloor benthos that are on otherwise important fishing grounds are being protected. This fishing ground was one targeted by inexperienced vessels during the 'race for fish' which occurred in 2000-2001, but there has been limited fishing since then. Large parts of this feature are impossible to fish without loss of fishing gear, which thus provides additional protection to much of the habitat. We estimate less than 10% of the habitat has been fished on.

Rogers, in an unsuccessful submission to declare this area as an EBSA reports that benthic data have been collected using direct observation by a remotely operated vehicle, the Kiel 6000, and also video grab, on *R.V. James Cook* cruise JC66 during November and December 2011. The depth range observed was from ~900 m to 1200 m. An intact cold-water coral reef was found at ~1000 – 1200 m depth, largely consisting of dead coral framework with high densities of associated fauna including both sessile (corals, sponges) and mobile (squat lobsters, echinoderms) species. However, the distribution of these organisms was patchy. The main peak of the Middle of What sea floor feature contains degraded cold-water coral reef that Rogers believes has probably been heavily impacted by trawling. However, Parasitic Volcanic Cones on the northern flanks of the seamount are comprised of a largely-intact coral framework and the surrounding areas, which were notably rugged in topography, comprised extensive coral garden habitat. There are also areas on the south-western flank of the seamount that are also rugged and comprise coral garden habitat. Rogers reports that this locality can be associated with strong currents. Large numbers of lantern sharks (Etmopteridae) were observed on ROV dives around the northern Parasitic Cones

Figure 32
Low Resolution of the MOW Benthic Protected Area



MOW seafloor features is reported as the only known example of a seamount with cold-water coral reef habitat lying in sub-Antarctic waters in the Southern Indian Ocean, though this may reflect more imcomplete information. The water mass overlying the seamount is Sub-Antarctic and hosts pelagic communities completely different to those found further north (i.e. north of the Sub-Antarctic and Sub-Tropical Fronts). Pelagic species include Antarctic myctophids (*Electrona* spp) and also pelagic grenadiers (Macrouridae). The benthic fauna varies depending on depth on the seamount and also the substratum slope and composition. Cold water coral reef is located on the eastern flanks of the seamount at 1,000m depth. The main framework building species appears to be the Scleractinian coral *Solenosmilia variabilis*. The framework is largely comprised of dead coral but is largely intact with fissures and holes probably created through seismic activity.

Figure 33

Solenosmilia variablis

Live colonies of the framework-building species are also present. The coral reef hosts high densities of a range of other coral species, particularly zoanthids and octocorals. Glass sponges also occur at high density. Mobile fauna include a variety of crustaceans, particularly squat lobsters, but also crinoids, sea stars and fish. Shark or ray eggs were also visible in areas attached to coral. Below the coral reef habitat lie dense sub-fossil beds of barnacle scutes. Other coral habitat is located on the upper slopes and summit of the seamount and comprises gardens and copses of coral including both octocorals and Scleractinia (possibly *Lophelia pertusa*). The western side of the seamount is much more rugged than the eastern side and in areas comprises vertical cliffs. These are colonised by dense communities of sponges, octocorals and brachiopods with mobile fauna including benthopelagic fish, sharks and also octopus.

This seamount remains an important fishing ground and the part that has been declared a Benthic Protected Area is adjacent to the area where fishing in commonly undertaken.

4. STATUS OF SIODFA BENTHIC PROTECTED AREAS

It is a requirement of membership of SIODFA that Association members respect the obligation to not fish within any of the SIODFA BPAs. Indeed, two flag states of SIODFA members, Australia and the Cook Islands have made it a licence condition that the high seas fishing permits they issue do not permit fishing within the SIODFA BPA areas. Box 1 shows this condition in an example of the Cook Islands high seas fishing permit.

All vessels operated by members of SIODFA are required to maintain continuous vessel monitoring systems (VMS). These can provide verification of compliance with the SIODFA BPA's. However there are still rights of free navigation through the areas that are closed to trawling as some of them occur on normal transit paths to other fishing grounds, and steaming around them would incur substantial additional costs and waste fuel.

Despite the adherence of SIODFA vessels to observing the no-fishing condition of the BPAs, it has been reported by vessel skippers that a South Korean flagged vessel has been seen fishing in one of the Benthic Protected Areas.

5. DISCUSSION

The benthic protected areas jointly declared by SIODFA and the IUCN, the first of which was in July 2006, then again in October 2013 when a further two Benthic Protected areas were declared. We believe that this action, initiated by SIODFA, was the first time ever that an industry group had voluntarily taken action to closed high seas fishing grounds. In the first instance, this was six years before the RFMO came into force, and at the time of writing, the Scientific Committee has still to meet (March 2016), ten years after this unique conservation action.

We are aware that there was been certain disquiet in some environmental circles that it was not appropriate for an industry group to take the action we have. One common comment, albeit usually *sotto voce*, was that the industry group was closing areas of no fishing importance. This is not the case, though some BPAs were of lesser fisheries importance. No matter that, we believe that it makes much sense to close areas of either no fishing importance where there are rich benthic communities, or where the fisheries that are prosecuted are of relatively minor importance. Such a win-win out come seems to be imminently sensible.

We are aware that the knowledge/scientific basis on which the BPAs were based was inadequate, though this may often be the case. We still believe that there was careful reflection *of the information that existed*! I.e. an exemplary example of 'using the best scientific information available' and consulting with relevant fishermen, i.e. those with the greatest knowledge and experience of the area. Lack of perfect knowledge was no reason not to act as there is always scope to expand the knowledge base, not least considering the proscription of the Precautionary Principle/Approach. Since the SIODFA conservation initiative ten years ago, there have been two research cruises to the Southern Indian Ocean.[6] The first of these cruises did not evidently contribute significantly to the knowledge base relating to sensitive benthic communities in the SIO while the second of these cruises confirmed the importance of Coral BPAs that had been declared ("The benthic habitats documented on the seamounts include a very high diversity of species, especially corals and coral associates"). This voyage also identified fragile benthic communities on an unfished part of a commonly fished sea floor feature which the cruise chief scientist later unsuccessfully attempted to have

[6] *Dr. Fritjof Nansen Southern Indian Ocean Seamounts (IUCN/ UNDP/ ASCLME/ NERC /EAF Nansen Project 2009 Cruise 410) 12th November – 19th December, 2009* and the R.V. *James Cook* 066 Southwest Indian Ocean Seamounts expedition – November 7th – December 21st, 2011.

Box 1
Amendment to Cook Islands High Seas Fishing Licence

Ministry of Marine Resources

Special Conditions

These Special Conditions are attached in accordance with Part 4 - Licensing of the Cook Islands Marine Resources Act 2005

Whereby:
Section 38. Conditions of licences –
(1) Every licence issued by the Minister or the Secretary shall be in the prescribed form, and may be subject to -
(a) such conditions as may be prescribed;
(b) such general conditions as may be specified under subsection (2); and
(c) such special conditions as may be specified under subsection (3).
(2) The Minister may, by notice published in the Gazette, specify general conditions additional to those to which any licence shall be subject.
(3) Subject to this Act, the Minister or Secretary may attach to any licence such special conditions as may be required for the proper management of fisheries, including conditions relating to –
(a) the type and method of fishing or related activity authorised;
(b) the areas within which such fishing or related activities are authorised; and
(c) the target species and amount of fish authorised to be taken, including any restriction on by-catch; and
(d) the times within which such fishing or related activities are authorised; and
(e) restrictions relating to the numbers, types, sizes, specifications or operation of fishing related equipment and/or vessels
(4) The Minister or Secretary as appropriate, may from time to time, where it is expedient for the proper management of fisheries, vary any special conditions attached to any licence or authorisation.
(5) Where the Minister or the Secretary varies any special conditions attached to any licence, the Minister or the Secretary shall notify the licence holder of the variation as soon as practicable.

The Ministry of Marine Resources hereby attaches the following Special Conditions:

Benthic Protected Areas (BPAs)

1) The Ministry of Marine Resources recognizes the Benthic Protected Areas (BPAs) as established by the South Indian Ocean Deepsea Fishers Association (SIODFA). Such BPAs are more particularly described in Table 1. attached to these Special Conditions.
2) The Ministry of Marine Resources hereby requires that the licensed vessel shall ensure that it does not undertake any fishing activities in any identified BPA in the Southern Indian Ocean area.
3) Consistent with the relevant conditions of the license and any related access agreement, the vessel operator shall provide the Ministry of Marine Resources with Entry and Exit reports in the prescribed form if/when transiting through a BPA.
4) The vessel shall ensure all fishing gear is correctly stowed when transiting a BPA.

declared an Environmental and Biological Sensitive Area (EBSA) through the Convention on Biological Diversity Process. Since then, SIODFA has declared that area of fragile benthos the MOW benthic protected area. Since then, SIODFA has declared that area of fragile benthos the MOW benthic protected area.

We believe the experience on the MOW seafloor feature to be of particular merit. Here, a benthic protected area was declared with good confidence that deep sea fishing vessels, through use of highly accurate navigational systems, could safely fish those areas of a seafloor feature where the fragile benthos existed. In this manner, fishing could continue *and* the fragile benthos is protected – an ideal solution.

SIODFA believes that it would be inexplicable and an enormously wasted opportunity not to build on their initiatives of establishing the SIODFA benthic protected areas. We trust that this past investment in conservation of fragile benthos, whose planning predated the well-known UNGA resolution 61/105 and which was taken before the existence of a regional management authority will be formally incorporated into a solid base for protection and conservation of fragile benthic populations in the Southern Indian Ocean.

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