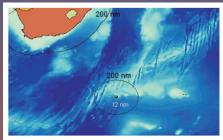
TOWARDS THE DEVELOPMENT OF A MARINE PROTECTED AREA AT THE PRINCE EDWARD ISLANDS













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Towards the Development of a Marine Protected Area at the Prince Edward Islands

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Executive Summary

In June 2004, the South African Minister of Environmental Affairs and Tourism, Minister van Schalkwyk, announced South Africa's intention to declare one of the largest Marine Protected Areas (MPAs) in the world around its sub-Antarctic Prince Edward Islands. This catalyzed a partnership between WWF and the Department of Environmental Affairs and Tourism (DEAT) to guide the implementation of this commitment. This report is a compilation of the work undertaken by this partnership over three years.

Firstly, in order to ensure that the Minister's commitment was implemented in a way which maximized its ecological significance and minimized its impact on the legal fishery operations, WWF and DEAT commissioned a systematic marine conservation plan for the Exclusive Economic Zone (EEZ) surrounding the Prince Edward Islands (Part 1). After collating all available distributional data on species, benthic habitats, ecosystem processes and fishing activities, and discussions with all stakeholders, C-Plan software was used to delineate a proposed MPA, with three management zones. Compromises between conservation target achievement and the commercial fishery are apparent in the final reserve design. It was recognised that this was the best delineation that could be made on the information available at the time and that the proposed MPA boundaries could change over time as new data become available and as impacts of climate change become more evident.

Subsequent to this report, further analyses were undertaken on new fisheries data to quantify the potential impact that the proposed MPA would have on the legal fishery operating around the islands. The outputs of these analyses (Part 2) were the subject of further negotiations with the industry. In these discussions it was clear that the legal fishery played an important surveillance role around the islands and that compromising the economic viability of the legal fishery could compromise the objectives of the MPA. These discussions were significant in agreeing on a set of recommended proposed regulations for each of the management zones.

An analysis of the legal context for such a MPA was also undertaken (Part 3). This analysis revealed that the declaration of this MPA was consistent with South Africa's commitments and obligations under several international legal agreements. Whilst the Prince Edward Islands themselves are declared as a Special Nature Reserve under the National Environmental Management: Protected Areas Act of 2003 (NEMPA), it is recommended that the entire Prince Edward Islands MPA is designated under the section 43 of the Marine Living Resources Act of 1998.

Further it is noted that national and international legal mechanisms exist for regulating marine traffic, which would greatly assist in the prosecution of illegal vessels in the area, by obviating the difficult challenge of proving that the errant vessel was in fact fishing at the time of detection. It was also recommended that South Africa, speedily conclude its bilateral compliance agreements with both France and Australia.

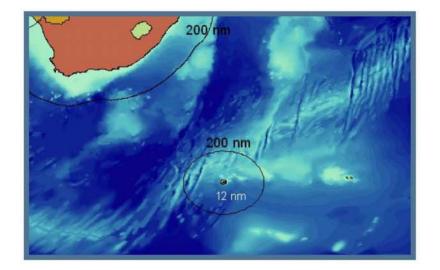
Subsequent to the development of the above reports it was made clear to WWF that the Minister would not move ahead with the declaration until a management plan was developed for the MPA. WWF therefore commissioned the development of a draft management plan which is found in Part 4. The draft management plan includes biophysical, governance and compliance, and socio-economic strategic components and puts forward an integrated compliance framework for this MPA. Importantly, the draft management plan points out that the enforcement of an MPA around the Prince Edward Islands would not require the commitment of additional resources, over and above those already required to fulfill South Africa's obligations to manage and protect the marine resources of this area as required by the Law of the Sea Convention (Articles 192 and 194). In fact the MPA is merely a spatial delineation that should facilitate more efficient protection of the most important biodiversity assets of the area.

Finally, after consideration of the outputs of the above processes and following five separate stakeholder consultation processes, a set of recommendations were put forward (Part 5) for the declaration of the Prince Edward Islands, in October 2007.

The marine biodiversity of the Prince Edward Islands is globally important and worthy of protection. So much so, that South Africa is in process of nominating the Islands as a World Heritage Site which would include a marine component. Unfortunately, the protection of these resources in the past has been poor, with the area dogged by rampant illegal poaching of Patagonian toothfish during the mid to late 1990's. Four years after the Ministers' announcement of his intentions, it is hoped that the work presented in this publication will finally culminate in the declaration of this important MPA.

PART 1

CONSERVING PATTERN AND PROCESS IN THE SOUTHERN OCEAN: DESIGNING A MARINE PROTECTED AREA FOR THE PRINCE EDWARD ISLANDS



CONSERVING PATTERN AND PROCESS IN THE SOUTHERN OCEAN: DESIGNING A MARINE PROTECTED AREA FOR THE PRINCE EDWARD ISLANDS

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ABSTRACT

The role of marine protected areas (MPAs) in conserving marine biodiversity while maximizing fishery benefits is gaining increased recognition internationally and was the basis for a proposal by the South African government to proclaim a major new MPA in the Exclusive Economic Zone (EEZ) around the Prince Edward Islands. This MPA would serve dual roles of 1) restoring populations of the commercially important Patagonian toothfish (Dissotichus eleginoides), while reducing the bycatch of the fishery, and 2) forming part of a representative global system of MPAs to protect marine biodiversity. This study follows systematic conservation planning methods to identify an MPA that will: (1) conserve biodiversity patterns and processes; (2) allow fishing to continue sustainably in the region; and (3) comprise sensible marine management boundaries. Following a significant data collation effort of distribution data on species, benthic habitats, ecosystem processes and fishing activities, we used C-Plan software to identify boundaries for a proposed MPA. The MPA consists of three zones: four IUCN Category 1A reserves (13% of EEZ), a Category IV reserve (21% of EEZ) and three Category VI reserves which cover the rest of the EEZ. The combined "no-take" area of the MPA (i.e. the Category 1A and IV reserves) thus covers 34% of the EEZ, which is greater than the 20% global recommendation but is necessary if the MPA is to achieve its objectives. Although MPA design has received much attention in recent times and management of the Southern Ocean is well developed, this study plays a vital role in ensuring the protection of representative habitats and will hopefully provide a starting point for future systematic studies in the Southern Ocean. Trade offs between conservation target achievement and the commercial fishery are apparent in the final reserve design. Several data gaps are highlighted in this study and include unknown climate change impacts, a lack of benthic habitat data, and a lack of foraging area data for several key species. The proposed MPA boundaries are expected to change over time as new data become available, as stakeholders are engaged, and as climate change impacts become evident.

Key words: MPA design, pattern and process, Prince Edward Islands, Southern Ocean

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1. INTRODUCTION

There is currently an increasing appreciation of the role that Marine Protected Areas (MPAs) can play in conserving marine biodiversity, while concurrently maximizing fishery benefits (e.g. Gell & Roberts 2003a). International endorsements for MPAs as a management tool include policy statements issued by the World Summit on Sustainable Development (WSSD) in 2002 and the World Parks Congress (WPC) in 2003. These statements set a target for governments to protect 20% of all marine habitats under their jurisdiction (i.e. including the 200 nautical mile Economic Exclusive Zone) by 2012. The South African government has publicly and repeatedly committed itself to these goals (e.g. Aucamp 2004), and has recently announced its intention to declare its largest MPA yet, within the EEZ of the sub-Antarctic Prince Edward Islands (Nel et al. 2005). The position of the Islands (Marion and Prince Edward) in the southern Indian Ocean (Fig. 1) also places them within the region managed by the Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR), whose Scientific Committee has recently endorsed the fact that a representative network of scientifically planned MPAs would be beneficial to furthering the guiding principles of both CCAMLR (Article 2) and the Madrid Protocol to the Antarctic Treaty. It therefore follows that the development of an ecologically representative and scientifically planned MPA around the Prince Edward Islands is consistent with both national policy as well as the regional international treaties that govern this area.

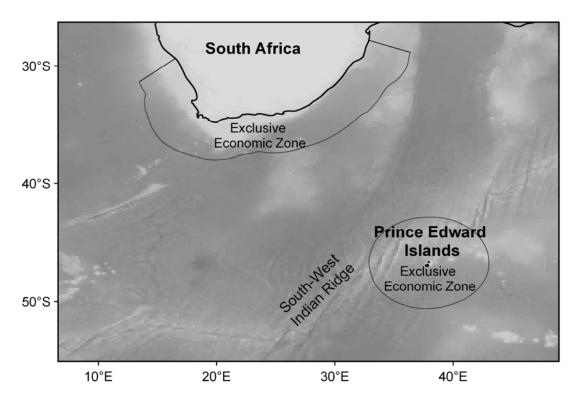


Fig. 1. The position of the Prince Edward Islands and the EEZ in the Southern Ocean.

Since November 1995, the Prince Edward Islands have been managed as a Special Nature Reserve (PEIMPWG 1996), but no marine component is included. However, in order to reduce the incidental mortality of procellariiform seabirds by longline fishing (Nel & Nel 1999, Nel *et al.* 2000, Nel *et al.* 2002b, Nel *et al.* 2002c, Nel *et al.* 2003), no fishing activities have been permitted within the 12 nautical mile (nm) territorial waters since December 2004. Additionally, fishing activities by South African vessels in waters surrounding the islands in the main abide by the CCAMLR regulations and guidelines. The announcement of the South African government in July 2004 to proclaim a major new MPA in the waters around the Islands (and not just the territorial waters) makes clear the national commitment to combat Illegal, Unreported and Unregulated (IUU) fishing in the Southern Ocean. This commitment is further supported by the purchase of new environmental patrol vessels, and ongoing bilateral negotiations aimed at international co-operation within the Southern Ocean.

A MPA around the Prince Edward Islands would fulfill two major objectives. First, if correctly designed and effectively managed, it could arrest the further decline of the Patagonian toothfish (*Dissotichus eleginoides*), which has been so over-exploited that its spawning biomass may be only a few percent of pre-exploitation levels just ten years ago (Brandão *et al.* 2002). The objective of the MPA would be to restore this resource, and reduce the bycatch of the fishery, particularly with respect to albatrosses and petrels (Nel & Nel 1999, Nel *et al.* 2002c). Second, the MPA would contribute to a national and global representative system of marine protected areas, by providing protection for unique species and habitats as well as scientific reference points that can inform the future management of these areas. MPA design, as well as its management, will be effective only if both of these objectives are met (i.e. fisheries management, as well as biodiversity conservation).

Many more specific reasons provide motivation for a large (inshore and offshore) MPA around the Prince Edward Islands. These include the following:

- The uniqueness, pristineness and high endemism of the islands themselves (Chown et al. 1998b). In a World Heritage Status assessment, Chown et al. (2001) demonstrated Prince Edward Island to be the most pristine in the Southern Ocean, and this emphasizes the need to exclude future human intervention as much as possible.
- The inseparable relationship between the marine and terrestrial environments. Terrestrial nutrient input (and thus ecosystem functioning) is strongly driven by birds and seals who forage in the marine environment, and the islands then provide nutrients to the ocean via run-off (Frost 1979, Froneman & McQuaid in press, Smith & Froneman in press). Protection of the terrestrial environment is thus reliant on a healthy marine environment.
- The foraging requirements of the top predators. Many bird and seal species breed on the Islands (Williams *et al.* 1979, Condy 1981, Hofmeyr & Bester 1997, Chown *et al.*

1998a, Pistorius *et al.* 1999a), and forage either close to the Islands (inshore feeders), or within the greater EEZ and further afield (offshore feeders). The birds especially are affected both indirectly (competition for resources), and directly (as bycatch), by fishing activities in the area. Many of these bird species are globally threatened (Crawford & Cooper 2003).

- The islands are showing rapid change in step with global climate change (Smith 1991, Bergstrom & Chown 1999, Pakhomov & Chown 2003). Any anthropogenic reduction in the resilience of the species within the EEZ may render them locally (or even globally) extinct, for example, if sea surface temperatures change drastically (Mélice et al. 2003), or if the position of the oceanic fronts moves too far south (Lutjeharms et al. 2002). There is evidence that many birds and seals forage in the vicinity of the fronts (Jonker & Bester 1998, Nel et al. 2001).
- The precautionary principle. Benthic surveys have been conducted only on the shelf between the two Islands (Beckley & ranch 1992, Branch *et al.* 1993), and very little is known about the benthic habitats within the EEZ. Undescribed species, as well as major geological features (such as hydrothermal vents on the South-West Indian Ridge), are all likely to occur within the EEZ. Given that there is potential for oil and gas exploration in the area (an interest has been shown), and increased tourism (especially if World Heritage Status is obtained), representative habitats need to be set aside to mitigate future threats.
- Many shipping-related processes threaten the marine (and therefore terrestrial)
 environment. These include the introduction of alien species via ballast water and on
 hulls (Frenot et al. 2005), and pollution such as oil spills. Vessels may exercise their
 right of passage and seek shelter near the islands, making it difficult to control any
 associated negative activities.
- A South African Marine Protected Area within its sub-Antarctic EEZ will match and complement the two Marine Parks (equivalent to MPAs) recently declared by Australia in the EEZs of its sub-Antarctic islands: Macquarie, and Heard and MacDonald (Environment Australia 2001, Environment Australia 2002).

Our objective was to design a MPA for the Prince Edward Islands EEZ that would: (1) conserve biodiversity patterns (species and ecosystems) and processes (e.g. breeding grounds, nutrient cycles); (2) allow fishing to continue sustainably in the region; and (3) have sensible marine management boundaries. The study followed a systematic conservation planning approach (see Margules & Pressey 2000) that entailed a significant data collation effort of all available information on the distribution of biodiversity patterns and processes, as well as fishing activity. Despite the extensive scientific research that has been conducted on the islands since 1965 (Siegfried *et al.* 1979, Cooper & Brooke 1981, Lutjeharms 1991, Hänel & Chown 1998, Hänel & Chown 1999, Pakhomov & Chown 2003), spatial information

for the entire EEZ is limited, and many different organizations and institutions curate existing data. In addition to providing a central location for all existing data, our study also forms the basis of a spatial planning framework that will allow future iterations of MPA design as new information becomes available.

2. METHODS

2.1 Study Area

The EEZ of the Prince Edward Islands covers 528 020 km² and lies in the Southern Ocean between approximately 42°45′ - 50°45′ S, and 32°45′ - 43° E (Fig. 1). It includes four broad habitats: the South-West Indian Ridge; a plateau area with seamounts and rises; an abyssal area; and the islands themselves (Fig. 2). The two islands, Marion and Prince Edward, lying approximately at 46° 45′ S and 37° 45′ E, have a terrestrial area of 339 km². The sub-Antarctic front (SAF) lies to the north of the islands, and the Antarctic polar front (APF) lies to the south (Lutjeharms 1985). Consequently, three major water masses occur within the EEZ: sub-Antarctic surface waters (north of the SAF); northern polar frontal waters (between the SAF and the Southern SAF); and southern polar frontal waters (between the SSAF and the APF).

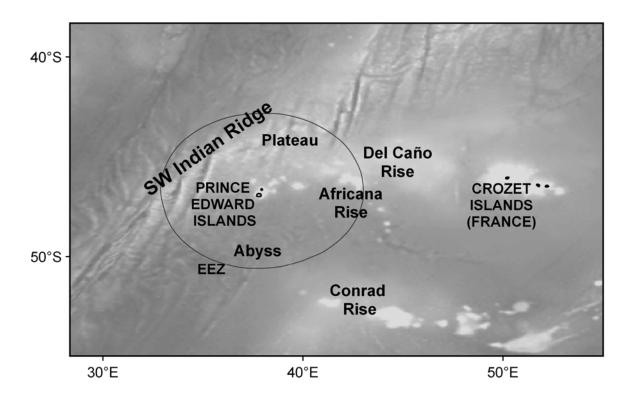


Fig. 2. Bathymetry of the Prince Edward Islands EEZ, with the Crozet Islands shown to the east. The four broad habitats within the EEZ include the South-West Indian Ridge in the west, the plateau area in the northern half (mostly shallower than 3500m), the abyss in the southern half (deeper than 3500m), and the islands themselves.

The eastern border of the EEZ falls on Africana Rise, which itself it part of the Del Caño Rise, to the east of which lie France's Crozet Islands (Fig. 2). The Prince Edward and Crozet Islands lie 1050 km apart, with approximately 310 km separating their EEZs.

2.2 Summary of the base data

Existing spatial data for biodiversity patterns and processes, as well as fishing activities, were housed in a number of different institutions, and our initial task was to compile and standardise all these data sets, as well as to generate new spatial data from existing data or from interviews with experts. Consultative workshops with stakeholders and an extensive literature survey completed the data acquisition phase. All data are now housed within the implementation agency (Marine and Coastal Management, Department of Environmental Affairs and Tourism), and are stored in Geographic Information Systems (GIS) format (ArcView 3.2 and ArcInfo 7, ESRI 1996). Those data sets that did not cover the entire EEZ were excluded from the systematic conservation planning process. Table I summarises the data collated and developed for the study.

2.3 Biodiversity patterns (species)

A database of the fish occurring in the Prince Edward Islands EEZ was compiled using distribution and habitat data from Gon & Heemstra (1990). A subset of these species was extracted for analyses. The subset (n = 19) contained all species from the family Nototheniidae, as well as near endemics, threatened species, and any species linked to benthic (as opposed to pelagic) habitats. Quantitative depth range data from Gon & Heemstra (1990) and 2-minute bathymetry data were used to create 2-minute GIS maps of predicted habitat ranges for each species, within the EEZ. These GIS maps were overlaid to produce a final species richness layer. Only 2-minute cells with ≥4 potential species were targeted in the conservation planning analyses (the maximum species richness of any one cell was 13).

Table 1/...

Table I. Data sets used in the systematic conservation planning of a marine protected area for the EEZ of the Prince Edward Islands in the Southern Ocean.

Data set	Data source	Used in the plan
Biodiversity patterns (species) Invertebrates Fish Cetaceans	Trawl data from MCM ¹ Gon and Heemstra (1990) P. Best ³ (pers. comm.)	No ² Yes No ²
Biodiversity patterns (habitats) Bathymetry (2 minute) Sediment thickness Benthic habitats Seamounts	NOAA (2001a) NOAA (2001b) Derived from Bathymetry and Sediment thickness Derived from Bathymetry	Yes Yes Yes Yes
Fixed processes 1 km coastal buffer Inshore island shelf Productive island areas 40 km buffer	Generated in GIS from island coastlines Derived from Bathymetry (500 m isobath) Derived from Bathymetry (1800 m isobath) Generated in GIS from island coastlines	Yes Yes Yes Yes
Flexible processes Seabird foraging areas Elephant seal foraging areas Average position of the fronts	BirdLife International (2004) M. Bester and C. Tosh Reproduced with kind permission from I. Ansorge ⁵	Yes ⁴ Yes Yes
Fishing activities Fishing effort Bird bycatch	MCM–CCAMLR ⁶ Scientific Observer Logbook data Nel <i>et al.</i> (2002a)	Yes Yes
Management boundaries Island outlines EEZ (200 nm)	K.I. Meiklejohn ⁷ 1:10 000 000 SAN ⁸ charts	Yes Yes

Marine and Coastal Management (Department of Environment Affairs and Tourism)

² Data available for only limited parts of the EEZ (R. Leslie)

Mammal Research Institute, University of Pretoria

Only data for birds tracked from the Prince Edward Islands were used (i.e. grey-headed and wandering albatrosses)

Hydrographic data used for this study were collected during the MOES, MIOS and DEIMEC programmes funded through the South African National Antarctic Programme (Department of Environmental Affairs and Tourism)

⁶ Commission on the Conservation of Antarctic Marine Living Resources

Department of Geography, Geoinformatics & Meteorology, University of Pretoria

⁸ South African Navy, Hydrographic Office

2.4 Biodiversity patterns (habitats)

Owing to a lack of regional-scale data on bathymetry, the ETOPO (2-minute) global gridded data (NOAA 2001a) were used. Within this data set, seafloor data for the Islands' EEZ were derived from satellite altimetry observations combined with quality-assured shipboard echosounding measurements (Smith & Sandwell 1997).

In order to produce a map of unsampled benthic habitats for the entire EEZ, we combined bathymetry data with a map of sediment thickness (5-minute, NOAA 2001b), and produced a surrogate benthic habitat map for use in the conservation planning analyses. Bathymetry and sediment thickness were the only two biophysical variables for which complete coverage of the EEZ was available. Habitat classes in the final map were derived by dividing the bathymetry map into five biologically meaningful classes: 0 to -200 m (island shelf), -200 to -500 m (shelf of mounts and rises), -500 to -1800 m (lower slope) and <-3500 m (Abyss) (Lombard et al. 2004 provide the rationale for these breaks). For consistency, the sediment map was similarly divided into five classes of thickness using a natural breaks (Jenks) classification methods. Values ranged from 13 to 1021 metres. Spatial intersections of these two classified maps produced a final map of 21 different combinations of classes (4 combinations did not exist). We treated these 21 combinations as benthic habitat surrogates, but recognize that no benthic data are currently available to test these surrogates. For ease of analyses, the islands themselves were classified as one of the 21 habitats.

Owing to the increased biodiversity and productivity associated with seamounts, we produced a map of seamounts and rises, using the 800 m isobath as a cut off. Eleven seamounts and rises occur in the northern half of the EEZ.

2.5 Biodiversity processes

In order to delineate spatial surrogates for biodiversity (ecological) processes, one needs to understand the spatial and temporal nature of the major processes driving ecosystem functioning within the study area. These processes usually operate at different scales, and MPA design needs to address this.

Like other small oceanic islands, the Prince Edward Islands rely primarily on the surrounding ocean for nutrient input. Top predators (birds and seals), which use the islands to breed and moult, bring nutrients to the islands from two main sources: the islands' shelf area, and the pelagic environment (both within and outside the EEZ). Island run off, driven by rainfall, then augments the nutrients in shelf waters. This close interaction between the marine and terrestrial environments is referred to as the islands' life support system (LSS), which has two components (Pakhomov & Chown 2003). Component one (the retention system) operates inshore and dominates when the SAF lies far to the north of the islands (Perissinotto & Duncombe Rae 1990). Water is retained on the shallow island shelf, and

increased macronutrient concentrations and water column stability generate phytoplankton blooms (the island mass effect, Allanson *et al.* 1985). Phytoplankton blooms sediment to depth, providing carbon to the benthos, which in turn provide food for the swimming shrimp, *Nauticaris marionis*. This shrimp is an important component in the diet of a variety of inshore feeding seabirds (Blankley 1982, Perissinotto & McQuaid 1990, Pakhomov *et al.* 1999), and couples the pelagic environment to the islands' benthic environment (Perissinotto & McQuaid 1990).

Component two operates offshore and dominates when the SAF is close to the islands. Two major food supply mechanisms have been proposed for this LSS (Pakhomov & Chown 2003). The replenishing and pulsing mechanism operates when flow-through regimes dominate between the islands (Perissinotto *et al.* 2000). Water is not trapped between the islands, and the Antarctic Circumpolar Current (ACC) advects zooplankton and nekton towards the islands, from west to east. This food source is subsequently trapped by the shallow island shelf and is depleted by island predators during the daytime, but stocks are replenished at night by advection from upstream, when the predators are inactive (the replenishing hypothesis) (Perissinotto 1989, Perissinotto & McQuaid 1992).

The second mechanism is associated with frontal movements and the formation of mesoscale eddies that are created as the ACC crosses the South-West Indian Ridge. Elevated plankton and fish biomass are associated with the two major frontal systems (the SAF and the APF) in the vicinity of the islands (Pakhomov & Froneman 2000, Barange *et al.* 1998, Pakhomov *et al.* 2000). Although only the pelagic feeders from the islands (e.g. king penguins and elephant seals) can travel to these fronts to forage (Bost *et al.* 1997, Jonker & Bester 1998), the advection of these food sources to the islands (previously described) can make them available to inshore foragers (Pakhomov & Froneman 1999b). There is also evidence that mesoscale eddies created upstream of the islands are important feeding grounds for top predators from the islands (Rodhouse *et al.* 1996, Hofmeyr & Bester 1997, Klages & Bester 1998, Pistorius *et al.* 1999a, Nel *et al.* 2001).

In order to capture these processes in a MPA design, we divided them into those that are small scale and spatially fixed, and those that are large scale and spatially flexible (variable).

2.6 Fixed processes

We defined a 1 km buffer around the islands as the coastal inshore zone. This zone incorporates the dense stands of *Macrocystis laevis*, an endemic kelp that occurs along the eastern coast of Marion Island approximately 100 m offshore in 5-20 m of water (Atwood *et al.* 1991, Beckley & Branch 1992). The kelp beds are areas of high biodiversity and add to ecosystem diversity on the shelf by providing important habitat for invertebrates (De Villiers 1976, Pakhomov *et al.* 2002), and by trapping fresh water run off from the islands, thereby reducing salinity and potentially promoting phytoplankton blooms. This buffer also covers the

foraging grounds of the kelp gull, the Kerguelen and Antarctic terns (Crawford & Cooper 2003).

To capture the shelf-related processes of the inshore LSS, we chose the 500 m isobath around the islands. This incorporates the shelf areas of both islands as well as the area between them. The shelf supports a diverse and rich biomass of benthos (Gon & Mostert 1992, Branch *et al.* 1993), and as previously mentioned, sustains a food web on which inshore feeding seabirds rely. Concern has been raised because populations of inshore feeding species (e.g. the imperial cormorant *Phalacrocorax [atriceps] melanogenis*, the gentoo penguin *Pygoscelis papua*, and the rockhopper penguin *Eudyptes chrysocome filholi*) have decreased in recent years (Crawford *et al.* 1998).

Although the gentoo and rockhopper penguins are described as inshore feeders, their foraging ranges extend off the shelf to average distances of 28.6 km and 33 km respectively (Brown 1987, Wilson *et al.* 1989). In order to capture these feeding areas, we buffered the islands by a distance of 40 km. This buffer also incorporates all territorial waters (12 nm = 22.224 km).

The fourth fixed process was delineated with the 1800 m isobath around the islands (i.e. the upper/lower slope division). This area captures elevated concentrations of myctophid fish around the islands, as well as a downstream area of high zooplankton biomass (Ansorge *et al.* 1999, Pakhomov & Froneman 1999a, Pakhomov & Froneman 2000). It may also be a nursery area for Patagonian toothfish (R. Leslie pers. comm.).

2.7 Flexible processes

A flexible process is an oceanographic or biological process that is not fixed in space, although its spatial occurrence may be predictable to varying degrees. Although flexible processes have formed part of terrestrial conservation plans in South Africa for some years now (e.g. Cowling *et al.* 1999, Balmford 2003, Cowling *et al.* 2003), their integration into MPA planning is still comparatively undeveloped. For the present study, we defined and mapped three flexible processes, namely foraging areas for wandering and grey-headed albatrosses; foraging areas for southern elephant seals; and the average positions of the SAF and the APF. These are all large scale, spatially variable processes that operate offshore, and the offshore foragers contribute by far the dominant component of nutrient input into the islands (Pakhomov & Froneman 1999b).

The Prince Edward Islands support 44% and 10% of the global populations of the wandering and grey-headed albatrosses respectively (Crawford & Cooper 2003). Both species are classified as Vulnerable (BirdLife International 2000), primarily as a result of population reductions since the 1980s (BirdLife International 2000), attributed mainly to mortality associated with longline fishing for tuna (*Thunnus* spp.) and Patagonian toothfish (Gales 1998, Nel *et al.* 2002b, Nel *et al.* 2002c, Nel *et al.* 2003). During 1997-1998, breeding

wandering and grey-headed albatrosses were tracked by satellite from Marion Island (Nel *et al.* 2000, Nel *et al.* 2001, Nel *et al.* 2002a). For the present study, habitat utilisation was calculated using kernel density estimators from the Animal Movement formula developed by Hooge and Eichenlaub (1997). Kernel density distribution maps were produced for each species using the same parameters used by the BirdLife International (2004) study. Maps show contours of 50%, 51-75%, and 76-95% levels of habitat utilisation. These contours represent the minimum polygon of densely clustered points that include a specified percent of the satellite points. Consequently, the 50% kernel represents the densest clustering of 50% of the points recorded and highlights areas of maximum utilisation.

In order to combine the habitat utilisation maps from both bird species, we scored the 50% habitat utilisation polygons with a three, and the 51-75%, and 76-95% polygons with twos and ones, respectively. We overlaid the polygon maps, and summed the scores, thereby generating polygons with values ranging from six (maximum usage by both species) to one (used minimally by only one species).

Steady declines in southern elephant seals (*Mirounga leonina*) have been reported for the Prince Edward Islands for the last fifteen years (Pistorius *et al.* 1999a, Bradshaw *et al.*2002, McMahon *et al.* 2005), but fortunately, the Marion Island population seems to be stabilizing (Pistorius *et al.* 1999b, McMahon *et al.* 2003, Pistorius *et al.* 2004). Causes for these declines are not clearly understood (McMahon *et al.* 2005). For the present study, 48 satellite tracks for Marion Island southern elephant seals were analysed. Outliers were removed, and habitat utilisation maps were produced with the same methods used for the seabirds.

Data from the seals were combined with the albatross data with the same scoring method used previously, thereby generating polygons with values ranging from nine (maximum usage by all three species) to one (used minimally by only one species).

Given the important role played by the two oceanic fronts (the SAF and the APF) in maintaining the LSS of the Prince Edward Islands, we attempted to calculate their average position within the EEZ, using sub-surface (200 m depth) temperature data (data reproduced with kind permission from I.J. Ansorge). Data from 771 points collected from cruises over 8 years (between 1989 and 2005) were converted to raster grids and contoured. The position of the APF occurs at the 2°C contour, whereas the SAF can be split into a northern (SAF) and southern front (SSAF), lying at the 6°C and 3.5°C contours respectively. These three fronts were extracted from the data for each of the 8 years. Unfortunately the entire EEZ was not surveyed in all years, nor was there consistency in area surveyed. Consequently, our maps of average frontal positions are incomplete and should be considered preliminary. Our contours, however, do fall within the described range of these frontal movements, which have a large spatial variation globally (Duncombe Rae 1989, Froneman *et al.* 2002, Lutjeharms *et al.* 2002).

2.8 Fishing activities

Demersal longline fishing for Patagonian toothfish has been in existence in the Southern Ocean since the late 1980s and is currently the only non-research related human activity in the region. Sanctioned fishing in the EEZ began in 1996, after considerable poaching by IUU vessels earlier in the year (Ryan *et al.* 1997). Since 1996, CCAMLR Scientific Observers have been on board the legal vessels in the EEZ and their Logbooks contain information on the fishing activities in the region from 1996 to present day. Data were extracted from these logbooks in order to map the locality of fishing and fishing effort. A single point per line set was extracted from the Logbooks, and this provided 15 datasets from 2001 to 2005. Data from 1996-2000 were extracted from Nel *et al.* 2002c. Fishing effort kernels were generated for each year using the same methods used for the tracked birds and seals, but contours were produced for only 50 and 95% utilisation levels.

CCAMLR Logbooks also include information on bycatch, and we extracted bird bycatch and mortality data. This provided five datasets from 2003 to 2005. Earlier data were extracted from Nel *et al.* (2002c).

2.9 Study area outlines

Coastlines for Marion and Prince Edward Island were derived from the vegetation map of Marion Island, and 2000 Landsat Imagery respectively (K.I. Meiklejohn, University of Pretoria). Territorial and jurisdiction zones (for example, the EEZ) were digitised from SA Navy charts (1:10 000 000, Hydrographic Office, SA Navy).

2.10 Systematic conservation planning

During the past two decades, there has been rapid development in the field of systematic conservation planning, a branch of conservation biology that identifies options and priorities for conservation in a spatially explicit fashion (Margules & Pressey 2000, Pressey *et al.* 1993). Systematic planning is based on the need to conserve a representative sample of a region's biodiversity and to ensure the persistence of this biodiversity through the exclusion of threatening processes and the inclusion of ecological and evolutionary processes that maintain and generate biodiversity (Balmford *et al.* 1998, Cowling *et al.* 2003).

A systematic conservation plan relies on the definition of conservation targets (quantitative expressions of a region's conservation goals), which define how much of each biodiversity pattern (e.g. habitat types or species), and which biodiversity processes (e.g. foraging areas), should be included within the protected area boundaries. Once biodiversity patterns and processes have been spatially delineated, the study area is subdivided into planning units (typically grid squares or hexagons). The contribution of each planning unit to the quantitative targets is then calculated, and an efficient and practical spatial arrangement of

planning units is then identified to meet all the targets. Various software systems are available to perform these calculations (e.g. C-Plan and MARXAN).

Targets defined for the present study are listed in Table II. The EEZ was divided into 9839 planning units of 4 x 4 nautical miles, and the contribution of each of these units to the targets was calculated with C-Plan software (Pressey 1999). C-Plan calculates the irreplaceability value of each planning unit – where irreplaceability is a value (from 0-1) of the likelihood that the planning unit will be needed to meet targets (Pressey 1999, Ferrier *et al.* 2000). Alternative software packages including MARXAN and CLUZ (Ball & Possingham 2000, Possingham *et al.* 2000, Smith 2004) that can include measures of cost and ensure spatial aggregation were used in exploratory analyses, but were not used to generate the final plan.

Table II. Targets for each of the biodiversity pattern and process data sets used in the systematic conservation planning of a marine protected area for the EEZ of the Prince Edward Islands.

Biodiversity patterns and processes	Target
Biodiversity patterns (species) Fish	All 2-minute cells with 4 to 13 species ¹
Biodiversity patterns (habitats) Broad scale habitats Major water masses Benthic habitats Seamounts	MPA to represent each of the four broad scale habitats MPA to represent each of the three major water masses 20% of the area of each of 20 habitats, and all of the Land habitat All of the 11 seamounts and rises
Fixed processes 1 km coastal buffer Inshore island shelf Productive island areas 40 km buffer	Entire area Entire area Entire area Entire area
Flexible processes Sea bird and elephant seal foraging areas Average position of the fronts	MPA to incorporate major movement axes as shown by the combined bird and seal habitat utilisation data, as well as all values from 8-9 (see Fig. 6c) MPA to incorporate average positions of the SAF, SSAF and APF (see Fig. 6c).

¹ Areas with 1-3 species covered too much of the EEZ to serve as practical targets

2.11 Design rules

In order to maximise effective implementation of a planning design, protected area planning should always be conducted in an implementation framework (Pierce *et al.* 2005, Knight *et al.* in press). We identified three primary factors that would facilitate implementation of our recommended MPA boundaries: the final area of the MPA, the overlap of the MPA with

current legal fishing activities, and the complexity of the boundaries. Consequently, we constrained our planning design by the following three rules:

- 1. Minimize the area required to meet targets
- 2. Avoid current fishing activity where choices exist, but do not compromise process targets
- 3. Keep the boundaries of the MPA as straight lines, joining points that are on exact degrees and minutes

2.12 Analyses

Our MPA design involved three steps. All planning units that were only partially in the EEZ (i.e. on the boundary) were excluded from analyses (n = 438).

In Step 1 we identified four zones as Strict Nature Reserves (IUCN Category IA). Each of these was representative of one of the four broad scale habitats, and the three water bodies, and was also delineated to achieve as many of the targets in the targets table as possible. Boundary lines were straight, and connected points on exact degrees and minutes (i.e. no seconds). Areas of more recent fishing activity were avoided where possible. Table III describes each reserve, and the rationale behind its boundaries. One of these four reserves (around the islands) met all four fixed process targets (Table II).

In Step 2, we connected the four reserves from Step 1 with straight lines, to incorporate the three movement axes defined by the highest values of the bird and elephant seal habitat utilization data. Again, we attempted to avoid areas of more recent fishing activity where possible. Because the Category IA reserves were placed in areas that also maximized targets for frontal zone average positions (Table III), the axes also incorporated the areas of variability of the frontal positions. Areas within these axes were defined as Habitat/Species Management Areas (IUCN Category IV), and together with the Category IA reserves, met all the flexible process targets.

At this point, the only targets that were not met by Steps 1 and 2 were those for fish, benthic habitats, and seamounts (Table II). In Step 3, we assigned all planning units that had >90% of their areas within the proposed Step 1 and 2 reserves to the "reserved" status within C-Plan. We then calculated the contribution of all remaining planning units to meeting outstanding targets. The planning units identified by Step 3, along with the proposed Category IA and IV reserves, met all the benthic habitat targets, however, Step 3 violated all three design rules, and still did not meet all fish and seamount targets. Delineation of the final reserve boundaries will thus involve a quantifiable trade off between meeting all targets, and keeping reserve boundaries straight while minimizing the area reserved, as well as avoiding competition with current legal fishing activities.

Designing the Prince Edward Islands Marine Protected Area

Table III. Biodiversity patterns and processes represented within the four IUCN Category IA reserves proposed for the Prince Edward Islands MPA (see Fig. 8).

Biodiversity patterns and processes	South-West Indian Ridge	Prince Edward Islands	Africana Rise	Abyss
Biodiversity patterns (species) Fish	8% of target area. Northeastern boundary of reserve informed by these data and bird bycatch data.	All the target areas on the three mounts (northern and eastern boundaries of reserve were set to these).	All the target areas on the Rise (all four reserve boundaries were set to these).	N/a
Biodiversity patterns (habitats) Broad scale habitats	South-West Indian Ridge and Prince Edward fracture zone ¹ . Northeastern boundary of reserve was set to capture a whole trench.	The two Islands (Marion and Prince Edward), and their shelf habitats.	Plateau (area shallower than 3500 m).	Abyss (area deeper than 3500 m).
Major water masses	Sub-Antarctic surface waters (i.e. north of the SAF ²).	Northern polar frontal zone waters (between the SAF and the SSAF ²).	Northern polar frontal zone waters (between the SAF and the SSAF).	Southern polar frontal zone waters (between the SSAF and the APF ²).
Benthic habitats	The four reserves combined mee	et targets for 6 of the 21 habitats		
Seamounts	One.	Three (the islands plus another two).	One. ³	N/a
Fixed processes 1 km coastal buffer Inshore island shelf 40 km buffer Productive island areas	N/a N/a N/a N/a	Entire target Entire target Entire target ⁴ Entire target (southern and western boundaries were defined by this polygon).	N/a N/a N/a N/a	N/a N/a N/a N/a

Designing the Prince Edward Islands Marine Protected Area

Biodiversity patterns and processes	South-West Indian Ridge	Prince Edward Islands	Africana Rise	Abyss
Flexible processes Sea bird and elephant seal foraging areas	The northwestern movement axis of the combined bird and seal habitat utilisation data, as well as a core area with values from 8-9 (see Fig. 6c).	The terrestrial habitat of all three species.	The eastern movement axis ⁵ of the bird habitat utilisation data, which links to the Crozet Islands (see Fig. 6c).	The southwestern movement axis of the combined bird and seal habitat utilisation data (see Fig. 6c).
Average position of the fronts	Southwestern boundary set to incorporate the SAF ⁶ .			Southern boundary is set by the EEZ (where APF comes closest to the EEZ), and northern boundary is set by the SSAF.

Area likely to contain active volcanoes and hydrothermal vents (I. McLachlan, Petroleum Agency, SA, pers. comm.). Sperm whales may utilise the deep canyons (M. Meyer, pers. comm.).

SAF (sub-Antarctic front), SSAF (southern sub-Antarctic front), APF (Antarctic polar front). This area may be a replenishment zone for many fish species, R. Leslie pers. comm.

This zone also incorporates all territorial waters. Also pilot whales, pygmy blue whales, killer whales (M. Meyer, pers. comm.). All bird bycatch data for the area also included in boundaries.

This axis is also used by many seabirds from the Crozets (BirdLife 2004).

The average position of the SAF, as calculated in the present study. This is also the area of frontal topographic steering, where the SAF moves north above the islands.

3. RESULTS

3.1 Biodiversity patterns (species)

Species richness of the 19 fish species, calculated per 2-minute cell, is shown in Fig. 3. Areas with ≥4 species are restricted to the shallower, northern half of the EEZ, and areas of highest richness are concentrated on the shelves of the islands, seamounts, and the tops of the South-West Indian Ridge.

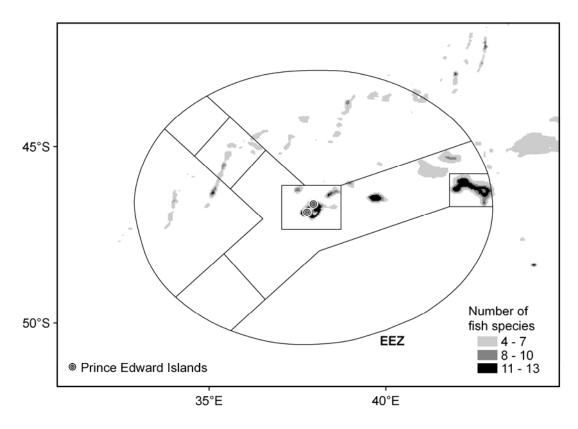


Fig. 3. Species richness of a subset of 19 fish species in the Prince Edward Islands EEZ. Only 2-minute grid cells with ≥4 species are shown, overlaid on the proposed MPA boundaries (see Fig. 8).

3.2 Biodiversity patterns (habitats)

The 21 habitat surrogates defined for the EEZ are shown in Fig. 4. Only two habitats make up just under half of the EEZ: abyss with very thin sediments in the south west (24% of EEZ), and lower slopes with very thin sediments in the northern half (25%). The South-West Indian Ridge dominates the western areas, and shallower habitats (islands, island shelf, seamounts, rises and their shelves) are limited to the northern half of the EEZ, particularly on a west-east axis that joins the islands to Africana Rise. Nine of 21 habitats contribute <1% to the EEZ's total area (these are all upper slope and shallower habitats).

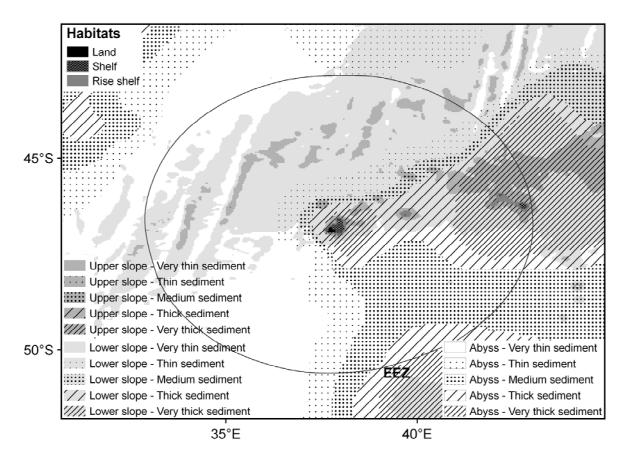


Fig. 4. Benthic habitats defined for the EEZ, using combinations of bathymetry and sediment thickness classes. The habitats labeled Shelf and Rise shelf are actually combinations of two Shelf habitats and three Rise shelf habitats respectively, but these have been combined into single shades for this figure, owing to their very small areas within the EEZ.

Fig. 5 shows the distribution of the 11 seamounts and rises defined for this study. Many are well known fishing grounds for the Patagonian toothfish (R. Leslie pers. comm.).

3.3 Fixed processes

The four fixed processes are illustrated in Fig. 5b. All are associated with the islands themselves, and the 40 km buffer incorporates the other three processes, except for a small portion of the productive island areas process.

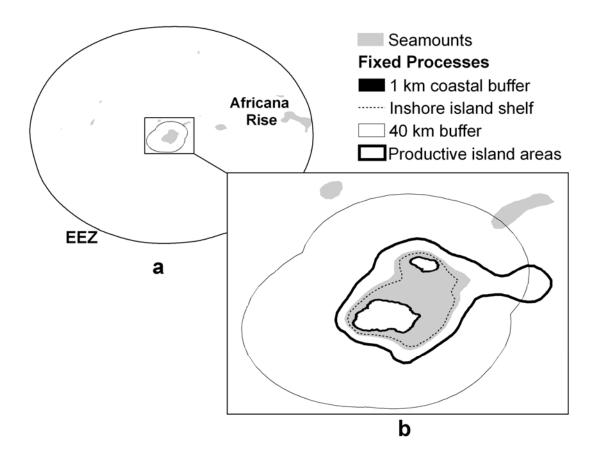


Fig. 5. The seamounts (and rises) defined within the EEZ (a). The scale of the figure precludes the drawing of the two smaller seamounts. The four fixed processes are shown in the inset (b), which also corresponds to the boundaries of the proposed Prince Edward Island Category 1A reserve (see Fig. 8).

3.4 Flexible processes

Habitat utilization maps for wandering and grey-headed albatrosses and southern elephant seals, tracked from Marion Island, show foraging patterns concentrated along three main exes (Fig. 6). The bird and seal axes are in similar positions, radiating out from the islands in a northwest direction across the plateau area to the ridge, and in a southwest direction again towards the ridge. Birds also use a third axis from the islands to Africana Rise, which forms part of the larger Del Caño Rise, which finally connects to the Crozet Islands further east (Fig Crozets). Although we did have spatial data for bird species tracked from the Crozets, they were not included in these maps. They are, however, mentioned later in the discussion. Average positions of the fronts, as calculated by our study, are shown in Fig. 6d. The three foraging axes take birds and seals across these fronts, and therefore across their zones of variability (Lutjeharms & Valentine 1984). Although not shown in the Figure, the APF regularly moves into the southern sector of the EEZ (Lutjeharms 1985).

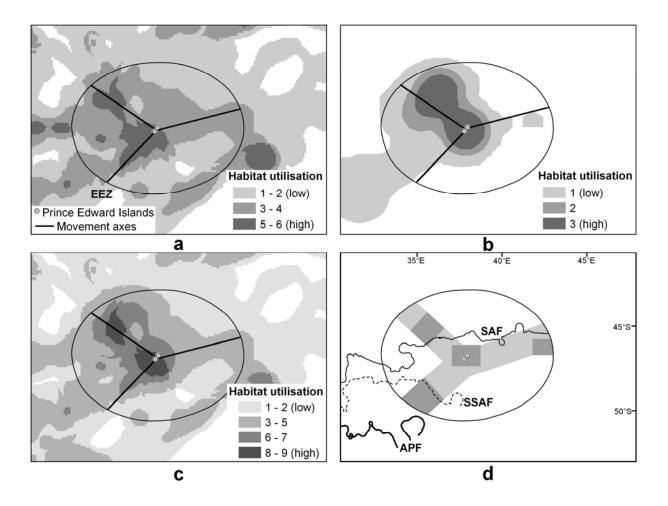


Fig. 6. Habitat utilisation maps for tracked wandering and grey-headed albatrosses (a), and southern elephant seals (b). Combined habitat utilisation map for both albatross species and elephant seals are shown in (c). Foraging movement axes are plotted in each map. Fig. (d) shows the average position of the major oceanic fronts (SAF, SSAF and APF), overlaid on the proposed MPA boundaries (see Fig. 8).

3.5 Fishing activities

Legal fishing effort was initially concentrated on the Islands' shelf and surrounding seamounts (1996, Fig. 7a). As catches began to decrease, activity moved mainly to the South-West Indian Ridge but was spread broadly over the plateau area (2000, Fig. 7b). By 2004, fishing activity was even more dispersed, with three major nodes (the Islands, the Ridge, and Africana Rise, Fig. 7c). Areas targeted by fishing over the last ten years encompass almost the entire plateau area in the north, and all seamounts now experience fishing pressure (Fig. 7d). Any areas that fell within either the 50 or the 95% kernels in any one year contributed to the mapped areas in Fig. 7d.

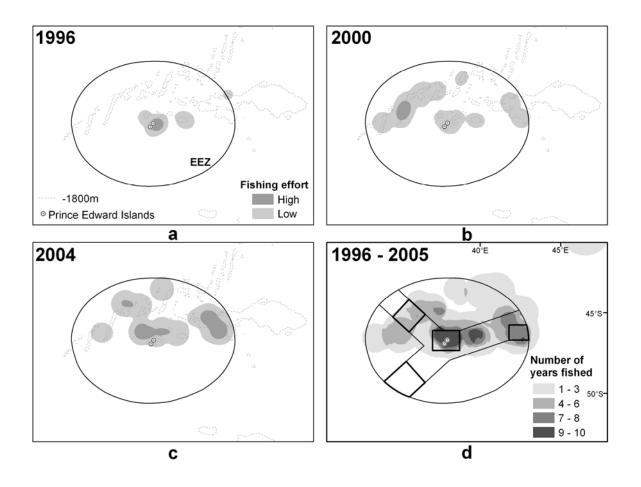


Fig. 7. Fishing effort kernels of legal Patagonian toothfish fishing vessels in the Prince Edward Islands EEZ for three of the ten years since the fishery began (a-c). High and low effort corresponds to the 50% and 95% kernels respectively (see text). The total number of years that areas were fished is shown in (d), overlaid on the proposed MPA boundaries (see Fig. 8).

3.6 Systematic conservation planning

The four Category IA reserves defined in Step 1 are illustrated in Fig. 8 and described fully in Table III. Their combined areas constitute 13% of the EEZ (Table IV), and they meet all broad habitat and major water mass targets, as well as all fixed process targets. They also contribute substantially to all other targets (Table V). No extractive activities may occur in IUCN Category IA, but although the Island and Africana Rise reserves fall on fishing grounds frequented in the late 1990s, most of the more recent fishing activity is dispersed across the plateau region, outside of these reserves.

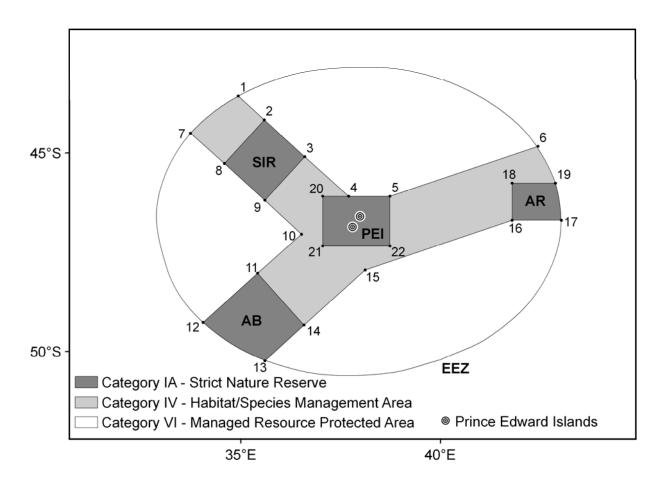


Fig. 8. The proposed boundaries for the Prince Edward Islands MPA. The four Category 1A reserves are: South-West Indian Ridge (SIR); Prince Edward Islands (PEI); Africana Rise (AR); and Abyss (AB) (see also Table III).

Table IV. Areas and EEZ percentages of the IUCN reserves proposed for the Prince Edward Islands MPA (see Fig. 8 for IUCN categories).

IUCN reserve category	Area (km²)	%EEZ	Sum area (km²)	%EEZ
IA - Ridge	17 926	3		
IA - Islands	17 903	3		
IA - Africana Rise	9 438	2		
IA - Abyss	23 157	4	68 425	13
IV (axes)	112 208	21	112 208	21
(4)				
VI (remainder of EEZ)	347 386	66	347 386	66
Total	528 019	100	528 019	100

The three axes defined in Step 2 to meet flexible process targets constitute another 21% of the EEZ (Table IV), and we have defined them provisionally as Habitat/Species Management Areas (IUCN Category IV), owing to the fishing grounds and shallower habitats present within them that require management and possible protection. These Category IV reserves also contribute substantially to outstanding targets (Table V). Design rules were not compromised in Steps 1 and 2, and unmet targets at this point included 30% of the species rich fish areas, 5 benthic habitats, and 3 seamounts (Table V).

Table V. Summary of the conservation planning steps and targets met by each step (data in each row include data of previous row).

		Targets met					
Step	Description	No. of PUs ¹ required	PUs ¹		Sea mounts (n=11)	Fixed processes	Flexible process
1	Four Category IA reserves	1135	46% ²	6 ³	5 ⁴	All	Partially
2	Category IV reserves	3077	70%	16	8	All	All
3	Additional areas for benthic habitat targets	3508	77%	All	9	All	All

¹ Planning units, total number completely within EEZ = 9401

In order to meet all benthic habitat targets, we used the C-Plan software in Step 3 to identify the smallest number of planning units, that were spatially clustered around the Category IA and IV reserves, that would meet outstanding benthic habitat targets, while simultaneously attempting to meet fish and seamount targets. Fig. 9 shows that four additional areas are required: one small area of three planning units in the north east (for Upper slope – Thin sediment habitats); two other areas on the SW Indian Ridge (for Upper slope – Very thin sediment, and Lower slope – Very thin sediment habitats); and a larger area in the south east to meet outstanding targets for Abyss – Medium sediments. However, these additional areas violate two of the design rules (they incorporate more recent fishing grounds and are not bordered by straight lines), while not substantially contributing to outstanding fish and seamount targets (Table V). In order to meet all targets fully, the MPA would require all four areas of Step 3, as well as another axis running along most of the ridge and plateau within the EEZ (Fig. 9).

We thus recommend that the results of Steps 1 and 2 (Fig. 8) are used as provisional MPA boundaries, and that the remaining areas within the EEZ are classified as Category VI reserves (Managed Resource Protected Areas). Targets not met by the Category 1A and IV reserves will therefore be able to benefit from a management strategy within these Category VI areas. The coordinates that define the reserve boundaries are listed in Table VI.

²46% of 2-minute grid cells with ≥4 species

³ 6 of the 21 benthic habitats

⁴ 5 of the 11 seamounts

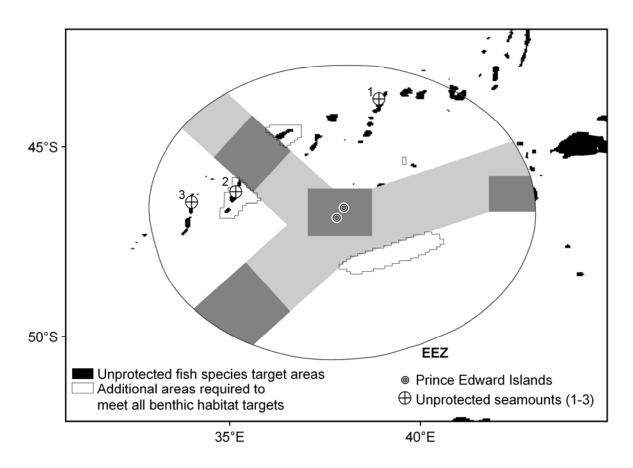


Fig. 9. The relationship between the proposed Category 1A (dark grey) and Category IV (light grey) reserves, and the three biodiversity patterns (fish target areas, seamounts and benthic habitats) whose targets are not met within these reserves.

Table VI. The exact geographic coordinates (WGS 84 spheroid) of points 1-22 in Fig. 8.

Point	Latitude Degrees	Minutes	Longitude Degrees	Minutes	Point	Latitude Degrees	Minutes	Longitude Degrees	Minutes
1	43	34	34	56	12	49	16	34	3
2	44	10	35	35	13	50	14	35	36
3	45	6	36	36	14	49	20	36	35
4	46	6	37	42	15	47	57	38	7
5	46	6	38	44	16	46	42	41	48
6	44	50	42	27	17	46	42	43	2
7	44	30	33	44	18	45	46	41	48
8	45	16	34	35	19	45	46	42	53
9	46	12	35	36	20	46	6	37	3
10	47	3	36	31	21	47	21	37	3
11	48	2	35	25	22	47	21	38	44

4. DISCUSSION

Marine protected area design has received much attention in recent times, primarily because of the collapse of many world fisheries (Myers *et al.* 1997, Hutchings 2000, Pauly *et al.* 2002), and the negative ecosystem effects of fishing activities (Pauly *et al.* 1998, Hall 1999, Myers & Worm 2003, Worm *et al.* 2005). We are now at the end of a 50-year fishing spree, and there is a transition between target stock management, to ecosystem management (Pitcher 2001, FAO 2002, Ward *et al.* 2002, Gell & Roberts 2003a). The role of MPAs as reference points, stock replenishment zones, management tools, and representative areas of marine habitats, is receiving increased attention and support (IMCRA 1998, Roberts *et al.* 2001, Ward *et al.* 2001, Roberts & Sargant 2002, Russ 2002, Gell & Roberts 2003b, Blundell 2004). Although management of Southern Ocean and Antarctic resources is well developed under CCAMLR, the protection of representative habitats is still in its infancy. We hope that this study will provide a starting point for further systematic studies in the region. We stress that the fisheries benefits of MPAs are separate from the role of MPAs in biodiversity protection.

The ability of MPAs to meet fisheries and biodiversity objectives depends upon an accurate description of the threats facing the region, the risks of these threats, and the strength of management actions to deal with these threats. At present, longline fishing for the Patagonian toothfish poses the greatest threat to marine biodiversity in our study area. Various measures are in place to deal with the negative effects of this fishery (e.g. altered fishing methods and increased capacity to combat IUU vessels), but other threats are increasing, for example, improved fishing gear that allows even deeper fishing (Roberts 2002), the potential for oil and gas exploration, increased shipping activity and associated negative effects, and the unpredictable consequences of climate change (Smith 2002). Although appropriate management plans can mitigate most of these threats, how do we deal with climate change in MPA design? In this study, we have tackled the problem by developing spatial surrogates for ecosystem processes, and by placing reserve boundaries to capture these processes. The boundaries also traverse latitudinal and longitudinal gradients, thereby maximizing the chances of incorporating the shifting position of the oceanic fronts. These fronts are critical to the offshore component of the Prince Edward Islands' life support system, and operate over very large scales. There is evidence that the average position of the SAF is shifting south, and that this movement is favouring the flowthrough system that supports the offshore feeders, over the retention system that supports the inshore feeders (Pakhomov and Chown 2003). Ongoing monitoring of the bird and seal populations on the islands and their movement patterns, as well as and the position of the fronts, is required if we wish to adapt the MPA boundaries in time.

Although the provisional MPA boundaries in Fig. 8 meet most of the targets defined for the study, the design rules force us to accept a trade off. This trade off means that the following targets fall outside of the "no-take" Category IA and IV reserves: 23% of the areas potentially rich in fish; remaining targets for five of the 21 benthic habitats; and three of the 11

seamounts. Meeting these targets will require the expansion of the Category IA and IV reserves to include almost all of the northern half of the EEZ.

There is another trade off that requires evaluation. The provisional Category IA and IV reserve boundaries in Fig. 8 may be one of the best possible solutions to meeting biodiversity process and pattern targets, but do they address the socio-economic component of the Patagonian toothfish fishery? We used a design rule that avoided more recent fishing grounds, but that allocated "no-take" reserves in older (over-exploited) fishing grounds. Adopting these boundaries will allow fishing activity to move serially to new fishing grounds as older ones are depleted. Given that the Patagonian toothfish is a demersal long-lived species, associated with seamounts (300-1500 m), perhaps this is not the best long-term strategy. The alternative would be to close off the newer fishing grounds while allowing fishing to continue in older grounds, but these older grounds overlap with the proposed Category IA and IV reserves that meet most targets for most biodiversity patterns and processes. The trade off is thus between biodiversity targets, and long versus short-term fishery rewards.

We have suggested that the MPA boundaries proposed here may need to be changed in the future to accommodate shifting processes, and these changes may also be driven by new data becoming available. There are some obvious gaps in the data upon which this preliminary planning was based. For example, no data exist on the foraging grounds of fur seals, king penguins, and other bird species. However, foraging areas of seabirds tracked from the adjacent Crozet Islands (sooty and wandering albatrosses and white-chinned petrels, BirdLife 2004), overlap largely with those from the Prince Edward Islands. Of note is the importance of the axis between the two islands, along the Del Cano Rise (Fig. 2). Many birds use this movement axis, and this emphasises the importance of co-management of Southern Ocean resources by neighbouring countries, and the areas of high seas in-between.

Benthic habitat data are another obvious gap, and we attempted to overcome this problem by using bathymetry and sediment thickness data as habitat surrogates. Only quantitative surveys in the EEZ will enable us to test these surrogates, but al least our stratification of the EEZ can serve as a starting point for planning future surveys.

4.1 Implementation issues

It is intended that the Prince Edward Islands Marine Protected Area will be zoned for management purposes. The exact nature and regulatory regime of each zone remain under discussion, but we provide the following recommendations for the three categories of reserves proposed in this study:

Category IA reserves (Strict Nature Reserve): These four reserves will be strictly protected with allowed activities restricted to approved scientific research conducted under permit.

Within the PEI reserve (Fig. 8), additional activities allowed will include those logistics necessary to supply and service the meteorological station on Marion Island. However, it is proposed that fishing vessels will be allowed to request entry to this reserve to take temporary shelter from storms in the islands' lee and to affect repairs that require relatively calm waters. It is intended that the whole of the 40 km buffer around the islands (this includes both islands' territorial waters) will be included in the PEI reserve (Fig. 8), and together with the islands, will form a Category IA reserve with both terrestrial and marine components.

Category IV reserves (Habitat/Species Management Area): These reserves (the three axes) will serve several purposes: they will link the four Category IA reserves situated within the EEZ and provide protection for foraging seabirds and elephant seals, especially during their breeding seasons. Like the Category IA reserves, they will also be "no-take" reserves, where no commercial activities (e.g. trawling or longline fishing) will be allowed, so that they may, inter alia, serve as a nursery for fish of commercial importance (such as Patagonian toothfish on sea mounts and rises). It is envisaged that vessels will be allowed to exercise their "right of passage" through these areas, and that non-consumptive activities (e.g. ship-based ecotourism, as well as scientific research) will be allowed.

Category VI reserves (Managed Resource Protected Area): The balance of the EEZ around the Prince Edward Islands will be zoned for multiple use, and might not formally fall within the declared Marine Protected Area. Commercial fishing will be allowed within this zone, but under a regulatory regime that may be restricted to longlining only (i.e. no demersal trawling will be allowed). Longlining will be operated under a quota system and will follow existing CCAMLR conservation measures to minimize seabird mortality, possibly including a closed season in summer months when most of the species at risk are breeding. Furthermore, all fishing vessels will be obliged to carry fishery observers, as is currently the case. Enforcement, particularly with respect to IUU vessels, will come by way of regular patrols by South African fishery protection vessels.

The above zoning scenario is preliminary, and will continue to be fully discussed by way of stakeholder meetings with representatives of commercial (especially fishing) interests, environmental non-governmental organizations, scientists active in the sub-Antarctic and Southern Ocean, government structures and the interested public. This process, currently underway, will also determine the exact boundaries of the MPA, and of each of its zones. Once agreement is reached on these issues, it is then intended to produce and adopt a comprehensive management plan for the MPA, so that it can be effectively managed from its promulgation. The management plan will also be subjected to a consultative process before its adoption.

4.2 Review of objectives

The study had as its starting point an announcement by the South African government of its desire to proclaim a large MPA in the EEZ of the Prince Edward Islands. This MPA would serve the dual objectives of recovery of the Patagonian toothfish stock and conservation of marine biodiversity. The decision was made to follow a scientifically defensible and systematic process to identify an MPA that would conserve biodiversity, allow for sustainable fisheries and comprise sensible marine boundaries. By following this approach it was hoped that the MPA would have broad stakeholder support thus ensuring its implementation and persistence. Despite the difficulties associated with a data poor region like the Prince Edward Island EEZ, the resultant proposed MPA largely satisfies the objectives for which it was designed and has had initial stakeholder support. It terms of achieving conservation targets a trade off exists between a few biodiversity features (fish, 5 benthic habitats and three sea mounts) and fishing activity in the region. This trade off, together with the expected advent of new data, climate change impacts and the fact that over 34% of the EEZ is required in Category IA and IV reserves, will require innovative management of the MPA, as well as future iterations of the conservation plan, in order to shift boundaries as and when required.

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6. REFERENCES

- Allanson, B.R., Boden, B., Parker, L. & Duncombe Rae, C. 1985. A contribution to the oceanology of the Prince Edward Islands. *In* Siegfried, W.R., Condy, P.R. & Laws, R.M., eds. *Antarctic Nutrient Cycles and Food Webs*. Berlin Heidelberg: Springer-Verlag, 38–45.
- Ansorge, I.J., Froneman, P.W., Pakhomov, E.A., Lutjeharms, J.R.E., Perissinotto, R. & Van Ballegooyen, R.C. 1999. Physical-biological coupling in the waters surrounding the Prince Edward Islands (Southern Ocean). *Polar Biology*, **21**, 135–145.

- Attwood, C.G., Lucas, M.I., Probyn, T.A., McQuaid, C.D. & Fielding, P.J. 1991. Production and standing stocks of the kelp *Macrocystis laevis* Hay at the Prince Edward Islands, Sub-Antarctic. *Polar Biology*, **11**, 129–133.
- Aucamp, R. 2004. Extract from remarks by Marthinus van Schalkwyk. Minister of Environmental Affairs and Tourism. Kalk Bay Harbour.
- Ball, I.R. &. Possingham, H.P. 2000. MARXAN (V1.8.2): Marine Reserve Design Using Spatially Explicit Annealing, a Manual.
- Balmford, A. 2003. Conservation planning in the real world: South Africa shows the way. *Trends in Ecology and Evolution*, **18**, 435–438.
- Balmford, A., Mace, G. & Ginsberg, J.R. 1998. The challenges to conservation in a changing world: putting processes on the map. *In* Mace, G., Balmford, A. & Ginsberg, J.R., *eds. Conservation in a Changing World.* Cambridge: Cambridge University Press, 1–28.
- Barange, M., Pakhomov, E.A., Perissinotto, R., Froneman, P.W., Verheye, H.M., Taunton-Clark, J. & Lucas, M.I. 1998. Pelagic community structure of the Subtropical Convergence region south of Africa and in the mid-Atlantic Ocean. *Deep-Sea Research I*, **45**, 1663–1687.
- Beckley, L. & Branch, G.M. 1992. A quantitative SCUBA-diving survey of the sublittoral macrobenthos at sub-Antarctic Marion Island. *Polar Biology*, **11**, 553–563.
- Bergstrom, D. &. Chown, S.L. 1999. Life at the front: history, ecology and change on southern ocean islands. *Trends in Ecology and Evolution*, **14**, 472–77.
- BirdLife International. 2000. *Threatened Birds of the World*. Barcelona & Cambridge, UK: Lynx Edicions & BirdLife International, 852 pp.
- BirdLife International. 2004. *Tracking ocean wanderers: the global distribution of albatrosses and petrels.* Results from the Global Procellariiform Tracking Workshop, 1-5-September, 2003, Gordon's Bay, South Africa. Cambridge, UK: BirdLife International.
- Blankley, W.O. 1982. Feeding ecology of three inshore fish species at Marion Island (Southern Ocean). South African Journal of Zoology, 17, 164–170.
- Blundell, T. 2004. *Turning the tide. Addressing the Impact of Fisheries of the Marine Environment.*Summary of the Royal Commission on Environmental Pollution's Report. London: The Royal Commission on Environmental Pollution.
- Bost, C.A., Georges, J.Y., Guinet, C., Cherel, Y., Pütz, K., Charrassin, J.B., Handrich, Y., Zorn, T., Lage, J. & Le Maho, Y. 1997. Foraging habitat and food intake of satellite-tracked king penguins during the austral summer at Crozet Archipelago. *Marine Ecology Progress Series*, **150**, 21–33.
- Bradshaw, C.J.A., McMahon, C.R., Hindell, M.A., Pistorius, P.A. & Bester, M.N. 2002. Do southern elephant seals show density dependence in fecundity? *Polar Biology*, **25**, 650–655.
- Branch, G.M., Attwood, C.G., Gianakouras, D. & Branch, M.L. 1993. Patterns in the benthic communities on the shelf of the sub-Antarctic Prince Edward Islands. *Polar Biology*, **13**, 23–34
- Brandão, A., Watkins, B.P., Butterworth, D.S. & Miller, D.G.M. 2002. A first attempt at an assessment of the Patagonian Toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands EEZ, *CCAMLR. Science*, **9**, 11–32.

- Brown, C.R. 1987. Traveling speed and foraging range of macaroni and rockhopper penguins at Marion Island. *Journal of Field Ornithology*, **58**, 2, 118–125.
- Chown, S.L., Gaston, K.J. & Williams, P.H. 1998a. Global patterns in species richness of pelagic seabirds: the Procellariiformes. *Ecography*, **21**, 342–350.
- Chown, S.L., Gremmen, N.J.M. & Gaston, K.J. 1998b. Ecological biogeography of southern ocean islands: species-area relationships, human impacts, and conservation. *The American Naturalist*, **152**, 4, 562–575.
- Chown, S.L., Rodrigues, S.L., Gremmen, J.M. & Gaston, K.J. 2001. World heritage status and conservation of southern ocean islands. *Conservation Biology*, **15**, 3, 550–557.
- Condy, P.R. 1981. Annual food consumption and seasonal fluctuations in biomass of seals at Marion Island. *Mammalia*, **45**, 21–30.
- Cooper, J. & Brooke, R.K. 1981. A bibliography of seabirds in the waters of southern Africa, the Prince Edward and Tristan groups. South African National Scientific Programmes Report, No. 48, 297 pp.
- Cowling, R.M., R.L. Pressey, A.T. Lombard, P.G. Desmet & Ellis, A.G. 1999. From representation to persistence: requirements for a sustainable system of conservation areas in the species-rich mediterranean-climate desert of southern Africa. *Diversity and Distributions*, **5**, 51–71.
- Cowling, R.M., Pressey, R.L., Rouget, M. & Lombard, A.T. 2003. A conservation plan for a global biodiversity hotspot the Cape Floristic Region, South Africa. *Biological Conservation*, **112**, 191–216.
- Crawford, R.J.M. & Cooper, J. 2003. Conserving surface-nesting seabirds at the Prince Edward Islands: the roles of research, monitoring and legislation. *African Journal of Marine Science*, **25**, 415–426.
- Crawford, R.J.M., Hurford, J., Greyling, M. & Nel, D.C. 1998. Population size and trends of some seabirds at Marion Island. *New Zealand Natural Sciences Supplement*, **23**, 42.
- De Villiers, A.F. 1976. Littoral ecology of Marion and Prince Edward Islands (Southern Ocean). *South African Journal of Antarctic Research*, Supplement **1**, 40 pp.
- Duncombe Rae, C.M. 1989. Frontal systems encountered between southern Africa and the Prince Edward Islands during April/May 1987. South African Journal of Antarctic Research, **19**, 21–25.
- Environment Australia. 2001. Macquarie Island Marine Park Management Plan. Canberra.
- Environment Australia. 2002. *Heard Island and McDonald Islands Marine Reserve Proposal.*Canberra.
- FAO. 2002. FAO Guidelines on the ecosystem approach to fisheries (Final Draft). Rome: FAO.
- Ferrier, S., Pressey, R.L. & Barrett, T.W. 2000. A new predictor of the irreplaceability of areas for achieving a conservation goal, its application to real-world planning, and a research agenda for further refinement. *Biological Conservation*, **93**,303–325.
- Frenot, Y., Chown, S.L., Whinam, J., Selkirk, P.M., Convey, P., Skotnicki, M. & Bergstrom, D.M. 2005. Biological invasions in the Antarctic: extent, impacts and implications. *Biological Review*, **80**, 45-72.

- Froneman, P.W. & McQuaid, C.D. In press. Chapter 5. Biology of the oceanographic environment. *In* Chown. S.L. & Froneman, P.W., *eds.* The Prince Edward Archipelago. *Land-sea interactions in a changing ecosystem.* Cambridge: Cambridge University Press.
- Froneman, P.W., Ansorge, I.J., Vumazonke, L. Gulekana, K., Bernard, K., Webb, A.M., Leukes, W., Risien, C.M., Thomalla, S., Hermes, J., Knott, M., Anderson, D., Hargey, N., Jennings, M., Veitch, J., Lutjeharms, J.R.E. & McQuaid, C.D. 2002. Physical and biological variability in the Antarctic Polar Frontal Zone: report on the research cruise 104 of the M.V. S.A. Agulhas. *South African Journal of Science*, **98**, 534–536.
- Frost, P.G.H. 1979. Seabird distribution and the transport of nutrients from marine to terrestrial ecosystems. *South African Journal of Antarctic Research*, **9**, 20–27.
- Gales, R. 1998. Albatross populations: status and threats. *In* Robertson, G. & Gales, R., *eds. Albatross Biology and Conservation*. Surrey Beatty: Chipping Norton, 20–45.
- Gell, F.R. & Roberts, C.M. 2003a. Benefits beyond boundaries: The fishery effects of Marine reserves. *Trends in Ecology and Evolution*, **18**, 9, 448–455.
- Gell, F.R. & Roberts, C.M. 2003b. *The fishery effects of marine reserves and fishery closures.* Washington, DC: WWF-US.
- Gon, O. & Heemstra, P.C., eds. 1990. Fishes of the Southern Ocean. Johannesburg: Macmillan South Africa, 462 pp.
- Gon, O. & Mostert, D. 1992. Aspects of the ecology of two nototheniid fish species in the inshore zone of the sub-Antarctic Marion Island. *South African Journal of Antarctic Research*, **22**, 59–67.
- Hall, S.J. 1999. *The Effects of Fishing on Marine Ecosystems and Communities*. Oxford: Blackwell Science.
- Hänel, C. & Chown, S. 1998. *An Introductory Guide to the Marion and Prince Edward Island Special Nature Reserves.* Pretoria: Department of Environmental Affairs and Tourism.
- Hänel, C. & Chown, S.L. 1999. Fifty years at Marion and Prince Edward Islands: a bibliography of scientific and popular literature. *South African Journal of Science*, **95**, 87–112.
- Hofmeyr, G.J.G. & Bester, M.N. 1997. Changes in population sizes and distribution of fur seals at Marion Island. *Polar Biology*, **17**, 150–58.
- Hooge, P.N. & Eichenlaub, B. 1997. *Animal movement extension to Arcview. Version 1.1.* Alaska Anchorage, AK, USA: Biological Science Center, U.S. Geological Survey.
- Hutchings, J. 2000. Collapse and recovery of marine fishes. Nature, 406, 882-885.
- IMCRA (Interim Marine and Coastal Regionalisation for Australia Technical Group). 1998. Interim Marine and Coastal Regionalisation for Australia: an ecosystem-based classification for marine and coastal environments. Version 3.3. Canberra: Environment Australia, Commonwealth Department of the Environment.
- Jonker, F.C. & Bester, M.N. 1998. Seasonal movements and foraging areas of adult southern female elephant seals, *Mirounga leonine*, from Marion Island, *Antarctic Science*, **10**, 21-30.
- Klages, N.T.W. & Bester, M.N. 1998. Fish prey of fur seals *Arctocephalus spp.* at subantarctic Marion Island. *Marine Biology*, **131**, 559–566.

- Knight, A.T., Driver, A., Cowling, R.M., Maze, K., Boshoff, A.F., Botha, M., Castley, J.G., Desmet, P.G., Goodman, P., Lombard, A.T., Mackinnon, K., Pierce, S.M., Rouget, M., Sims-Castley, R., Stewart, W., & von Hase, A. In press. Improving our practice through collaborative learning: perspectives and lessons from planning living landscapes in South Africa. *Conservation Biology.*
- Lombard, A.T., Strauss, T., Harris, J., Sink, K., Attwood, C. & Hutchings, L. 2004. *South African National Spatial Biodiversity Assessment 2004: Technical Report.* Volume 4: Marine Component. Pretoria: South African National Biodiversity Institute, 26–37.
- Lutjeharms, J.R.E. 1985. Location of frontal systems between Africa and Antarctica: some preliminary results. *Deep-Sea Research*, **32**, 1499–1509.
- Lutjeharms, J.R.E. 1991. A history of recent South African marine research in the Southern Ocean. South African Journal of Antarctic Research, **21**, 159–64.
- Lutjeharms, J.R.E. & Valentine, H.R. 1984. Southern Ocean thermal fronts south of Africa. *Deep-Sea Research*, **31**, 1461–1476.
- Lutjeharms, J.R.E., Jamaloodien, S. & Ansorge, I.J. 2002. The temporal displacement of ocean fronts south-east of Africa. *South African Journal of Science*, **98**, 304–306.
- Margules, C.R. and Pressey, R.L. 2000. Systematic conservation planning. Nature 405: 243-253
- McMahon, C.R., Burton, H.R. & Bester, M.N. 2003. *A demographic comparison of two Southern Elephant Seal populations*. Journal of Animal Ecology, **72**, 61–74.
- McMahon, C.R., Hindell, M.A., Burton, H.R. & Bester, M.N. 2005. Comparison of southern elephant seal populations, and observations of a population on a demographic knife-edge. *Marine Ecology Progress Series*, **288**, 273–283.
- Mélice, J-L., Lutjeharms, J.R.E. Rouault, M., & Ansorge, I.J. 2003. Sea-surface temperatures at the sub-Antarctic islands Marion and Gough during the past 50 years. *South African Journal of Science*, **99**, 363–366.
- Myers, R.A. & Worm, B. 2003. Rapid worldwide depletion of predatory fish communities. *Nature*, **423**, 280-283.
- Myers, R.A., Hutchings, J.A. & Barrowman, N.J. 1997. Why do fish stocks collapse? The example of cod in Atlantic Canada. *Ecological Applications*, **7**, 91-106.
- Nel, D.C. & Nel, J.L. 1999. Marine debris and fishing gear associated with seabirds at sub-antarctic Marion Island, 1996/97 and 1997/98: In relation to longline fishing activity, CCAMLR. *Science*, **6**, 85–96.
- Nel, D.C., Lombard, A.T., Akkers, T., Cooper, J. & Reyers, B. 2005. Progress towards the declaration of a large Marine Protected Area around South Africa's sub-Antarctic Prince Edward Islands. CCAMLR Workshop on Marine Protected Areas 29 August to 1 September 2005, WS-MPA-05/15. MD, USA: Silver Spring.
- Nel, D.C., Lutjeharms, J.R.E., Pakhomov, E.A., Ansorge, I.J., Ryan, P.G. & Klages, N.T.W. 2001. Exploitation of mesoscale oceanographic features by grey-headed albatrosses *Thalassarche chryosostoma* in the southern Indian Ocean. *Marine Ecology Progress Series*, **217**, 15–26.

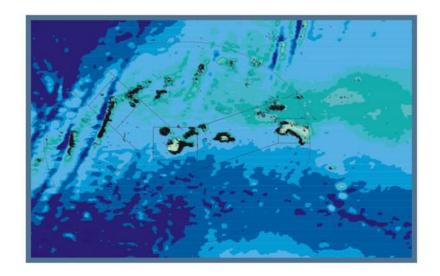
- Nel, D.C., Nel, J.C., Ryan, P.G., Klages, N.T.W., Wilson, R.W. & Robertson, G. 2000. Foraging ecology of Grey-headed Mollymawks at Marion Island, southern Indian Ocean, in relation to longline fishing activity. *Biological Conservation*, 96, 219–231.
- Nel, D.C., Ryan, P.G., Crawford, R.J.M., Cooper, J. & Huyser, O.A.W. 2002a. Population trends of albatrosses and petrels at sub-Antarctic Marion Island. *Polar Biology*, **25**, 81–89.
- Nel, D.C., Ryan, P.G., Nel, J.L., Klages, T.W., Wilson, R.P., Robertson, G. & Tuck, G.N., 2002b. Foraging interaction between Wandering Albatrosses *Ciomedea exulans* breeding on Marion Island and long-line fisheries in the southern Indian Ocean. *Ibis*, **144** (on-line), E141–E154.
- Nel, D.C., Ryan, P.G. & Watkins, B.P. 2002c. Seabird mortality in the Patagonian Toothfish longline fishery around the Prince Edward Islands, 1996-2000. *Antarctic Science*, **14**, 151–161.
- Nel, D.C., Taylor, F., Ryan, P.G. & Cooper, J. 2003. Population dynamics of the wandering albatross *Diomedea exulans* at Marion Island: longline fishing and environmental influences. *African Journal of Marine Science*, **25**, 503–517.
- NOAA (National Oceanic and Atmospheric Administration). 2001a. *2-minute Gridded Global Relief Data (ETOPO2)*. National Geophysical Data Center.
- NOAA (National Oceanic and Atmospheric Administration). 2001b. Sediment thickness of the world's ocean and marginal seas. National Geophysical Data Center.
- Pakhomov, E.A. & Chown, S.L. 2003. The Prince Edward Islands: Southern Ocean oasis. *Ocean Yearbook*, **17**, 348–379.
- Pakhomov, E.A. & Froneman, P.W. 1999a. Macroplankton/micronekton dynamics in the vicinity of the Prince Edward Islands (Southern Ocean). *Marine Biology*, **134**, 501–515.
- Pakhomov, E.A. & Froneman, P.W. 1999b. The Prince Edward Islands pelagic ecosystem, south Indian Ocean: a review of achievements, 1976-1990. *Journal of Marine Systems*, **18**, 355–367.
- Pakhomov, E.A. & Froneman, P.W. 2000. Composition and spatial variability of macroplankton and micronekton within the Antarctic Polar Frontal Zone of the Indian Ocean during austral autumn 1997. *Polar Biology*, **23**, 410–419.
- Pakhomov, E.A. & Froneman, P.W., Kuun, P.J. & Balarin, M. 1999. Feeding dynamics and respiration of the bottom-dwelling Caribean shrimp *Nauticaris marionis* Bate, 1888 (Crustacea: Decapoda) in the vicinity of Marion Island (Southern Ocean). *Polar Biology*, **21**, 112–121.
- Pakhomov, E.A., Kaehler, S. & McQuiad, C.D. 2002. Zooplankton community structure in the kelp beds of the sub-Antarctic Prince Edward Archipelago: are they a refuge for larval stages? *Polar Biology*, **25**, 778–788.
- Pakhomov, E.A., Perissinotto, R., McQuiad, C.D. & Froneman, P.W. 2000. Zooplankton structure and grazing in the Atlantic sector of the Southern Ocean in late austral summer 1993. Part 1. Ecological zonation. *Deep-Sea Research I*, **47**, 1663–1686.
- Pauly, D. Christensen, V., Dalsgaard, J., Froese, R. & Torres, F. 1998. Fishing down marine food webs. *Science*, **279**, 860-863.
- Pauly, D., Christensen, V., Guenette S., Pitcher, T.J., Sumaila, U.R., Walters, C.J., Watson, R. & Zeller, D. 2002. Towards sustainability in world fisheries. *Nature*, **418**, 689-695.

- PEIMPWG (Prince Edward Islands Management Plan Working Group). 1996. *Prince Edward Islands Management Plan*. Pretoria: Department of Environmental Affairs & Tourism.
- Perissinotto, R. 1989. The structure and diurnal variations of the zooplankton of the Prince Edward Islands: Implications for the biomass build-up of higher trophic levels. *Polar Biology*, **9**, 505–510.
- Perissinotto, R. & Duncombe Rae, C.M. 1990. Occurrence of anticyclonic eddies on the Prince Edward Plateau (Southern Ocean): effects on phytoplankton biomass and production. *Deep-Sea Research*, **37**, 777–793.
- Perissinotto, R. & McQuaid, C.D. 1990. Role of the sub-antarctic shrimp *Nauticaris marionis* in coupling benthic and pelagic food-webs. *Marine Ecology Progress Series*, **64**, 81–87.
- Perissinotto, R. & McQuaid, C.D. 1992. Deep occurrence of the giant kelp *Macrocystis laevis* in the Southern Ocean. *Marine Ecology Progress* Series, **81**, 89–95.
- Perissinotto, R., Lutjeharms, J.R.E., & van Ballegooyen, R. C. 2000. Biological-physical interactions and pelagic productivity at the Prince Edward Islands, Southern Ocean. *Journal of Marine Systems*, **24**, 327–341.
- Pierce, S.M., R.M. Cowling, A.T. Knight, A.T. Lombard, M. Rouget & T. Wolf. 2005. Systematic conservation planning products for land-use planning: Interpretation for implementation. *Biological Conservation*, **125**, 441–458.
- Pistorius, P.A., Bester, M.N. & Kirkman, S.P. 1999a. Dynamic age-distributions in a declining population of Southern Elephant Seals. *Antarctic Science*, **11**, 445–450.
- Pistorius, P.A., Bester, M.N. & Kirkman, S.P. 1999b. Survivorship of a declining population of Southern Elephant Seals, *Mirounga leonina*, in relation to age, sex and cohort. *Oecologia*, 121, 201–211.
- Pistorius, P.A., Bester, M.N., Lewis, M.N., Taylor, F.E., Campagna, C. & Kirkman, S.P. 2004. Adult female survival, population trend, and the implications of early primiparity in a capital breeder, the Southern Elephant Seal (*Mirounga leonina*). *Journal of Zoology, London*, **263**, 107–119.
- Pitcher, T.J. 2001. Fisheries managed to rebuild ecosystems? Reconstructing the past to salvage the future. *Ecological Applications*, **11**, 601-617.
- Possingham, H.P., Ball, I.R. & Andelman, S. 2000. Mathematical methods for identifying representative reserve networks. *In* Ferson, S. & Burgman, M., *eds. Quantitative methods for conservation biology*. New York: Springer-Verlag, 291-305.
- Pressey, R.L. 1999. Applications of irreplaceability analysis to planning and management problems. Parks 9.
- Pressey, R.L., Humphries, C.L., Margules, C.R., Vane-Wright, R.I., & Williams, P.H. 1993. Beyond opportunism: Key principles for systematic reserve selection. *Trends in Ecology & Evolution*, **8**, 124–128.
- Roberts, C.M. 2002. Deep impact: the rising toll of fishing in the deep sea. *Trends in Ecology and Evolution* **242**: 242-245.
- Roberts, C.M. & Sargant, H. 2002. The fishery benefits of fully protected marine reserves: why habitat and behavior are important. *Natural Resource Modeling*, **15**, 487–507.

- Roberts, C.M. Bohnsack, J.A. Gell, F. Hawkins, J.P. & Goodridge, R. 2001. Effects of marine reserves on adjacent fisheries. *Science*, **294**, 1920-1923.
- Rodhouse, P.G., Prince, P.A., Trathan, P.N., Hatfield, E.M.C., Watkins, J.L., Bone, D.G., Murphy, E.J. & White, M.G. 1996. Cephalopods and mesoscale oceanography at the Antarctic Polar Front: satellite-tracked predators locate pelagic trophic interactions. *Marine Ecology Progress Series*, **136**, 37–50.
- Russ, G.R. 2002. Yet another review of marine reserves as reef fishery management tools. *In* Sale, P.F., ed. Coral Reef Fishes: Dynamics and Diversity in a Complex Ecosystem. San Diego: Academic Press. 421-443.
- Ryan, P.G., Boix-Hinzen, C., Enticott, J.W., Nel, D.C., Wanless, R. & Purves, M. 1997. Seabird mortality in the longline fishery for patagonian toothfish at the Prince Edward Islands: 1996-97. Document CCAMLR-WG-FSA 97/51. CCAMLR, Hobart, Australia.
- Siegfried, W.R., Forbes, P.F. & Condy, P.R. 1979. Scientific research at the Prince Edward Islands, 1847-1979: a bibliography. *South African Journal of Antarctic Research*, **9**, 35-41.
- Smith, R.J. 2004. *Conservation Land-Use Zoning (CLUZ) software*. Canterbury, UK: Durrell Institute of Conservation and Ecology.
- Smith, V.R. 1991. Climate change and its ecological consequences at Marion and Prince Edward Islands. South African Journal of Antarctic Research, **21**, 223-24.
- Smith, V.R. 2002. Climate change in the sub-Antarctic: an illustration from Marion Island. *Climatic Change* **52**: 345-357.
- Smith, V. & Froneman, P.W. In press. Chapter 7. Nutrient cycles and land-sea interactions. *In* Chown. S.L. & Froneman, P.W., *eds. The Prince Edward Archipelago. Land-sea interactions in a changing ecosystem.* Cambridge: Cambridge University Press.
- Smith, W.H.F. & Sandwell, D.T. 1997. Global Sea Floor Topography from Satellite Altimetry and Ship Depth Soundings. *Science*, **277**, 5334, 1956–1962.
- Ward, T.J., Heinemann, D. & Evans, N. 2001. The role of marine reserves as fisheries management tools: a review of concepts, evidence and international experience. Kingston, Australia: Department of Agriculture, Fisheries and Forestry Australia, Bureau of Rural Sciences (BRS).
- Ward, T.J., Tarte, D., Hegerl, E.J. & Short, K. 2002. *Policy Proposals and Operational Guidance for Ecosystem-Based Management of Marine Capture Fisheries*. Sydney: WWF Australia, 80 pp.
- Williams, A.J., Siegfried, W.R. Burger, A.I. & Berruti, A. 1979. The Prince Edward Islands: a sanctuary for seabirds in the Southern Ocean. *Biological Conservation*, **15**, 59-71.
- Wilson, R.P., Nagy, K.A. & Obst, B.S. 1989. Foraging ranges in penguins. *Polar Record*, **25**, 155, 303–307.
- Worm, B., Sandow, M., Oschlies, A., Lotze, H.K. & Myers, R.A. 2005. Global patterns of predator diversity in the open oceans. *Science*, **309**, 1365-1369.

PART 2

UPDATED MAPS AND STATISTICS OF THE LEGAL PATAGONIAN TOOTHFISH (Dissostichus Eleginoides)
FISHERY IN SOUTH AFRICA'S EXCLUSIVE ECONOMIC ZONE AT THE PRINCE EDWARD ISLANDS



UPDATED MAPS AND STATISTICS OF THE LEGAL PATAGONIAN TOOTHFISH (Dissostichus eleginoides) FISHERY IN SOUTH AFRICA'S EXCLUSIVE ECONOMIC ZONE AT THE PRINCE EDWARD ISLANDS

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1. PROJECT DESCRIPTION

This document follows the report by Lombard *et al.* (2005) and a submitted manuscript (Lombard *et al.* 2006) in which a conservation plan for South Africa's Prince Edward Islands delineated proposed boundaries for a marine protected area within the Exclusive Economic Zone at the islands. Since the report was produced, updated information for the legal Patagonian toothfish fishery within the area was made available by CCAMLR (the Commission on the Conservation of Antarctic Marine Living Resources) and CAPFISH (Capricorn Fisheries Monitoring cc). These new data have been collated, mapped and analysed within this report.

2. DATA DICTIONARY

A complete data dictionary of all the source data and analysed data is provided on the CD (accessed from WWF South Africa on request) in the file: Fishing_data_May06 data dictionary.xls. ArcView 3.2 software was used to create and display all GIS maps. All spatial data are presented in decimal degrees on the WGS 84 spheroid.

Citation: A.T. Lombard. 2008. Updated maps and Statistics of the Legal Patagonian Toothfish (*Dissostichus Eleginoides*) Fishery in South Africa's exclusive Economic Zone at the Prince Edward Islands. *In:* Nel D. & Omardien A. (eds). *Towards the Development of a Marine Protected Area at the Prince Edwards Islands.* WWF South Africa Report Series - 2008/Marine/001.

3. PROPOSED BOUNDARIES AND ZONES OF THE MPA (MARINE PROTECTED AREA)

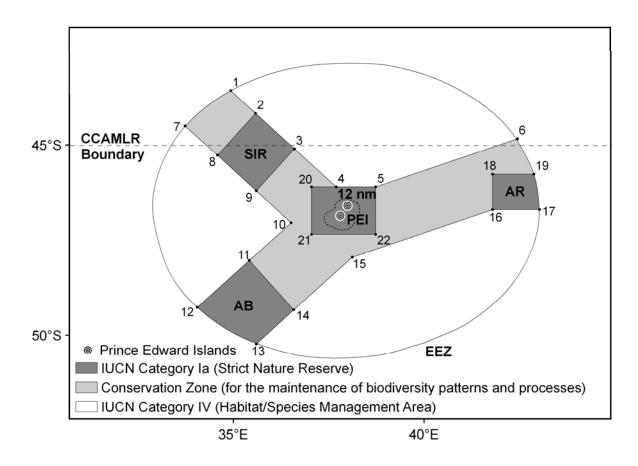


Fig. 1. The proposed boundaries for the Prince Edward Islands MPA. The four Category 1a reserves are: Southwest Indian Ridge (SIR); Prince Edward Islands (PEI); Africana II Rise (AR); and Abyss (AB) (see also Table IV). The CCAMLR Convention Area lies to the south of the CCAMLR boundary. The outer oval is the South African Exclusive Economic Zone (EEZ).

4. DISTRIBUTION OF THE FISHERY

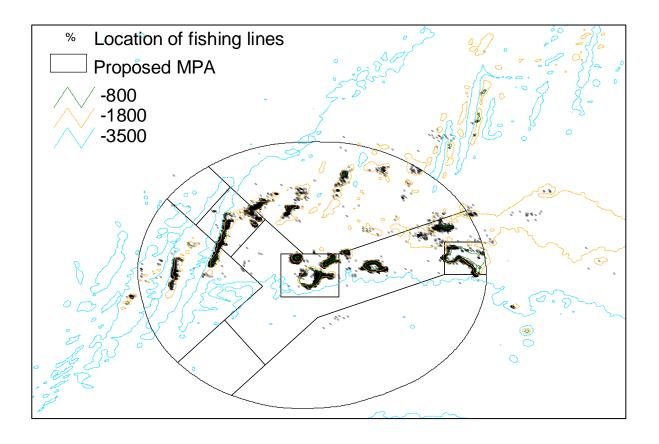
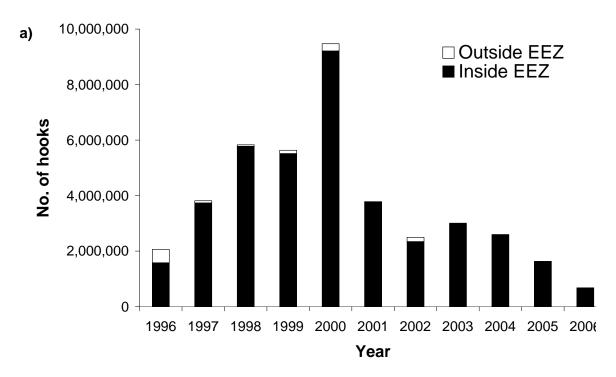


Fig. 2. The location of fishing lines set by the legal Patagonian toothfish fishery between 1996 and the first cruise of 2006. Points indicate where lines (with either hooks, pots or traps) were set, or hauled.

5. FISHING EFFORT



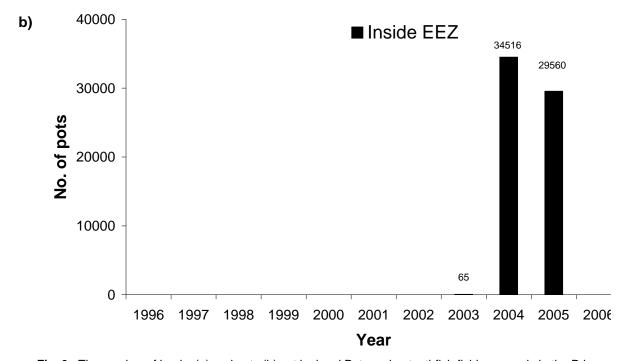
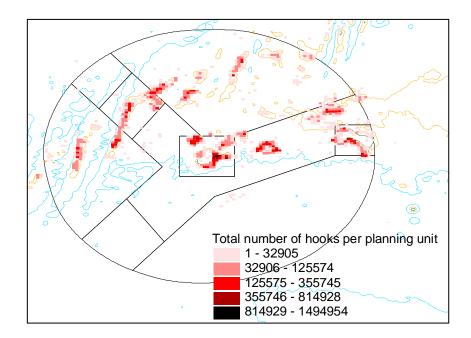


Fig. 3. The number of hooks (a) and pots (b) set by legal Patagonian toothfish fishing vessels in the Prince Edward Islands region between 1996 and the first cruise of 2006.







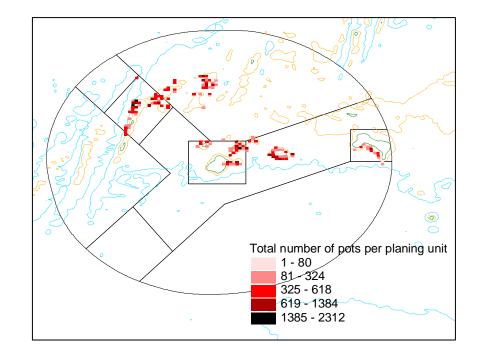
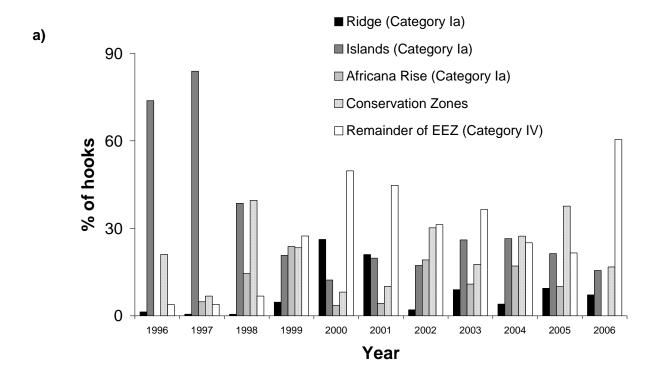


Fig. 4. The total number of hooks (a) and pots (b) per planning unit set by the legal fishery between 1996 and the first cruise of 2006. Planning units are 4 x 4 nautical miles.



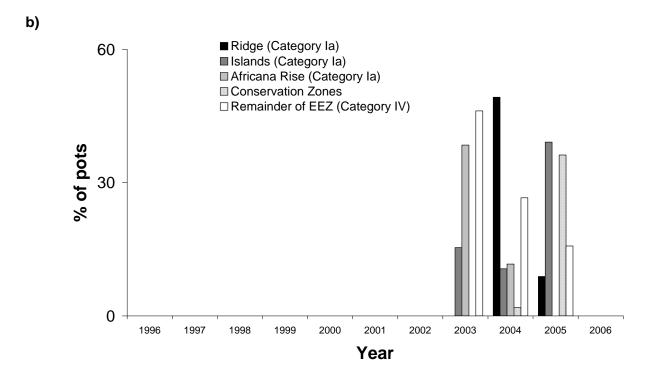


Fig. 5. The percentage of hooks (a) and pots (b) set within the zones of the proposed MPA by the legal fishery between 1996 and the first cruise of 2006.

6. FISHING CATCH

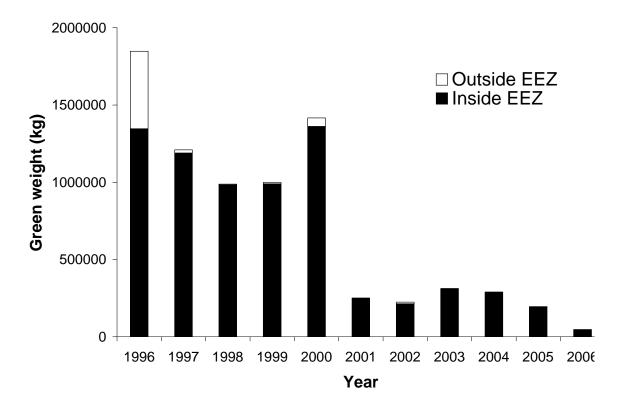
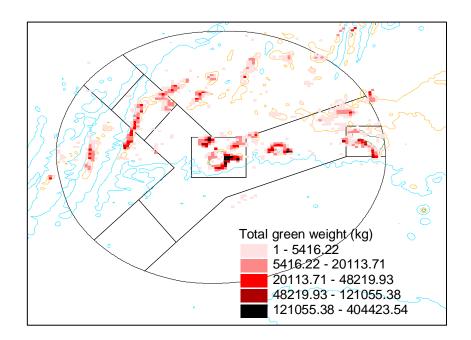


Fig. 6. The total green weight retained per year by the legal fishery between 1996 and the first cruise of 2006. Data are for lines set with hooks, pots and traps.







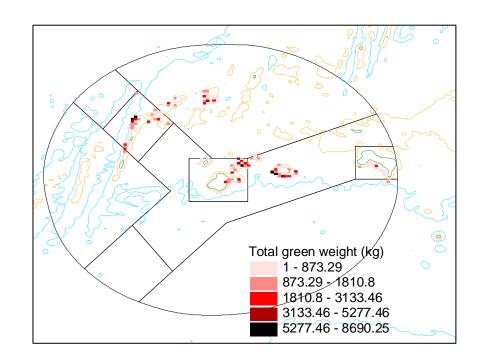
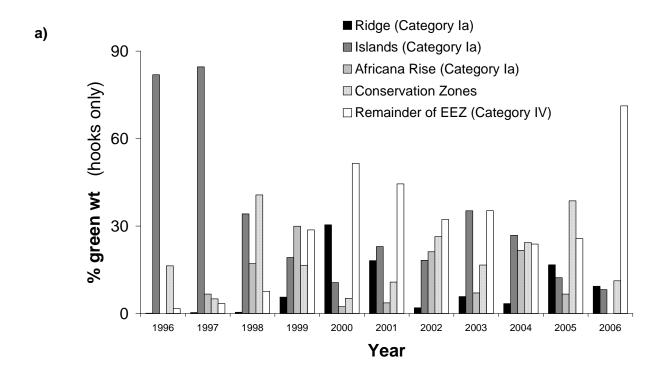


Fig. 7. The total green weight (kg) retained per planning unit by the legal fishery between 1996 and the first cruise of 2006. Data are for lines set with hooks (a) and pots (b).



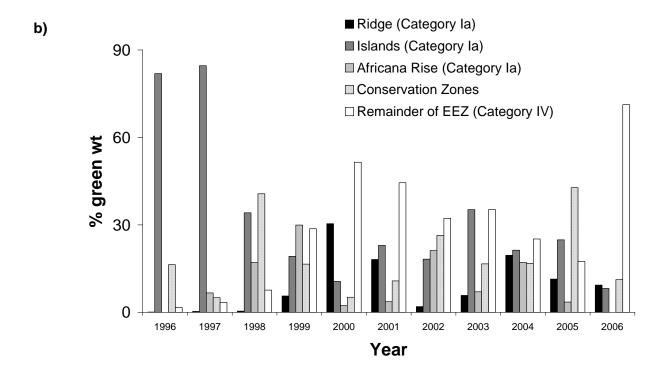


Fig. 8. The percentage green weight (kg) retained within the zones of the proposed MPA by the legal fishery between 1996 and the first cruise of 2006. Data are for hooks (a) and pots (b).

7. THE KORYO MARU

Effort, catch and catch per unit effort (CPUE) statistics were calculated for only one of the vessels, the Koryo Maru, because this vessel has conducted the majority of cruises (22) to the region since 1996 and provides a standard fishing platform from which to generate more reliable statistics. Only hooks were used by this vessel (no pots or traps).

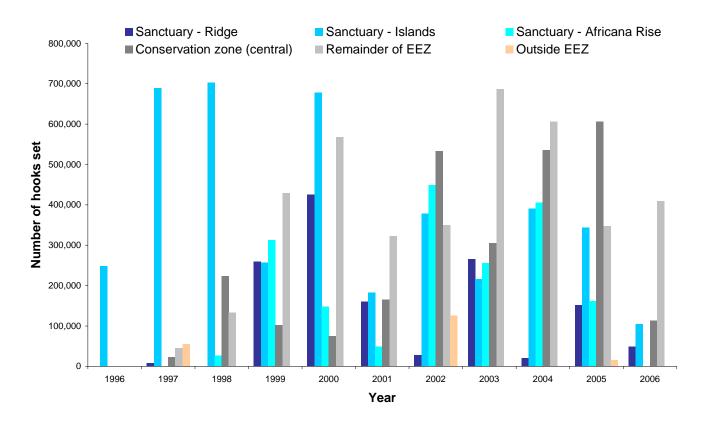
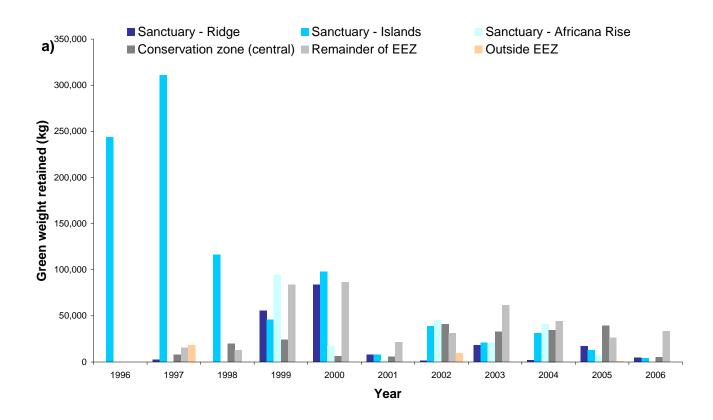


Fig. 9. The number of hooks set within the zones of the proposed MPA by the Koryo Maru between 1996 and the first cruise of 2006.

Updated Fisheries Maps and Statistics



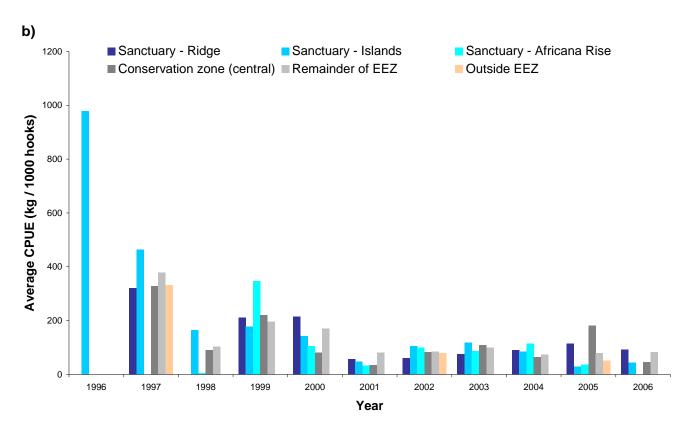


Fig. 10. The green weight (kg) retained within the zones of the proposed MPA by the Koryo Maru between 1996 and the first cruise of 2006 (a). The average CPUE per zone per year was calculated as the average of all CPUEs for each line set (b).

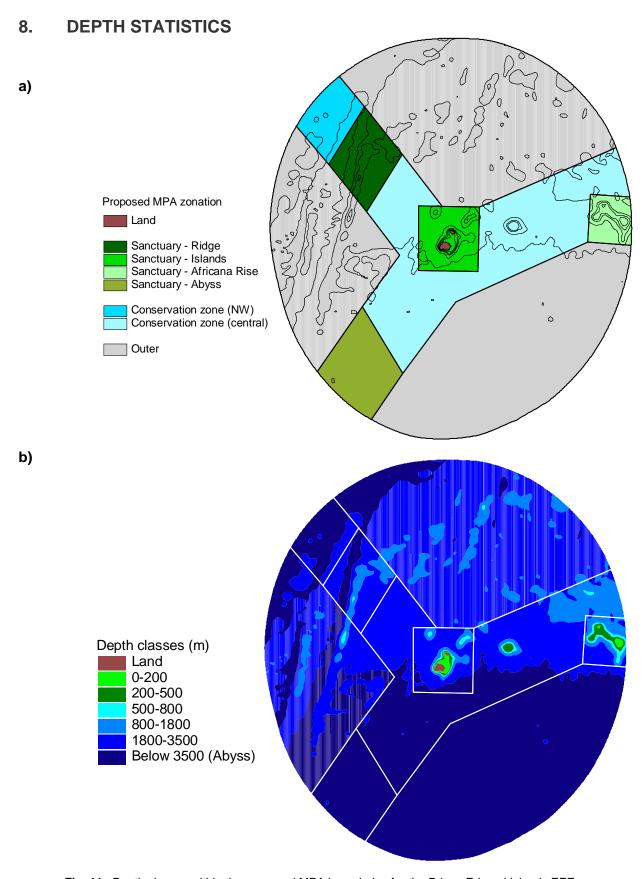


Fig. 11. Depth classes within the proposed MPA boundaries for the Prince Edward Islands EEZ.

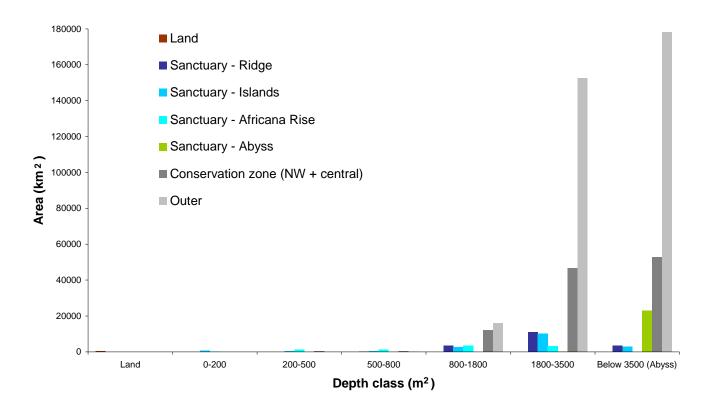


Fig. 12. The area (km²) within selected depth classes and zones of the proposed MPA for the Prince Edward Islands EEZ.

9. REFERENCES

- Lombard, A.T., B. Reyers, L. Schonegevel, J. Cooper, L. Smith-Adao, D. Nel, W. Froneman, I. Ansorge, M. Bester, C. Tosh, T. Strauss, T. Akkers, O. Gon, R. Leslie and S. Chown. 2005. Developing the Prince Edward Islands Marine Protected Area (MPA). CSIR Report Number: CSIR/NRE/ECO/ER/2005/0013/C, South Africa.
- Lombard, A.T., B. Reyers, L.Y. Schonegevel, J. Cooper, L.B. Smith-Adao, D.C. Nel, P.W. Froneman, I.J. Ansorge, M.N. Bester, C.A. Tosh, T. Strauss, T. Akkers, O. Gon, R.W. Leslie And S.L. Chown. Conserving pattern and process in the Southern Ocean: designing a Marine Protected Area for the Prince Edward Islands. Submitted to *Antarctic Science*, March 2006.

10. ACKNOWLEDGEMENTS

Many thanks go to the pleasant and helpful data providers from Capricorn Fisheries (Chris Heinecken, Dave Japp, Sarah Wilkinson and Jan Wissema). Thanks also to Eric Appleyard at CCAMLR for providing South African datasets in rapid time. Colin Attwood and Theressa Akkers of Marine and Coastal Management provided much needed support, and Taniia Strauss helped with much of the data collation. Deon Nel was an understanding and supportive client, and I thank him and the WWF Sanlam Marine Programme and the Charl van der Merwe Trust for funding this report.

PART 3

SOUTH AFRICA'S PROPOSED MARINE PROTECTED AREA AT THE PRINCE EDWARDS ISLANDS: AN ANALYSIS OF LEGAL OBLIGATIONS, OPTIONS AND OPPORTUNITIES



SOUTH AFRICA'S PROPOSED MARINE PROTECTED AREA AT THE PRINCE EDWARD ISLANDS: AN ANALYSIS OF LEGAL OBLIGATIONS, OPTIONS AND OPPORTUNITIES

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1. EXECUTIVE SUMMARY

The marine resources of the Prince Edward Islands suffered a massive impact over the past decade, mainly due rampant Illegal, Unregulated and Unreported (IUU) fishing activity for Patagonian toothfish. This was amongst the reasons behind the South African Minister of Environmental Affairs and Tourism's announcement in June 2004, to declare 'one of the largest Marine Protected Areas (MPAs) in the world' around the Prince Edward Islands. Subsequent to this announcement, the Department of Environmental Affairs and Tourism (DEAT) and the WWF Sanlam Marine Programme combined resources to develop a marine conservation plan that will inform the delineation of the proposed MPA.

The Prince Edward Islands are the sovereign territory of South Africa as declared in the Prince Edward Islands Act 43 of 1948, and South Africa asserts its right under the 1982 United Nations Law of the Sea Convention (LOSC) to a 12 nautical mile territorial sea and a 200 nautical mile exclusive economic zone (EEZ), through its Maritime Zones Act 15 of 1994. However, most of the EEZ surrounding the islands also falls within the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) area of competence, to which South Africa is a member. Although, nothing can derogate from South Africa's sovereign rights in its EEZ, international law (through the LOSC and the UN Fish Stocks Agreement (UNFSA)) requires South Africa to implement management measures that are compatible with those of CCAMLR.

Although the LOSC confers sovereign rights on coastal States to explore and exploit the marine resources of their EEZ, it also places a general obligation on these States to protect and preserve the marine environment through 'proper conservation and management measures' that can include, amongst other, 'fishing area regulations'. South Africa's membership to the 1992 Convention on Biological Diversity (CBD), obligates the State to plan and develop protected area networks.

Citation: D.C. Nel. 2008. South Africa's Proposed Marine Protected Area at the Prince Edward Islands: An Analysis of Legal Obligations, Options and Opportunities. *In:* Nel D. & Omardien A. (eds). *Towards the Development of a Marine Protected Area at the Prince Edwards Islands.* WWF South Africa Report Series - 2008/Marine/001.

The CBD's application to the marine environment was developed through the 1995 Jarkarta mandate and culminated in the advice to the 8th Conference of Parties, which set a global goal to develop a representative global network of MPAs by 2012. South Africa has also publicly committed itself to two global policy statements, the 2002 World Summit on Sustainable Development (WSSD) and the 2003 World Parks Congress, that collectively require States to develop representative networks of MPAs that amount to at least 20-30% of each marine habitat. South Africa's participation in the Agreement for the Conservation of Albatrosses and Petrels (ACAP) also obligates the State to protect the foraging and migration habitats of four species of albatross that breed on the Prince Edward Islands.

CCAMLR, the principle regional body dealing with conservation of biodiversity and management of fisheries in the Southern Ocean, is firmly based on an ecosystem approach to harvesting activities and makes explicit provision for the use of closed marine areas for the purposes of protection and scientific study. The 24th meeting of the Commission, held in 2005, concluded that the development of a representative network of MPAs in the convention area had considerable potential for furthering the objectives of the convention.

All existing MPAs in South Africa are declared in terms of the Marine Living Resources Act 18 of 1998 (MLRA). However, the Prince Edward Islands themselves are currently declared as a Special Nature Reserve under the National Environmental Management: Protected Areas Act 57 of 2003 (NEMPA) with the boundary set at the high water mark. Extension of the Special Nature Reserve status to include the 12 nautical mile territorial sea is being investigated by the Prince Edward Islands Management Committee. The MLRA allows the Minister of Environmental Affairs and Tourism to regulate of a wide range of activities, including 'any activity that may adversely impact the ecosystems of that area'. This provision has been used widely to regulate inter alia the passage of fishing vessels through MPAs. Such fishing vessel 'exclusion zones' are used internationally for the main purpose of simplifying prosecution of fishing vessels within restricted zones (i.e. the State merely has to prove presence of the vessel in the area, and not actual fishing activity, which is more difficult to prove). Special Nature Reserve status under NEMPA on the other hand invokes a far more restrictive visitation regime, and sets aside protected areas exclusively for scientific purposes and monitoring. Passage of vessels not engaged in these activities would thus be prohibited from such areas.

The Maritime Traffic Act 2 of 1981 allows the Minister of Transport to regulate shipping traffic through inter alia the prescription of designated sealanes and routeing measures. Although foreign vessels enjoy the right of innocent passage within the territorial seas of coastal States under the LOSC, this right is not unconditional and coastal States may regulate the passage of vessels in respect to a number of issues, including the conservation of living marine resources. When prescribing such measures the coastal State merely needs to take into account the recommendations of the International Maritime Organization (IMO). In the EEZ of coastal States foreign vessels enjoy freedom of navigation. However, these rights are also

not unconditional and coastal States can, with the consent of IMO, adopt special measures for specific designated areas. These measures may include mandatory reporting and routeing measures. The IMO also provides for the designation of Particularly Sensitive Sea Areas (PSSAs) for areas that need special protection because of its significance for recognized ecological, socio-economic and scientific reasons. The protective measures for PSSAs are those within the purview of the IMO and include mandatory reporting and routeing measures, and 'areas to be avoided'.

One of the important outcomes of the marine biodiversity planning exercise for the Prince Edward Islands MPA was the realization that certain important ecosystem processes either straddled the EEZ boundary or were located in areas adjacent to the South African EEZ. It is held that South Africa's extended continental shelf claim (which is currently under development) could aid in the protection of these areas. However, more importantly modern developments in international law (mainly through the UNFSA) have clarified the obligation for foreign vessels fishing for stocks that straddle the EEZ boundary, to co-operate with the coastal State as well as the competent regional fisheries organization (in this case CCAMLR). Recent developments within CCAMLR suggest that this organization may be sympathetic to a proposal by South Africa for greater area protection for these important ecosystem processes adjacent to its EEZ.

Clearly the development of an MPA around the Prince Edward Islands would be futile, without the necessary enforcement and compliance measures. Recent developments within CCAMLR will allow better monitoring, control and surveillance of such areas. Firstly, the adoption of a mandatory satellite-based Vessel Monitoring System (VMS) will greatly increase the ability of member States and the Commission to monitor the movements of their vessels. Similarly, South Africa's national legislation requires all large fishing vessels (clusters A,B & C) to be fitted with VMS's. South Africa has also acquired a purpose-built fisheries patrol vessel with extended blue water capabilities, as well as four new navy corvettes. The Marine Living Resources Act allows South Africa to set a minimum financial security for vessels apprehended contravening the Act, which includes the costs incurred by the State in making the arrest. This allows for cost recovery of costly surveillance exercises. South Africa is also in the process of concluding a bilateral compliance agreement with Australia, which will allow for co-operative surveillance operations around the two States' South Ocean territories.

In summary, it is submitted that the development of a MPA around the Prince Edward Islands will greatly advance South Africa's progress towards meeting its international legal obligations and policy commitments, including the:

- development of representative networks of MPAs in its waters, and
- sound conservation and management of the marine resources under its jurisdiction.

It is also held that, taking into account the arguments and recommendations put forward in this report, the development of such an MPA is:

- consistent with international and national law.
- feasible to implement, manage and enforce using current international, regional, bilateral and national legal and policy instruments.

Based on this legal analysis, the following recommendations are made for ensuring comprehensive legal protection for the marine biodiversity and resources of the Prince Edward Islands:

- 1) The proclamation of a multi-zoned MPA around the Prince Edward Islands (as illustrated in Figure 2) should be pursued entirely under section 43 of the Marine Living Resources Act. All extractive activities should be prohibited from the four IUCN Category 1a reserves, whilst controlled fishing should be permitted in the conservation zone.
- Passage of all fishing vessels should be prohibited within all four category 1a reserves within the Prince Edward Islands MPA (see figure 2); under section 43 of the Marine Living Resources Act.
- 3) Passage of all fishing vessels through other parts of the MPA (i.e. conservation zones) should be subject to mandatory reporting; under section 43 of the Marine Living Resources Act.
- 4) The 12 nautical mile territorial sea surrounding the islands, should be designated as an 'area to be avoided' by all shipping, with specific designated approach sea lanes and anchoring sites for vessels wishing to approach the island or fishing vessels wishing to seek shelter from storms. A minimum approach and anchoring distance should also be stipulated. Whilst such measures are not contingent on IMO approval, this proposal will need to be sent to IMO for its recommendations. These regulations can be passed under Marine Traffic Act as amended by section 25 (a) of the General Shipping Amendment Act.
- 5) The parts of the MPA falling outside of the territorial sea should be proposed as a mandatory reporting zone for all foreign vessels, through the appropriate IMO channels. For South African vessels, the Marine Traffic Act can be used to legislate such measures.
- 6) The Prince Edward Islands MPA should be included in South Africa's current PSSA proposal to the IMO
- 7) Bilateral surveillance co-operation agreements need to be concluded with Australia, France and Norway as soon as possible.
- 8) South Africa should put forward a proposal to CCAMLR to justify the protection of important ecosystem processes in areas adjacent to the South African EEZ, but within the CCAMLR area.

An Analysis of Legal Obligations, Options and Opportunities

- 9) South Africa should pursue the delimitation of its extended continental shelf claim in this area with urgency, as it is held that this claim can afford added to protection to these areas adjacent to the South African EEZ.
- 10) Whilst World Heritage Site status will probably not add any extra protection to the marine resources of this area on its own, such status could have a secondary effect of increased conservation and precautionary management in this area. If South Africa is to proceed with the nomination process, careful consideration should be given to not create a situation of overlapping legislative and institutional authority.

2. INTRODUCTION

2.1 Background

In June 2004, the South African Minister of Environmental Affairs and Tourism, Minister van Schalkwyk, announced South Africa's intention to declare one of the largest MPAs in the world around its sub-Antarctic Prince Edward Islands. It was clear from the announcement that the objective of the proposed MPA was for both fisheries management purposes as well as conservation of marine ecosystems and biodiversity in the area. As a first step the Minister announced that the current "no-fishing" zone would be extended from 8 to 12 nautical miles. This was done a few months later by means of an amendment to fishing regulations for licensed South African vessels fishing for Patagonian toothfish *Dissostichus eleginoides*.

This announcement followed South Africa's recent declaration of four new MPAs along its continental coastline, bringing the proportion of its coastline under MPA protection to 18%. These developments are consistent with international efforts¹ to increase the proportion of marine habitats under formal protection, and follow a greater appreciation over the last decade for the role that MPAs can play in both fisheries management and conservation of marine ecosystems².

Separate to the Minister's announcement, two other initiatives are underway that could afford increased legal protection and status of the maritime zones surrounding the Prince Edward Islands. Firstly, at the 15th meeting of the Prince Edward Islands Management Committee in January 2004, the Committee endorsed a proposal to investigate expanding the Special Nature Reserve Status to include the territorial sea around the islands. Currently the terrestrial components of the islands are managed as a Special Nature Reserve in terms of South Africa's National Environmental Management: Protected Areas Act 57 of 2003. The boundaries of the Special Nature Reserve are currently set at the low water mark. Secondly, it is also South Africa's intention to submit the Prince Edward Islands as a World Heritage Site under the 1972 World Heritage Convention³. It has been proposed that this nomination include the 12 nautical mile Territorial Sea surrounding the islands. This will have the effect of linking the two islands into a single geographic entity.

In response to the announcement of the Minister's intention to declare a large MPA in the South African Economic Exclusive Zone (EEZ) surrounding the Prince Edward Islands, the World Wide Fund for Nature (WWF) South Africa teamed up with the Department of

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See 2002 World Summit on Sustainable Development Plan of Implementation, 2003 World Parks Congress Recommendations.

² Roberts, C.M., Bohnsack, J.A., Gell, F.R., Hawkins, J.P. and Goodridge, R. (2002) Marine reserves and fisheries management. *Science* 295, 1233-1235.

³ Full Title: 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage

Environmental Affairs and Tourism to commission a marine conservation plan⁴ for the area that would inform the proposed delineation of the MPA. This plan collated all available spatial biodiversity pattern, ecosystem process and threat data (using both 'real' spatial data as well as a process of expert mapping) into a central spatial database. The proposed delineation of the MPA was then derived based on measurable conservation targets (e.g. desired proportions of habitats to be protected, ecologically important spawning grounds, feeding areas etc).

One of the important conclusions of this report was the realization that whilst the delineation of a MPA within the South African EEZ would greatly enhance the conservation status of the area, certain important ecosystem process were located adjacent to the South African EEZ (i.e. on the high seas). In order to afford complete protection and secure the ecosystem integrity of the area, the ideal network of MPAs would include protected areas with the EEZ as well as in these adjacent areas.

2.2 Threats to the marine environment surrounding the Prince Edward Islands

Prior to 1996, few human threats occurred within the South African Exclusive Economic Zone (EEZ) surrounding the Prince Edward Islands (situated in the Southern Ocean: 46° 45' S and 37° 45' E; See Figure 1). Threats to the marine biodiversity of this area either occurred outside the EEZ surrounding the islands (e.g. bycatch of seabirds in fishing operations to the north of the islands) or on the islands themselves (e.g. introduced feral cats predating on seabirds breeding on the islands). This was all to change when commercially viable stocks of Patagonian Toothfish were discovered around the Prince Edward Islands and a longline fishery was initiated in 1996. Unfortunately, South Africa was poorly prepared to manage such a fishery in the Southern Ocean and the same year saw an influx of large numbers of Illegal, Unreported and Unregulated (IUU) fishing vessels to the area. In a matter of three years these illegal fishing activities had decimated the toothfish stocks in the area and killed significant proportions of the populations of seabirds breeding on the islands through incidental mortality during fishing operations⁵. This activity went largely unchecked due to South Africa's lack of blue water fisheries patrol capacity. Increased compliance efforts in the neighbouring EEZs of France (Crozet and Kergulen Islands) and Australia (Heard and McDonald Islands) only served to worsen South Africa's predicament by simply shifting IUU fishing activity into the unprotected Prince Edward Islands' EEZ. Since the year 2000, IUU activity in the area has decreased, probably due to the low commercial viability of the stocks in this area. A small legal fishery survives in the area despite the depleted state of the stock. This fishery has been maintained mainly due to its surveillance role in the area, despite recommendations that the fishery should be closed based on stock levels.

Nel DC, Ryan PG, Watkins B. 2002. Population trends of albatrosses and petrels at sub-Antarctic Marion Island. *Polar Biology*, 25, 81–89.

⁴ Lombard et al. (2006) Conserving pattern and process in the Southern Ocean: Designing a Marine Protected Area for the Prince Edward Islands. WWF South Africa report, Stellenbosch, South Africa. www.wwf.org.za/marine

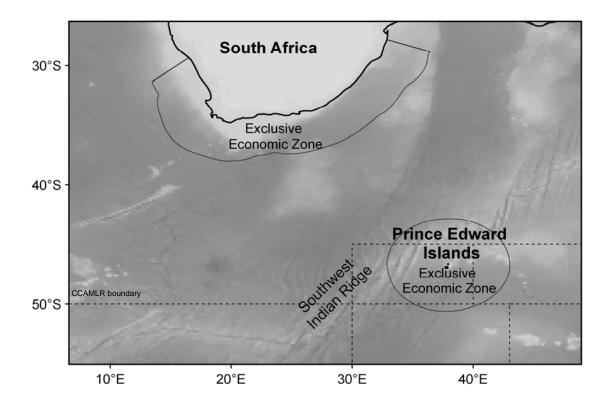


Figure 1. The position of the Prince Edward Islands and its EEZ in the Southern Ocean, in relation to CCAMLR statistical areas (dashed lines). From Lombard *et al.* 2006

Although to date longline fishing for Toothfish has been the main threat to the marine ecosystem and biodiversity in this area, we should be very aware that the Southern Ocean and Antarctica, perceived as "the last frontier" a decade ago, is currently the scene of a rapid increase in human activity and related impacts. To date these activities have been mainly related to fishing and tourism activities; however it is difficult to predict what form future threats may take. We can, however, be certain of one thing; human pressures in this area are likely to increase dramatically over the next decade.

Bottom trawling for Toothfish occurs around the neighbouring Heard & McDonald Islands (sovereign territory of Australia). This fishing practice, which has impacts on benthic biota and habitats could potentially be used in areas around the Prince Edward Islands in the future. Other marine resources that have been harvested elsewhere in the Southern Ocean and occur within the South African EEZ include crustaceans (most notably krill *Euphausia surperba* elsewhere, but other species occurring in the South African EEZ could also potentially be harvested), notothenid and myctophid fish and squid (specifically *Martiala hyadesi*). These species are important forage food for many of the top predators that breed at the islands (seabirds, seals and cetaceans) and harvesting activities could have associated impacts on these predators.

During the 1990s, an Environmental Impact Assessment (EIA) was conducted to investigate the potential of land-based tourism on the island. Although this EIA recommended against land-based tourism activities (mainly due to the restrictive Special Nature Reserve status of the islands), the close inshore area of the islands has been used for boat-based nature tourism subsequently. The MV SA Agulhas was chartered in 2002 to take bird watchers to view seabirds in the Southern Ocean. It spent several days within the Prince Edward Islands' EEZ, approaching the islands to within 100 metres of the coastline. Other potential future marine threats could include the introduction of exotic species, marine mining, bioprospecting, climate change and general shipping related risks.

In short a comprehensive legal regime is needed to protect this area from a wide range of current and potential future threats, and to allow recovery and restoration from past impacts.

2.3 Jurisdiction

The Prince Edward Islands were annexed in 1947, and are the sovereign territory of South Africa as declared in the Prince Edward Islands Act 43 of 1948. An interesting aspect of the Prince Edward Islands Act is that it limits the application of future South African Laws to only those Acts which have "specifically expressed so to apply" to the Prince Edward Islands. The Maritime Zones Act 15 of 1994 specifically expresses its application to the Prince Edward Islands⁶ and asserts South Africa's right under the United Nations Law of the Sea Convention (LOSC)⁷ to a Territorial Sea (12 nautical miles from coast) and an Exclusive Economic Zone (EEZ) extending 200 nautical miles to sea from the island's coastal baselines⁸. Since no straight baselines have been stipulated for the coast of these islands, the low water mark is taken as the coastal baseline and no internal waters exist around the islands⁹. Interestingly, the Maritime Zones Act stipulates geographical co-ordinates for a Continental Shelf around the Prince Edward Islands. However, the co-ordinates were not delineated according to the principles stipulated in Article 76 of the LOSC and have not been submitted to the Commission on the Limits of the Continental Shelf¹⁰. As such this claim lacks international validity and South Africa is at present surveying the area for the purposes of preparing an internationally valid claim to the Commission on the Limits of the Continental Shelf under the LOSC provisions.

Although South Africa enjoys sovereign rights to the natural resources in its EEZ around the PEIs, this area also falls within the geographic area of competence of the 1980 Convention for the Conservation of Antarctic Living Resources (CCAMLR) of which South Africa is a member. The LOSC stipulates that in the case where fish stocks occur within the EEZ and in the area beyond and adjacent to it, coastal States need to co-operate with other nations

⁶ Section 14

⁷ United Nations Convention on the Law of the Sea, Montego Bay, 10 December 1982. In force 16 November 1994.

⁸ LOSC Article 57

Maritime Zones Act 15 of 1994, section 2(1)

¹⁰ LOSC Article 76 (8)

fishing for these resources on the high seas, either directly or through the competent regional organizations¹¹. The UN Fish Stocks Agreement, of which South Africa is also a member, is more explicit and asserts that coastal States and States fishing for straddling stocks and highly migratory species in the adjacent areas have a "duty to co-operate for the purpose of achieving compatible measures in respect of such stocks¹²." The relevant and competent regional fisheries organisation is identified as the preferred mechanism of such co-operation. In summary then, in terms of international law, although South Africa enjoys ultimate sovereignty over the EEZ surrounding the Prince Edward Islands, it has a duty to co-operate with CCAMLR and should ensure that its conservation and management measures are 'compatible' with those of CCAMLR.

The CCAMLR regime is primarily an extension of the Antarctic Treaty System and was negotiated with the objective of protection, scientific study and rational use of Antarctic marine living resources ¹³. This was largely in response to the perceived threat of large scale krill harvesting on the dependent ecosystems of the Southern Ocean in the 1970s. The Antarctic Treaty System is underpinned by the Antarctic Treaty, which came into force in 1961. The Antarctic Treaty has itself adopted environmental protocols (most importantly the Madrid Protocol) that have pertinence to the conservation of living marine resources and protection of important marine habitats. This has led to some degree of uncertainty in terms of overlapping jurisdiction between the Antarctic Treaty and CCAMLR. A very relevant example is the unclear jurisdiction between Antarctic Treaty Parties and CCAMLR Parties in the identification of MPAs in the Antarctic Treaty area. Annex V of the Madrid Protocol to the Antarctic Treaty makes provision for the identification of marine Antarctic Specially Protected Areas (ASPAs), whilst the conservation of marine ecosystems and biodiversity falls squarely within CCAMLR's jurisdiction ¹⁴. This has resulted in the current clumsy and time consuming process of identifying these areas. Clearly, a way needs to found to streamline this process.

South Africa is a member of both the Antarctic Treaty and CCAMLR. However, potential jurisdictional uncertainty is avoided in the case of the Prince Edward Islands due to their geographical position. The Antarctic Treaty applies to all areas South of 60° S, whilst the CCAMLR area of competence is based on the Antarctic Convergence (a more meaningful marine biophysical boundary). The boundaries of CCAMLR thus differ from those of the Antarctic Treaty by including areas north of 60° S but south of prescribed latitudes and longitudes that approximate the average position of the Antarctic Convergence. The Prince Edward Islands (at 47° S) are situated north of the Antarctic Treaty boundary but within the CCAMLR area of competence (see Figure 1), and thus avoid any potential overlap in jurisdiction between these two conventions.

¹¹ LOSC Article 63

¹² 1995 United Nations Fish Stocks Agreement Article 7 (2); Full Title: 1995 Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of The Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks.

¹³ Howard M (1989) The Convention on the Conservation of Antarctic Living Marine Resources: A five year review. International and Comparative Law Quarterly, 38, 104-149

¹⁴ CCAMLR-WS-MPA-05/9 (2005) Improving the process of declaring Marine Protected Areas by CCAMLR and Antarctic Treaty Parties. Delegation of Australia, CCAMLR MPA Workshop 29 August – 1 September 2005, Washington.

2.4 MPA definition

For the purposes of this paper we will consider an MPA to conform to the definition adopted by the Convention on Biological Diversity at its 7th meeting of parties in 2004 (Decision VII/5), which defines an MPA as:

"any defined area within or adjacent to the marine environment, together with its overlaying waters and associated flora, fauna and historical and cultures features, which has been reserved by legislation or other effective means, including custom, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings".

2.5 Aims of this paper

This paper examines the international, regional and national legal context for the declaration of a large multi-zoned MPA around the Prince Edward Islands. In particular I examine South Africa's obligations in terms of international and regional treaty law as well as its commitments to global policy statements. Legal options and opportunities for providing the most comprehensive, and yet practical, legal protection for such a MPA are examined. Recommendations are made based on this analysis.

3. INTERNATIONAL OBLIGATIONS AND COMMITMENTS TO THE ESTABLISHMENT OF NETWORKS OF MARINE PROTECTED AREAS (MPA)

3.1 Global Legal Instruments

3.1.1 1982 United Nations Law of the Sea Convention (LOSC)

South Africa's principal international obligation and responsibility in terms of the management of the marine resources of the EEZ surrounding the Prince Edward Islands is drawn from the LOSC. Under the LOSC all States have a general obligation to "protect and preserve the marine environment" 15. Within their EEZ Coastal States are conferred "sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources" of this area¹⁶ and have jurisdiction with regard to the "protection and preservation of the marine environment"17. However, these rights come with responsibilities and coastal States are under a specific obligation and duty to 'ensure through proper conservation and management measures that the maintenance of the living resources in the exclusive economic zone is not endangered by over-exploitation.' Furthermore, coastal States should co-operate with the competent international organization (in this case CCAMLR) to this end. The present state of the toothfish stocks in this area, clearly bears testimony to the fact that South Africa has been unable to fulfill these conservation and management obligations in the past. Article 61 (3) & (4) goes on to obligate States to restore populations of over-exploited species and associated and dependent species to maximum sustainable levels. MPAs were not widely used during the 1970s when the Convention was being negotiated and consequently UNCLOS does not make explicit mention of this management tool. However Article 62 (4c) does mention fishing area regulations, as a specific tool that States may use to manage fisheries in their EEZs.

Part XII of the LOSC also specifically requires coastal States to take measures "to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life" 18. States may also define areas within their EEZs where special shipping measures need to be applied to prevent the risk of pollution events 19 (see later discussions). It is therefore held the development of a network of MPAs for the purposes of "protecting and preserving" marine habitats and biodiversity as well as for fisheries management reasons (in particular for restoring depleted populations), is entirely consistent with the LOSC and in fact could be seen as going a long way towards fulfilling South Africa's obligations under this almost universally accepted Convention.

¹⁵ LOSC Art 192 and Art 194

¹⁶ LOSC Art 56 (1) (a)

¹⁷ LOSC Art 56 (1) (b) (iii)

¹⁸ LOSC Art 194 (5)

¹⁹ LOSC Art 211 (6a)

3.1.2 Convention on Biological Diversity (CBD) (1992)

The CBD (to which South Africa is a party) explicitly requires States, as far as possible and is appropriate, to:

- a) Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity;
- b) Develop, where necessary, guidelines for the selection, establishment and management of protected areas or areas where special measures need to be taken to conserve biological diversity²⁰.

For these purposes, the CBD requires states to identify:

...components of biological diversity important for its conservation and sustainable use having regard to the indicative list of categories set down in Annex I;²¹

Annex 1 in turn outlines the following components:

(a) Ecosystems and habitats: containing high diversity, large numbers of endemic or threatened species, or wilderness; required by migratory species; of social, economic, cultural or scientific importance; or, which are representative, unique or associated with key evolutionary or other biological processes;²²

Furthermore, the CBD requires states to:

Develop national strategies, plans or programmes for the conservation and sustainable use of biological diversity... ²³

From the above, one can deduce that member States of the CBD have accepted an international obligation towards developing a system of protected areas and that this involves identifying spatially defined areas that can benefit from area protection and entrenching these plans within accepted National Strategies.

In 1995, the second Conference of Parties (COP) of the CBD adopted the Jakarta Mandate²⁴ on the Conservation and Sustainable Use of Marine and Coastal Biodiversity and subsequently developed a Programme of Work on Marine and Coastal Biological Diversity in 1998²⁵. This work programme included Marine and Coastal Protected Areas as one of its five key programme elements.

²⁴ Decision II/10 of the second meeting of the Conference of the Parties (Jakarta, Indonesia, 1995)

²⁰ CBD Art 8 (a)

²¹ CBD Art 7 (a) CBD Annex 1

²³ CBD Art 6 (a)

²⁵ Annex to Decision IV/5 on Conservation and Sustainable Use of Marine and Coastal Biodiversity, as adopted by the fourth meeting of the Conference of the Parties (Bratislava, Slovak Republic, 1998)

It is interesting to note the criterion of 'a representative network of MPAs' was originally only included in an indicative list²⁶ in the 1992 Convention text. However, the concept of representative networks of MPAs gained strong support in later years. The eighth meeting of the Convention's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) held in 2003 recommended that COP endorse a global goal for the Convention with regard to MPAs, which provides for the "establishment and maintenance, by 2012, of a system of MPAs that are effectively managed, ecologically based and contribute to a permanent representative global network."

3.1.3 The 2002 World Summit on Sustainable Development (WSSD)

The WSSD was successful in agreeing on a Plan of Implementation that included a number of global targets for the management of our oceans. The Plan of Implementation explicitly requests States to:

Develop and facilitate the use of diverse approaches and tools, including the ecosystem approach, the elimination of destructive fishing practices, the establishment of marine protected areas consistent with international law and based on scientific information, including representative networks by 2012...²⁷

The Plan also calls for the application of an ecosystem approach to fisheries by 2010²⁸ and the restoration of depleted fish stocks by 2015²⁹. A system of MPAs could contribute greatly towards both these targets.

Although not a binding agreement, the WSSD was successful in setting a global agenda and goal for MPA implementation. South Africa has publicly and repeatedly committed itself to this goal³⁰.

Furthermore, although the WSSD Plan of Implementation does not explicitly mention the development of MPAs in areas beyond national jurisdiction (i.e. on the high seas) neither does it restrict itself to this. It is evident that by definition, for a system of MPAs to be globally *representative* it would need to include areas on the high seas.

3.1.4 2003 World Parks Congress

The 2003 World Parks Congress built on the international commitment made by the WSSD Plan of Implementation, but it took it a step further by setting a very specific goal as to the amount of area that needed to be set aside in MPAs. The recommendations of the World Parks Congress thus called on States to establish by 2012:

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²⁶ CBD Annex 1

WSSD recommendation 31 (c)

²⁸ WSSD recommendation 29 (d)

²⁹ WSSD recommendation 30 (a)

³⁰ Department of Environmental Affairs and Tourism (2004) Extract from remarks made by Marthinus van Schalkwyk, Minister of Environmental Affairs and Tourism. Kalk Bay Harbour. www.environment.gov.za

...a global system of effectively managed, representative networks of marine and coastal protected areas, consistent with international law and based on scientific information, that:

a. Greatly increases the marine and coastal area managed in MPAs by 2012; these networks should be extensive and include strictly protected areas that **amount to at least 20–30%** of each habitat, and contribute to a global target for healthy and productive oceans;³¹

The World Parks Congress also went further in explicitly calling for this global system of representative networks of MPAs to include areas beyond national jurisdiction (i.e. on the high seas).³² To date there has been little progress in declaring effective MPAs in areas beyond national jurisdiction, although this has been the subject of much recent debate in various international fora³³.

3.1.5 South Africa's performance in meeting these international obligations and commitments

South Africa has made good progress over the past few years in meeting some of its international obligations under the CBD. In terms of developing national strategies and plans³⁴; South Africa recently concluded its National Biodiversity Strategic Action Plan (NBSAP)³⁵, which incorporated a National Spatial Biodiversity Assessment for the marine areas under South African jurisdiction³⁶. Interestingly, this marine report was flawed in that it did not consider the EEZ surrounding the Prince Edward Islands. The marine conservation plan recently developed for the Prince Edward Islands will largely fill this gap³⁷.

South Africa has recently made good recent in developing a comprehensive system of marine protected areas. During 2004, South Africa proclaimed four new MPAs, increasing the proportion of coastline under formal protection to some 18% of the total. However, all of South Africa's current MPAs are situated in the close inshore region of the continental EEZ. Substantial work is therefore still needed before South Africa's current system of MPAs could be considered to be a truly 'representative network' as stipulated by the SBSTTA to the CBD, the WSSD Plan of Implementation, and the World Parks Congress recommendations. As mentioned previously, the South African government has publicly committed itself to these goals³⁸. The marine habitats surrounding the Prince Edward Islands are not represented elsewhere in the current South African system of MPAs. As such the development of a systematic MPA surrounding the Prince Edward Islands will contribute greatly towards South

³¹ World Parks Congress recommendation V22

³² World Parks Congress recommendation V23

³³ Gjerde K (2005) Editors note: Moving from Words to Actions. The International Journal of Marine and Coastal Law, 20, 323-344

³⁴ CBD Art 6a

³⁵ Driver et al. 2004. National Biodiversity Strategic Action Plan. South African National Biodiversity Institute

³⁶ Lombard et al.2004. National Spatial Biodiversity Assessment: Marine Component. South African National Biodiversity Institute

³⁷ See Lombard et al. 2006. Conservation pattern and process in the southern Ocean: Designing a Marine Protected Area for the Prince Edwards Islands. WWF South Africa Report.

³⁸ Department of Environmental Affairs and Tourism. 2004. See note 30 above

Africa meeting its obligations under the CBD and its commitments with regard to the WSSD Plan of Implementation and the World parks Congress.

3.2 Site protection

3.2.1 World Heritage Convention

As mentioned earlier it is also South Africa's intention to nominate the Prince Edward Islands as a World Heritage Site and that the nomination is likely to include the territorial sea around the islands. This will have the effect of linking the two islands into a single geographic entity. A marine component to this proposal will help to meet the World Heritage Site criteria for selecting natural sites, which require sites to be of sufficient size and contain the necessary elements to ensure the integrity of ongoing ecological and biological processes. Given the inextricable link between the terrestrial and marine ecosystems on the Prince Edward Islands (i.e. terrestrial ecosystems are largely driven by nutrients brought ashore by seabirds and seals which feed offshore), a purely terrestrial nomination would be significantly less convincing to the World Heritage Site Committee.

The most important effect that a successful World Heritage Site nomination of the Prince Edward Islands will have is to elevate the duty to protect this site to an international level. However, the World Heritage Convention is careful to ensure that this international duty does not derogate from South Africa's sovereignty over the territory³⁹. Amongst the mechanisms available to give effect to this international duty, is the establishment of the 'World Heritage Fund' through contributions by Member States⁴⁰, which can be used to assist with the protection, conservation and rehabilitation of Sites.

An important aspect of World Heritage Sites is their educational value and States undertake to "endeavor by all appropriate means, and in particular by educational and information programmes, to strengthen appreciation and respect by their peoples of the cultural and natural heritage" of these Sites. This aspiration is interesting in the context of the present national legal status of the islands. The islands are declared as a Special Nature Reserve under the National Environmental Protection Act (NEMPA) Act 57 of 2003. Special Nature Reserve status makes an area primarily available for scientific research and environmental monitoring⁴¹. As such Special Nature Reserves have very restrictive visitation conditions (see later discussion on national legislation pertaining to protected areas). These could be seen to conflict with the need to use these sites for "education and information" programmes as envisaged under the World Heritage Convention.

⁴⁰ Aricles 15 & 16

³⁹ Article 6 (1)

⁴¹ NEMPA s18 (2) (b)

3.3 Species protection by means of MPAs

3.3.1 Agreement on the Conservation of Albatrosses and Petrels (ACAP)

The Prince Edward Islands are the breeding site for five species of Albatrosses listed in Annex 1 of the Agreement on the Conservation of Albatrosses and Petrels (ACAP). These species have the capability of traveling large distances to feed (especially when not breeding). However, while breeding all five species probably spend a significant proportion of their time feeding within the EEZ surrounding the Prince Edward Islands^{42,43}. These are amongst the reasons why South Africa was a leading force in the development of this Agreement (the negotiations of the final text were held in Cape Town), and amongst the first countries to ratify this agreement.

Amongst the key requirements of parties to the ACAP, is the obligation to protect habitats that are important for the survival of these species⁴⁴. The main text of the Agreement is supplemented by an Action Plan⁴⁵ that requires parties to:

... individually or collectively seek to develop management plans for the most important foraging and migratory habitats of albatrosses and petrels⁴⁶.

and

...take special measures individually and collectively to conserve marine areas which they consider critical to the survival and/or restoration of species of albatrosses and petrels which have unfavourable conservation status 47.

Furthermore, the Action Plan to ACAP requires parties 'to reduce or eliminate the mortality of albatrosses and petrels resulting incidentally from fishing activities^{48.}'

The use of Albatross foraging areas as one of the criteria for identifying and zoning a MPA within the South African EEZ and consequently reducing risk of mortality in fishing operations, is thus entirely consistent with the provisions of ACAP and could be seen as meeting the obligation to protect these areas, under this convention.

⁴⁶ Annex 2 Article 2.3.2

⁴² Nel *et al.* 2000. Foraging ecology of Grey-headed Mollymawks at Marion Island, southern Indian Ocean, in relation to longline fishing activity. *Biological Conservation*, 96, 219–231.

⁴³ Nel *et al.* 2002. Foraging interaction between Wandering Albatrosses *Diomedea exulans* breeding on Marion Island and long-line fisheries in the southern Indian Ocean. *Ibis*, 144 (on-line), E141–E154.

⁴⁴ Article 3 (1a)

⁴⁵ Annex 2

⁴⁷ Annex 2 Article 2.3.3

⁴⁸ Annex 2 Article 3.2.1

4. REGIONAL ARRANGEMENTS

4.1 1980 Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR)

The overall objective of the 1980 Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) is "the conservation of Antarctic Marine Living Resources" However Article 2 of this convention goes on to elaborate that for the purposes of this convention "the term 'conservation' shall include rational use" This Article has led to the somewhat split personality of CCAMLR, caught halfway between a traditional conservation treaty concerned primarily with biodiversity conservation and a Regional Fisheries Management Organisation (RFMO) concerned mainly in setting fisheries regulations and Total Allowable Catches (TACs). Despite this, the Convention text was ground-breaking at the time of its conclusion in its provisions that alluded for the first time towards an 'ecosystem approach' to fisheries management. Article 2 stipulates that any harvesting of species or associated activities need to be conducted in accordance with three basic principles.

- (a) prevention of decrease in the size of any harvested population to levels below those which ensure its stable recruitment. For this purpose its size should not be allowed to fall below a level close to that which ensures the greatest net annual increment;
- (b) maintenance of the ecological relationships between harvested, dependent and related populations of Antarctic marine living resources and the restoration of depleted populations to the levels defined in sub-paragraph (a) above; and
- (c) prevention of changes or minimisation of the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades, ..., with the aim of making possible the sustained conservation of Antarctic marine living resources.

Article IX (1) of the convention then requires the Commission to give effect to the principles of CCAMLR through the formulation of conservation measures. Included in the illustrative list of possible conservation measures is:

(g) the designation of the opening and closing of areas, regions or sub-regions for purposes of scientific study or conservation, including special areas for protection and scientific study;

Although not specifically referred to as MPAs, it is clear that an area closed to fishing for the purposes "scientific study or conservation" certainly qualifies as a MPA as defined by the Convention on Biological Diversity. The degree to which such closed areas afford comprehensive biodiversity protection depends on whether the area is closed to all fisheries or just certain directed fisheries and whether any associated protection has been afforded

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⁴⁹ Article 2 (1)

⁵⁰ Article 2 (2)

from other threats, either through CCAMLR itself or through complementary international arrangements (e.g. protection from mining and shipping related risks; see later discussions).

CCAMLR has passed several conservation measures (e.g. Conservation Measures 32-02 and 32-03) that close certain statistical reporting areas or sub-areas to certain directed fisheries for all finfish or for named species (either year-round or seasonally), to allow stock recovery, prevent by-catch, protect spawning grounds, prevent unregulated fishing, or to allow time for scientific surveys to be carried out. In fact all three CCAMLR Statistical Areas surrounding the Prince Edward islands EEZ (58.6, 58.7, 58.4.4) are closed to directed fishing for Patagonian Toothfish (Conservation Measures 32-11(2002); 32-12(1998); 32-10(2002)). However, none of these areas provide long term protection from all types of extractive activities, and some closed areas may only be in force for a limited number of seasons. The only true MPAs within the CCAMLR area in which all extractive activities are prohibited have been designated in EEZs under national jurisdiction (for example, Australia's Heard and McDonald Islands Marine Reserve).

It should be noted that Article IX (2) (i) of Convention also appears to give the Commission a general power to adopt "such other conservation measures" (i.e. beyond pure fisheries measures) "as the Commission considers necessary for the fulfillment of the objective of this Convention". The Commission has used this provision to pass general conservation measures that relate to the prohibition of discharge of oil, sewage, garbage etc in designated areas (Conservation Measures 41-09(2005) & 41-10(2005)⁵¹.

At CCAMLR-XXIII held in 2004, the Commission addressed the topic of MPAs and urged the Scientific Committee to proceed with work on this topic as a matter of urgency. The Commission reaffirmed the need to develop advice consistent with Articles II and IX of the Convention⁵². In this regard the Scientific Committee endorsed in principle an expert workshop to be held during 2005, to discuss how the use of MPAs could contribute to furthering the objectives of CCAMLR. This workshop was held from 29 August to 1 September 2005. At CCAMLR-XXIV held in 2005, the Commission endorsed the report of this workshop which concluded that MPAs had considerable potential for furthering CCAMLR's objectives in applications ranging from protection of ecosystem processes, habitats and biodiversity, and protection of species. The workshop further concluded that in establishing a network of MPAs, special attention needs to be given to the protection of: a) representative areas, b) scientific areas and c) areas vulnerable to impacts by human activities⁵³. Furthermore the Scientific Committee noted that there was a need to develop a strategic approach to MPA design and implementation throughout the Southern Ocean, notably in relation to a system of protected areas⁵⁴. The Commission called on the Scientific

⁵¹ For more detailed discussion see Millar et al. (2004) Managing Antarctic Marine Living Resources: The CCAMLR Approach. The International Journal of Marine and Coastal Law, 19, 317-359.

⁵² CCAMLR-XXIII (2004) Report of the 23rd meeting of the Commission. CCAMLR, Hobart, Australia. www.ccamlr.org; Paragraph 4.13

⁵³ CCAMLR-XXIV (2005) Report of the 23rd meeting of the Commission. CCAMLR, Hobart, Australia. <u>www.ccamlr.org</u>; Para 4 14

⁵⁴ SC-CCAMLR-XXIV (2005) Report of the Scientific Committee. CCAMLR, Hobart, Australia. www.ccamlr.org; Para 3.51 (i)

An Analysis of Legal Obligations, Options and Opportunities

Committee to proceed in a bioregional and fine-scale mapping exercise that would inform the development of a representative network of MPAs⁵⁵

The scientific approach taken by South Africa in attempting to delineate the MPA around its Prince Edward Islands was specifically commended in the CCAMLR MPA workshop report⁵⁶.

It can therefore be concluded that the use MPAs in furthering its objectives shows considerable promise and the efforts undertaken by South Africa to delineate and declare a MPA around the Prince Edward Islands, is entirely consistent with the current thinking under CCAMLR.

⁵⁶ SC-CCAMLR-XXIV (2005) Para 81

⁵⁵ CCAMLR-XXIV (2005) Para 4.15

5. NATIONAL LEGISLATION

All of South Africa's current MPAs have been declared under the section 43 of the Marine Living Resources Act 18 of 1998. However, two MPAs (Greater St Lucia Wetland and the Table Mountain National Park) also form part of World Heritage Sites.

The terrestrial components of the Prince Edward Islands have been managed as a Special Nature Reserve since 3 November 1995 in terms of Section 18 of South Africa's Environment Conservation Act 73 of 1989. The boundaries of the reserve were then set at the low-water mark. South Africa's National Environmental Management: Protected Areas Act 57 of 2003 (NEMPA) allows for the continued proclamation of Special Nature Reserves, and as well as applying to territorial waters "also applies to the exclusive economic zone and continental shelf of the Republic". At the 15th meeting of the Prince Edward Islands Management Committee held in January 2003, the committee endorsed a proposal to investigate expanding the Special Nature Reserve Status to include the Territorial Sea around the islands.

Parallel to this process, it is also South Africa's intention to nominate the Prince Edward Islands as a World Heritage Site. In order to create a contiguous geographical entity and to incorporate integral ecosystem links, it has been proposed that the World Heritage Site nomination include the 12 Nautical Mile territorial seas around the islands.

These initiatives were somewhat overshadowed when the Minister declared his intention to declare "one of the worlds largest MPAs" around the Prince Edward Islands in July 2004. He was clear that the objective of such an MPA would be to provide both biodiversity conservation and fisheries management benefits in this area. Particular reference was made to combating the scourge of IUU fishing in the area and restoring the damage that this had caused in the past.

In this next section we consider the implications of these proposals and the options under South African domestic legislation.

5.1 Marine Living Resources Act 18 of 1998

Section 43 of the Marine Living Resources Act allows the Minister to declare MPAs for three purposes⁵⁷;

(a) for the protection of fauna and flora or a particular species of fauna or flora and the physical features on which they depend;

⁵⁷ Marine Living Resources Act 18 of 1998. Section 43 (1)

- (b) to facilitate fishery management by protecting spawning stock, allowing stock recovery, enhancing stock abundance in adjacent areas, and providing pristine communities for research; or
- (c) to diminish any conflict that may arise from competing uses in that area.

Within an MPAs no person may (unless exempt by the Minister for the purposes of proper management):⁵⁸

- (a) fish or attempt to fish;
- (b) take or destroy any fauna and flora other than fish;
- (c) dredge, extract sand or gravel, discharge or deposit waste or any other polluting matter, or in any way disturb, alter or destroy the natural environment;
- (d) construct or erect any building or other structure on or over any land or water within such a marine protected area; or
- (e) carry on any activity which may adversely impact on the ecosystems of that area.

MPAs promulgated under the Marine Living Resources Act therefore allow vessels (including fishing and tourism vessels) to pass through or be otherwise be present within MPAs, subject to provision (e) above. Should the presence or passage of the vessel be deemed to be an activity "which may adversely impact on the ecosystems of that area", it could therefore be regulated. There is some precedence for this and the regulations pertaining to several newly declared MPAs have specific regulations pertaining to the usage of vessels in these areas. For instance the regulations for three new MPAs in the Border region of South Africa prohibit persons from "enter(ing) the Marine Protected Area with a vessel that has fishing gear on board". These measures have presumably been put in place to assist with compliance and enforcement efforts. In other words, the State merely has to prove that the fishing vessel was present in such an MPA to make it guilty of an offence and does not have to prove that the vessel was indeed attempting to fish. South Africa is not alone in imposing such measures. Such 'exclusion zones' are also being used in Australia⁵⁹.

So while it is clearly possible to regulate the transit and passage of national fishing vessels within MPAs under the Marine Living Resources Act, the default position is that vessels that do not pose an adverse threat to the ecosystems of the area, will be allowed to be present within MPAs.

Section 43 (2) (c) of the Marine Living Resources Act also makes it highly unlikely that any mining activity will be allowed inside an MPA. This is strengthened further by the National Environmental Management Act: Protected Areas (NEMPA) Act 57 of 2003, which expressly

⁵⁸ Marine Living Resources Act 18 of 1998. Section 43 (2)

⁵⁹ Molenaar EJ (2000) Satellite Based Vessel Monitoring Systems for Fisheries Management: International Legal Aspects. International Journal of Marine and Coastal Law, 15, 65-109

prohibits commercial prospecting or mining activities in all protected areas (including MPAs⁶⁰).

5.2 A Special Nature Reserve under the National Environmental Management Act: Protected Areas (NEMPA) Act 57 of 2003

One of the options considered in the planning of the Prince Edward Islands MPA was that the Special Nature Reserve Status be extended to the 12 nautical mile territorial sea and that this becomes an "inner sanctuary" within a larger multi-zoned MPA. The other components of the larger MPA would be afforded protection through the traditional means of the Marine Living Resources Act. In this section we consider the implications of this.

Under NEMPA the Minister may only declare a Special Nature Reserve for the following purposes: ⁶¹

- (a) To protect highly sensitive, outstanding ecosystems, species or geological or physical features in the area; and
- (b) To make the area primarily available for scientific research or environmental monitoring.

Consequently, access to Special Nature Reserves is very restricted. Only officials of the Department of Environmental Affairs and Tourism or other organs of state, monitoring the state of conservation or biodiversity, or implementing the management plan, and the police, customs and excise officials are allowed access.⁶² The management authority may grant further exemptions, after consultation with the Minister, to the following persons:⁶³

- (a) a scientist to perform scientific work;
- (b) a person to perform an activity related to the conservation of the reserve or of the biodiversity in the reserve;
- (c) a person recording a news event that occurred in the reserve or an educational or scientific programme;
- (d) an official of the management authority to perform official duties; or
- (e) an official of an organ of state to perform official duties.

Clearly under this legal regime it would be difficult (if not impossible) to allow access to any non-governmental vessels and other vessels not officially commissioned or mandated by an organ of the state. For example, fishing and tourism vessels would be prohibited from marine

⁶⁰ As amended by the National Environmental Management: Protected Areas Amendment Act 31 of 2004

⁶¹ NEMPA Section 18 (2)

⁶² NEMPA Section 45 (2)

⁶³ NEMPA Section 45 (3)

areas declared as a Special Nature Reserve under NEMPA, unless undertaking official duty on behalf of the government.

Mining and commercial prospecting in Special Nature Reserves are unequivocally prohibited⁶⁴.

It is also clear that "if a marine protected area has been included in a special nature reserve, national park or nature reserve, such area must be managed and regulated as part of the special nature reserve, national park or nature reserve in terms of this Act^{65} ." There would thus be a need to harmonize management plans and align institutions involved in the management of the terrestrial and marine components.

5.3 World Heritage Act 49 of 1999

The World Heritage Act is largely an administrative act that seeks to implement the World Heritage Convention within South Africa's national legislation. The Act requires the appointment of a single "Authority" that will oversee the management of any World Heritage Site. This can either be an existing management authority⁶⁶ or a newly established legal entity⁶⁷, established expressly for the purpose managing the site. The marine and terrestrial components of the Prince Edward Islands are currently managed by different branches within the same government department (Department of Environmental Affairs and Tourism). It is unclear, if such an arrangement would qualify as a single "Authority" or whether a new arrangement would need to be established.

The Act also requires the development of an integrated management plan for the heritage site⁶⁸. The inclusion of marine areas within a successful nomination of the Prince Edward Islands would thus necessitate the development of an integrated management plan that would harmonize marine and terrestrial management efforts.

⁶⁴ NEMPA Section 48 (1) (a)

⁶⁵ NEMPA Amendment Act 31 of 2004

⁶⁶ World heritage Act Section 8

⁶⁷ World heritage Act Section 9

⁶⁸ World Heritage Act Chapter IV (sections 21 – 28)

6. REGULATION OF SHIPPING ACTIVITIES

The Prince Edward Islands are not situated on any major shipping lanes and are therefore subject to reasonably low levels of international shipping traffic. However, as mentioned in the introductory remarks, the last decade has seen a dramatic rise in shipping traffic to the Southern Ocean and Antarctica, mainly due to increased fishing and tourism activity. This increase has been reflected around the Prince Edward Islands. To date, most of the shipping traffic around the Prince Edward Islands has been by South African flagged vessels and thus clearly easier to regulate under domestic legislation, however, occasional foreign flagged vessels have also visited the islands. It would certainly not be unreasonable to expect shipping traffic (domestic and foreign flagged) to the Southern Ocean and to the Prince Edward Islands specifically, to continue to increase significantly over the next decade. For the sake of comprehensiveness therefore and to avert possible future threats to the islands, we consider in this next section the options South Africa has in terms of controlling the potential risks from international shipping activities in the South African maritime zones surrounding the Prince Edward Island.

6.1 International law as it relates to the passage of foreign vessels

6.1.1 The Law of the Sea Convention (LOSC)

Part XII of the LOSC places a general obligation on States to take all measures consistent with the Convention "that are necessary to prevent, reduce and control pollution of the marine environment from any source...⁶⁹". These measures "shall include those necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life⁷⁰."

These general provisions indicate a need to impose more stringent measures in certain designated areas that may be more vulnerable to the effects pollution, potentially through the proclamation of MPAs or other area protection measures. In this next section we will examine in more detail the measures that Coastal States can take to protect such designated areas under their domestic legislation or through the competent international authority.

Territorial Sea

Foreign vessels enjoy 'the right of innocent passage' within the territorial sea of coastal states⁷¹. Passage is defined as being expressly 'for the purposes of traversing the territorial sea', and needs to be 'continuous and expeditious'. Vessels are allowed to stop and anchor, but only 'in so far as the same are incidental to ordinary navigation or are rendered necessary by *force majeure* or distress or for the purpose of rendering assistance to persons,

⁶⁹ LOSC Article 194 (1)

⁷⁰ LOSC Article 194 (5)

⁷¹ LOSC Article 17

ships or aircraft in danger or distress.'⁷² Passage is in turn considered to be 'innocent' as long as it is 'not prejudicial to the peace, good order or security of the coastal state'⁷³. The Law of the Sea Convention goes on to list a number of activities that can be considered to be 'prejudicial to the peace, good order or security of a coastal state'. This includes; 'launching, landing or taking on board of any aircraft' and 'any fishing activities'. However the list is merely indicative and ends with the open-ended qualification of 'any other activity not having a direct bearing on passage'. In other words, should a vessel engage in any activity not having a direct bearing on passage, its passage will be deemed to not be innocent and the vessel can be excluded from the territorial sea of a coastal State.

Passage of a foreign tourist vessel cruising or 'hovering' around the Prince Edward Islands or any other vessel engaged in any activity within the territorial sea of the Prince Edward Islands *not having a direct bearing its passage*, will therefore not be deemed innocent and South Africa has a right under international law to exclude such a vessel.

Despite the right of foreign vessels to innocent passage, the Part II of LOSC goes on to allow coastal States to adopt laws and regulations with regard to innocent passage of foreign vessels in their territorial seas with respect to a number of issues. Included in this list of issues are⁷⁴:

- (a) the safety of navigation and the regulation of maritime traffic;....
- (d) the conservation of the living resources of the sea;
- (e) the prevention of infringement of the fisheries laws and regulations of the coastal State;
- (f) the preservation of the environment of the coastal State and the prevention, reduction and control of pollution thereof;
- (g) marine scientific research and hydrographic surveys;

The only proviso to these regulations is that they "shall not apply to the design, construction, manning or equipment of foreign ships unless they are giving effect to generally accepted international rules or standards"⁷⁵. Coastal states may therefore require foreign vessels to use designated sea lanes and traffic separation schemes for regulation of traffic⁷⁶. In particular, tankers, nuclear powered vessels and other vessels carrying dangerous and noxious substances may be required to use designated sea lanes⁷⁷. In the designation of such sea lanes, coastal states need to take into account the recommendations of 'the competent international authority' (in this case the International Maritime Organization (IMO)) and give due publicity to these regulations⁷⁸.

⁷³ LOSC Article 19

⁷² LOSC Article 18

⁷⁴ LOSC Article 21 (1)

⁷⁵ LOSC Article 21 (2)

⁷⁶ LOSC Article 22 (1)

⁷⁷ LOSC Article 22 (1)

⁷⁸ LOSC Article 22 (3) & (4)

Part XII of the LOSC which deals with the protection of the marine environment goes on to assert that:

Coastal States may, in the exercise of their sovereignty within their territorial sea, adopt laws and regulations for the prevention, reduction and control of marine pollution from foreign vessels, including vessels exercising the right of innocent passage. Such laws and regulations shall, in accordance with Part II, section 3, not hamper innocent passage of foreign vessels.

Part II and Part XII of the LOSC when read together, are clear that coastal States have a sovereign right to regulate shipping traffic within their territorial sea for the purposes of conserving marine living resources and preventing, reducing and controlling marine pollution. However, these regulations should not unduly hamper the right of innocent passage of foreign vessels, and coastal States should take into account the recommendations of the IMO. It is important to note that the designation of such sea lanes and other marine traffic regulation measures by a coastal State is not conditional on the consent of IMO, but the coastal State merely needs to *take into account* the recommendations of IMO.

EEZ

Coastal States rights in the EEZ relate to their sovereign rights for the purpose of "exploring and exploiting, conserving and managing the natural resources" of this area⁷⁹. In this respect coastal States are conferred jurisdiction as provided for in the relevant provisions of the LOSC for the "the protection and preservation of the marine environment"⁸⁰.

The relevant provisions are found in Part XII of the convention. With regard to coastal States rights and duties to protect the natural resources under their jurisdiction, Article 211 is clear that "where the international rules and standards... are inadequate to meet special circumstances and coastal States have reasonable grounds for believing that a particular, clearly defined area of their respective exclusive economic zones is an area where the adoption of special mandatory measures for the prevention of pollution from vessels is required for recognized technical reasons in relation to its oceanographical and ecological conditions" the coastal States may submit this information to the IMO for its consideration. The IMO will consider this information within 12 months and "if the organization so determines, the coastal States may, for that area, adopt laws and regulations for the prevention, reduction and control of pollution from vessels implementing such international rules and standards or navigational practices as are made applicable, through the organization, for special areas."

It is therefore clear that coastal States can, with the consent of IMO and without hampering the freedom of navigation of foreign vessels, adopt special measures to reduce the risk of

80 LOSC Article 56 (1) (b) (iii)

⁷⁹ LOSC Article 56 (1) (a)

⁸¹ LOSC Article 211 (6a)

ship-based pollution in specific designated areas. These measures may include routeing measures 82.

It was a traditionally held view that the establishment of routeing measures for the purposes of protecting the marine environment needed to be related to the risk of pollution. In other words Article 56 of the LOSC was subject to Article 211 (5). However, a contrary argument held that if coastal States are to give effect to Part V of the Convention as well as Articles 192 and 194(5), they may need to adopt ship regulation measures for the purposes of protection and preservation of the marine environment, other than reducing the risk of pollution⁸³. It is this position that has led to Canada recently amending a traffic separation scheme in the Bay of Fundy for the purposes of reducing ship strikes on North Atlantic right whales. The United States has also proposed three mandatory no-anchoring areas to protect the coral reefs of the Flower Garden Banks in the Gulf of Mexico⁸⁴.

Rights of Coastal States in Territorial Sea vs EEZ

For the purposes of informing the management of a large MPA around the Prince Edward Islands MPA, it is necessary to draw some distinctions between the coastal States rights in its territorial sea as opposed to its EEZ and the role of IMO. It is important to note that in designating international sea lanes in its territorial sea a coastal State merely needs to "take into account" the "recommendations" of IMO. In other words, such regulation of marine traffic is not contingent on IMO's consent. In its EEZ on the other hand, a coastal State does require IMO's specific consent to impose controls on international navigation in the form of routeing measures.

6.1.2 Special Areas and Particularly Sensitive Sea Areas (PSSAs) under IMO

The International Convention for the Prevention of Pollution from Ships (1973) and its 1978 Protocol (together known as MARPOL 73/78) is the principle IMO treaty dealing with the threat of pollution from ships. MARPOL 73/78 allows for the designation of "special areas" where the adoption of special mandatory operational standards for the prevention of sea pollution are required due to its oceanographical and ecological condition and to the particular character of the maritime traffic in the area. The measures that need to be adopted in Special Areas are outlined in Annex I, II, IV and V and mainly relate to limitation of operational discharge and pollution from vessels.

In 1991 the IMO Assembly adopted Resolution A.720 (17), which allowed for the designation of *Particularly Sensitive Sea Areas* (PSSAs). In 2001 a further resolution was adopted that describes guidelines for the designation of Special Areas and PSSAs⁸⁵. A PSSA is defined as "an area that needs special protection through action by IMO because of its significance

Roberts J (2005) Protecting Sensitive Marine Environments: The Role and Application of Ships Routeing Measures. Internation Journal of Marine and Coastal Law, 20, 135-159

⁸³ Johnson LS (2004), Coastal State Regulation of International Shipping. Oceana Publications, p. 61.

⁸⁴ Roberts J (2005) see note 82 above⁸⁵ IMO Assembly Resolution A.927 (22)

for recognized ecological, socio-economic, or scientific reasons and because it may be vulnerable to damage by international shipping activities."

The resolution goes on to outline ecological, socio-economic and scientific criteria that may be used to designate a PSSA. Amongst the ecological criteria are: uniqueness and rarity of ecosystems, critical habitat, ecological dependence on a habitat, representativeness, biological diversity, spawning or breeding grounds, naturalness, ecological integrity, and biogeographic importance. Scientific criteria include areas that have a high scientific interest, or areas that provide important baseline or monitoring studies.

The protective measures for PSSAs are those within the purview of the IMO and include:⁸⁶

- 1. Designation of an area as a Special Area under Annexes I, II, IV or V of MARPOL 73/78, or application of special discharge restrictions to vessels operating in a PSSA.
- 2. Adoption of ships' routeing and reporting systems near or in the area, under the International Convention for the Safety of Life at Sea (SOLAS)87 and in accordance with the General Provisions on Ships' Routeing and the Guidelines and Criteria for Ship Reporting Systems. For example, a PSSA may be designated as an 'area to be avoided' or it may be protected by other ships' routeing or reporting systems;
- 3. Development and adoption of other measures aimed at protecting specific sea areas against environmental damage from ships, such as compulsory pilotage schemes or vessel traffic management systems.

A coastal State may therefore designate PSSAs within its territorial sea or EEZ, through consultation and approval by IMO. Within these areas coastal States may require vessels to observe special discharge restrictions, totally avoid the area, or be subject to compulsory pilotage or reporting systems and other vessel traffic management systems.

PSSA vs stand alone regulations

The LOSC allows coastal States to adopt measures that regulate shipping traffic within its territorial sea and EEZ for the purposes protection and preservation of the marine environment, without any special designation as a PSSA or Special Area. In fact identification as a PSSA is nothing more than a qualification and basis on which protective measures can be taken through existing IMO measures⁸⁸. What then are the advantages of coastal States pursuing a PSSA designation?

Most importantly, it provides global recognition of a designated area through identification of PSSA status on international navigational charts. This serves to keep mariners aware of the need to take extra care and to abide by the stipulated measures. PSSA status also provides coastal States with considerable political leverage to adopt protective measures (i.e. measures that may not be as readily accepted by the international community in the absence

87 SOLAS Chapter V Regulation 8

⁸⁶ IMO Assembly Resolution A.927 (22)

Peet G (1994) Particularly Sensitive Sea Areas—A Documentary History. International Journal of Marine and Coastal Law, 9,

of PSSA status). The disadvantage is that PSSA designation does add the additional procedural hurdles of submitting a proposal to the Marine Environment Protection Committee (MEPC) of the IMO.

South Africa is currently preparing a PSSA proposal for the MEPC for its continental EEZ. Unfortunately, this proposal currently does not include the maritime zones around the Prince Edward Islands.

6.2 South African National Legislation

The Marine Traffic Act 2 of 1981 as amended by the General Shipping Amendment Act 23 of 1997 gives effect to the rights conferred on coastal states over its territorial seas and empowers the Minister of Transport may make regulations that regulate marine traffic in the territorial and internal waters of South Africa, "including the prescribing of ship reporting procedures, sea lanes and traffic separation schemes" ⁸⁹. Interestingly, the Marine Traffic Act did not originally apply to the Prince Edward Islands and only did so after amendment by the General Shipping Amendment Act in 1997⁹⁰.

The Marine Pollution (Prevention of Pollution from Ships) Act 2 of 1986 empowers the Minister of Transport to make regulations that give effect to the MARPOL 73/78 Convention⁹¹. However, this act and regulations made under it deal mostly with preventing, minimizing and regulating operational pollution generated by ships. The Marine Living Resources Act 18 of 1998 empowers the Minister of Environmental Affairs and Tourism to make regulations pertaining to "the prevention of marine pollution". Furthermore, the Minister is empowered to proclaim MPAs and can prohibit "any activity which may adversely impact on the ecosystems" of a MPA⁹². As discussed previously this can include the regulation of the passage of fishing vessels that have fishing gear aboard. However, any regulation pertaining more widely to the passage of other vessels would presumably require close liaison with the Minister of Transport and the South African Maritime Safety Authority (SAMSA), as this would be an area of overlapping jurisdiction.

If the passage of a foreign vessel is deemed or believed to be not innocent by the Minister of Transport, the Marine Traffic Act empowers the Minister to require the master of the vessel to stop the vessel, order it to anchor, move the vessel to a place specified by the Minister, and to allow authorized personnel aboard to inspect the vessel and its cargo⁹³. If the master of the vessel fails to perform any act ordered by the Minister, the Minister may use "such force as may be necessary" to cause the act to be performed⁹⁴.

⁸⁹ Shipping General Amendment Act 23 of 1997 Section 25 (a)

⁹⁰ Marine Traffic Act Section 26

⁹¹ Marine Traffic Act Section 3 (1)a

⁹² Marine Living Resources Act s43 (2)e

⁹³ Marine Traffic Act s9 (1)

⁹⁴ Marine Traffic Act s9 (2)

7. SITE PROTECTION FOR ECOLOGICALLY IMPORTANT AREAS ADJACENT TO THE PRINCE EDWARD ISLANDS EEZ

As mentioned in the introductory section, the marine conservation plan for the Prince Edward Islands revealed that the marine ecosystems occurring within the South African EEZ are supported by specific and spatially defined ecosystem processes (e.g. areas of high primary productivity) that are located adjacent to the South African EEZ. A truly comprehensive and representative network of MPAs in the region of the Prince Edward Islands would ideally also require protection of these areas adjacent to the South African EEZ (but within the CCAMLR jurisdiction). In this section we briefly examine the possible jurisdiction for such potential MPAs on the high seas. This is a topic which currently enjoys a great amount of deliberation 95,96,97 and could be the subject of several reports on its own. In this report, I will therefore not try to be complete but merely outline the broad framework and present arguments as they pertain to the Prince Edward Islands.

7.1 The South African Extended Continental Shelf Claim

South Africa is currently in the process of conducting extensive surveys around the Prince Edward Islands in order to delineate the outer limits of the continental shelf and finalize its extended continental shelf claim as conferred on coastal States under the LOSC (Article 76). How then would a successful extended continental shelf claim affect South Africa's ability to manage living marine resources and habitats adjacent to its EEZ, but on its extended continental shelf?

Coastal States that have successfully delimited the outer limits of their continental shelf can claim sovereign rights to explore and exploit the natural resources of the continental shelf⁹⁸. However, these natural resources are defined as:

"...the mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species, that is to say, organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil "99."

99 LOSC Article 77 (4)

⁹⁵ Gjerge M (2005) Editors introduction: Moving from words to Action. International Journal of Marine and Coastal Law, 20, 323-

⁹⁶ Gjerde M, Breide C (2003) Towards a Strategy for High Seas Marine Protected Areas. Proceedings of the IUCN, WCPA and WWF Workshop on High Seas Marine Protected Areas. 15-17 January 2003, Malaga, Spain

⁹⁷ Scovazzi (2003) Marine Protected Areas on the High Seas: Some Legal and Policy Considerations. Paper presented at the World Parks Congresss, Durban South Africa

⁹⁸ LOSC Article 77 (1)

At first glance, this definition would seem to severely limit South Africa's ability to manage international activities and particularly foreign fishing vessels targeting mobile species. However, when one considers the wider ecosystem impacts of many fisheries on benthic species and habitats, an interesting interpretation of these provisions becomes apparent. To explain, a non-specific fishery, such as a trawl fishery, targeting mobile fish on South Africa's extended continental shelf would certainly be damaging and harvesting (as bycatch) a wide range 'sedentary' benthic species. South Africa could therefore claim that such a fishery was impinging on its sovereign rights to explore and exploit these benthic species. In terms of exploitation, one should also not loose sight of the modern commercial opportunities afforded through bioprospecting. In other words, South Africa could claim that even the smallest and most insignificant benthic species could potentially contain important genetic material that could afford future commercial opportunities to the country. Similarly, other fisheries such as longlining and pot fishing for Patagonian toothfish can have significant bycatches of sedentary species (e.g. crabs). Once again, although these resources are not currently being commercially exploited, South Africa could claim that significant bycatches of these sedentary species affects its right to exploit these resources in the future.

It is therefore submitted that South Africa could use its extended continental shelf claim to manage a significant amount of fishing activity in these areas, should the need arise.

7.2 MPAs in areas beyond national jurisdiction

The "Freedom of the High Seas" ¹⁰⁰ and its apparent conflict with the need to regulate high seas fisheries and thereby afford better protection to marine biodiversity of the high seas, is currently one of the most widely debated provisions of the LOSC (see earlier references).

The LOSC confers upon all States certain freedoms in respect to the high seas (e.g. navigation, overflight, laying submarine cables, scientific research and fishing). However, it is important to note that these freedoms are <u>not unconditional rights</u> and are subject to certain conditions and duties. Firstly, States have a general obligation to "protect and preserve the marine environment"¹⁰¹. Secondly, States have a very specific duty to "take such measures for their respective nationals as may be necessary for conservation of the living resources of the high seas"¹⁰². Thirdly, and perhaps most importantly for our purposes, States have a duty to:

"...cooperate with each other in the conservation and management of living resources in the areas of the high seas. States whose nationals exploit identical living resources, or different living resources in the same area, shall enter into negotiations with a view to taking the measures necessary for the conservation of the living resources concerned. They shall, as

101 LOSC Article 192

102 LOSC Article 117

¹⁰⁰ LOSC Article 87

appropriate, cooperate to establish subregional or regional fisheries organizations to this end."103

It is therefore be clear that the right for all States to fish on the high seas is in no way a blanket right for States to act unilaterally in this regard. States have a duty to co-operate with one another and to establish or participate in regional fisheries organizations to this end (in the case of the Prince Edward Islands, CCAMLR qualifies as the relevant and competent regional fisheries organisation). Furthermore, the obligation of States to co-operate when fishing on the high seas is not devoid of legal meaning. It implies a duty to act in good faith in entering into negotiations with a view to arriving at an agreement and in taking into account the positions of other interested States 104.

The duty of States to co-operate has been further developed under the 1995 United Nations Fish Stocks Agreement (UNFSA)¹⁰⁵, which is very clear that:

Where a ... regional fisheries management organization ... has the competence to establish conservation and management measures for particular straddling fish stocks ..., States fishing for the stocks on the high seas ... shall give effect to their duty to cooperate by becoming members of such organization ..., or by agreeing to apply the conservation and management measures established by such organization ... 106

The UNFSA goes on state that:

Only those States which are members of such an organization ..., or which agree to apply the conservation and management measures established by such organization ..., shall have access to the fishery resources to which those measures apply 107.

The UNFSA now enjoys participation from 56 states 108. Although still not yet as comprehensive as one would wish, this treaty is starting to become a truly global treaty and it is hoped that it will become even more widely ratified in the future.

The UNFSA obviously only has direct application for very specific fish stocks (i.e. highly migratory species and those that straddle international boundaries). However, more importantly we should consider how the emergence and wide ratification of the UNFSA may have affected the modern understanding and interpretation of the provisions of the more widely accepted LOSC. This principle, coined as the Principle of Contemporaneity by Judge

¹⁰³ LOSC Article 118

North Sea Continental Shelf case (1969) ICJ Rep 3, para 85 of the Judgement

¹⁰⁵ Full Title: Agreement For The Implementation Of The Provisions Of The United Nations Convention On The Law Of The Sea Of 10 December 1982 Relating To The Conservation And Management Of Straddling Fish Stocks And Highly Migratory Fish Stocks.

¹⁰⁶ UNFSA Article 8 (3)

¹⁰⁷ UNFSA Article 8 (4)

http://www.un.org/Depts/los/convention_agreements/convention_overview_convention.htm

Weeramantry in the *Gabcikovo-Nagymaros Dam Case*¹⁰⁹ and reinforced in the *Shrimp-Turtle* cases¹¹⁰, upholds the dynamic nature of international treaty law. In particular it holds that treaty law needs to be interpreted and applied in the light of customary international law and new environmental law. In this regard, it is widely held that the UNFSA has had an effect of redefining and clarifying the legal concept of the 'Freedom of the High Seas' (and its conditions) in terms of modern global threats to high seas biodiversity and the modern framework of Sustainable Development^{111,112}. The growing acceptance of the provisions of the UNFSA in modern fisheries law is clearly visible in the effect it has had on the provisions of more modern regional fisheries organizations (e.g. the Convention on the Conservation and Management of Fishery Resources in the South-East Atlantic Ocean; and the Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean)

It is therefore held that the provisions of the LOSC and the UNFSA together provide a compelling legal argument that any State wishing to conduct fishing activity in the area adjacent to the Prince Edward Islands EEZ (but with the CCAMLR area of competence), should either become a member of CCAMLR or abide by its management and conservation measures. Failing this, the State should seek to co-operate directly with South Africa if fishing for stocks that straddle the EEZ boundary. This interpretation provides South Africa with considerable legal ground for protecting important ecosystem processes occurring in areas adjacent to its EEZ.

As described earlier, CCAMLR has been very positive about the role that MPAs can play in furthering the objectives of the Convention¹¹³. The 'protection of ecosystem processes' was one of the applications of MPAs that was explicitly listed by the Commission. The Commission has also endorsed a work plan that will inform the development of a representative network of MPAs in the entire Convention area. It is therefore submitted that a proposal by South Africa to further work towards formal protection of areas important for the ecosystem processes of the region, but occurring adjacent to the South African EEZ, will be aligned with international law and recent developments under the CCAMLR regime. As such it should receive due consideration from the Scientific Committee and Commission.

A successful pursuance of the path described above would afford protection for the ecosystems of this area from mainly fishing and other harvesting activities. This could hypothetically still leave these areas vulnerable to non-living resource extractive activities, such as mining. Part XI of the LOSC and the 1994 Implementation Agreement¹¹⁴ govern the exploitation of non-living resources in areas beyond national jurisdiction (known as "the

¹⁰⁹ ICJ Rep. (1997), 7, at paras. 112 and 140.

US – Import Prohibition of Certain Shrimp and Shrimp Products. Report of the Appellate Body (1998) WT/DS58/AB/R

Scovazzi T (2004) Marine Protected Areas on the High Seas: Some Legal and Policy Considerations. *The International Journal of Marine and Coastal Law*, Vol 19, No 1.

Bialek D (2003) Sink or Swim: Measures Under International Law for the Conservation of the Patagonian Toothfish in the Southern Ocean. Ocean Development and International Law, 34: 105-137

¹¹³ Report of CCAMLR-XXIV Para 4.14

Full Title: 1994 Agreement relating to the implementation of Part XI of the United Nations Convention on the Law of the Sea of 10 December 1982

An Analysis of Legal Obligations, Options and Opportunities

Area"). These instruments establish the International Seabed Authority and its various decision making bodies. The primary decision making authority is the Council 115. Amongst the many powers and functions of the Council is the power to "disapprove areas for exploitation by contractors or the Enterprise in cases where substantial evidence indicates the risk of serious harm to the marine environment 116." Should the threat of deep sea marine mining ever arise in these areas, it would be incumbent upon South Africa and other sympathetic States to provide "substantial evidence" to the International Seabed Authority as to threats that this may pose to the marine environment and local ecosystems, and urge the Council to disapprove such plans.

¹¹⁵ LOSC Part XI, Section 4, Subsection C.

¹¹⁶ LOSC Article 162 (x)

8. ENFORCEMENT OF A MPA AROUND THE PRINCE EDWARD ISLANDS

Clearly the enforcement of a MPA in the Southern Ocean more than 1,500km from the nearest port is difficult for any country, let alone a developing country with limited resources. This shortfall was painfully evident during the mid 1990s when rampant IUU fishing around the Prince Edward Islands virtually led to the commercial extinction of toothfish stocks in the area. Clearly there would be little sense to the declaration of an MPA around the Prince Edward Islands if this was still the state of South Africa's enforcement capabilities. In this section we will examine legal and policy changes that should lead to an enhanced ability to enforce the proposed MPA around the Prince Edward Islands.

8.1 CCAMLR efforts

Since the mid 1990s CCAMLR has adopted a number of Conservation Measures relating to IUU fishing. These include Conservation Measures aimed at improving flag state control (CM 10-06 (2005)), port state control (CM 10-03 (2005)), trade measures (CM10-05 (2005)) and inspection and observation schemes. In this section we will only examine the Conservation Measures that could have direct pertinence to the monitoring, control and surveillance (MCS) of the proposed Prince Edward Islands MPA.

Perhaps the most significant development that will enable CCAMLR member states to monitor the detailed movement of their own vessels has been the adoption of mandatory satellite-based vessel monitoring systems (VMS) on all vessels operating within the CCAMLR area, except those fishing for krill 117. In brief, the VMS allows States to monitor the movements of their licensed vessels remotely via a satellite transmitter attached to the vessel. Member States are further required to forward all VMS reports to the CCAMLR secretariat for collation and verification 118. The main weakness in the current system is that vessels are only required to keep their VMS active while in the CCAMLR area. During the negotiation of this conservation measure, a number of States argued for the need to have the VMS active from port to port, but several fishing nations were strongly opposed to this and saw it as CCAMLR acting beyond its jurisdiction. The weakness in the adopted conservation measure is that a vessel may move into the CCAMLR area, activate its VMS as required, attempt to fish legally in its allocated area, find catches to be poor, move out of the CCAMLR area, deactivate the VMS and then move back into the CCAMLR area and fish illegally in another area (e.g. a MPA or EEZ of a coastal state). Despite this, it can be said that overall CCAMLR has been successful in implementing a system that is fairly robust for monitoring the activities and movements of legal vessels of CCAMLR Member States.

¹¹⁷ Conservation Measure 10-04 (2005)

¹¹⁸ Conservation Measure 10-04 (2005) Article 11

The second major set of developments that affects the monitoring, control and surveillance of MPAs in the Southern Ocean are the CCAMLR System of Inspection and the CCAMLR System of International Scientific Observation. These developments were in response to Article XXIV of the Convention. Article III of the text of the CCAMLR System of Inspection entitles designated inspectors of member States to board fishing vessels in the CCAMLR area in order to verify compliance with conservation measures. Although the original text did not discern between fishing vessels of member States and non-member States, this was later clarified to only apply to vessels of other Member States. However, the entry into force of the UNFSA once again adds an interesting dimension to these provisions. Article 21 (1) of the UNFSA gives a State which is party to the UNFSA and a particular Regional Fisheries Organisation (RFO), the right to board and inspect fishing vessels of another member of the UNFSA in order to ensure compliance with conservation measures adopted by the RFO, regardless of whether such a State party is member of the particular RFO. Hence, under the provisions of the UNFSA, a CCAMLR inspector may board a vessel of another member of the UNFSA fishing in the CCAMLR area, even if the second party is not a CCAMLR member.

Should a CCAMLR inspector detect a violation, the CCAMLR System of Inspection only allows that the violation be reported to the flag State. The flag State is then required to initiate further legal proceedings. Under the UNFSA however, substantially more power is given to the inspecting State. In the case where there are clear grounds for believing a 'serious offence' has been committed and the flag State fails to fulfill its obligation to initiate proceeding, the inspectors may remain aboard, and if appropriate, bring the vessel to the nearest port¹¹⁹. However, the UNFSA is also clear that its provisions should only apply in the absence of inspection procedures being set up by the RFO itself¹²⁰. Therefore in the case of an inspection by one CCAMLR member on the vessel of another CCAMLR member, the provisions of the CCAMLR system of inspection will apply. However, the 1969 Vienna Convention on the Law of Treaties is clear that if a CCAMLR member State inspects the vessel of a non-CCAMLR member, and both States are party to the UNFSA, then the provisions of the UNFSA should apply. The nett effect of this is that non-CCAMLR members, but who are party to the UNFSA, may be subject to more stringent inspection procedures than CCAMLR members. This could serve as a good incentive for such States to become members of the CCAMLR regime.

UNFSA has therefore had an effect of widening the number of nations that would be subject to inspection, under either the CCAMLR or UNFSA regimes. However, CCAMLR should also be commended for the efforts it has made to widen its own membership and to increase cooperation with non-contracting parties, most notably through the 1999 adoption of a comprehensive Policy to Enhance Co-operation between CCAMLR and Non-Contracting Parties¹²¹. These efforts have gone a long way towards widening flag state compliance under the CCAMLR regime¹²².

¹¹⁹ UNFSA Article 21 (8)

¹²⁰ UNFSA Article 21 (3)

¹²¹ CCAMLR, Report of the Eighteenth Meeting of the Commission (CCAMLRXVIII) Annex 8

¹²² Millar *et al.* note 51 above

Over and above the CCAMLR System of Inspection, all vessels of CCAMLR member States are required to carry International Scientific Observers. Observers are required, amongst other duties, to record details of vessels operations¹²³, including the position of fishing activity. This information is an additional means of monitoring the activities of vessels of CCAMLR members in relation to restricted areas such as the EEZs of coastal States and MPAs.

8.2 National legislation and policy

Over and above the provisions of CCAMLR, South Africa's national fisheries policy¹²⁴ also requires all licensed large commercial fishing vessels (Cluster A, B & C) to be fitted with an approved and functioning satellite-based VMS. Furthermore all South African licensed vessels fishing within the Prince Edward Islands EEZ are required to carry a scientific observer. An interesting application of the use of satellite-based VMS is the use of so-called 'exclusion zones' in which all fishing vessels are excluded, irrespective of whether the vessels are actually fishing or not. As we have seen earlier, there is some precedent for such 'exclusion zones' in both South African and Australian MPA regulations. In Australia, the Commonwealth has prosecuted fishing vessels for being present in such exclusion zones, based purely on their satellite VMS data¹²⁵. The fact that the VMS navigation pattern might suggest the vessel had been fishing can be used to jusitify a steeper penalty, but there no need for the Commonwealth to prove that the vessel was actually fishing. Its mere presence is an offence.

During 2003 South Africa acquired three new purpose-built fisheries patrol vessels. One of these vessels, the *Sarah Baartman*, was built specifically for its blue water capabilities and ability to patrol waters around the Prince Edward Islands. Furthermore, the South African Navy recently acquired four new Corvettes. Although these vessels are not operational yet, an integral part of the motivation to acquire these vessels was the need to secure South Africa's offshore marine resources, including those adjacent to the Prince Edward Islands.

The Marine Living Resources Act empowers fisheries control officers aboard such vessels to order foreign or local fishing vessels within the South African EEZ to stop and to board and inspect such vessels¹²⁶. Should the officer have reasonable grounds to suspect that an offence has been committed he or she may take the vessel to a port, or seize the vessel¹²⁷. Seizure of vessels (or other property) by the State is subject to application for release upon the provision of appropriate security¹²⁸. In the case of foreign vessels, this would be consistent with the provisions for "prompt release" on the posting of a "reasonable bond"

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¹²³ Text of the CCAMLR Scheme of International Scientific Observation, Annex I, 2 (i)

General Policy on the Allocation and Management of Long Term Commercial Fishing Rights: 2004. Department of Environmental Affairs and Tourism, South Africa.

¹²⁵ See Molenaar note 59 above

¹²⁶ Marine Living Resources Act (1998) s51 (2) (a) & (h)

¹²⁷ Marine Living Resources Act (1998) s51 (2) (j) & (3) (c)

¹²⁸ Marine Living Resources Act (1998) s62 (1)

under article 73 of the LOSC 129. Interestingly though, the South African legislation stipulates that such financial security or bond should be calculated by adding the maximum possible fine for the offences (in this case two million South African Rands per offence 130) allegedly committed and the "costs and expenses incurred or reasonably foreseen to be incurred by the State" 131. In the case of a several thousand kilometer "hot pursuit" across the Southern Ocean, as we witnessed in the recent case of the Viarsa I, the costs incurred by the State can amount to several million dollars. These provisions are obviously important for the coastal States in order to recover expenses of very costly surveillance and enforcement operations. However, Articles 73 of the LOSC only speaks of the posting a "reasonable bond" for "prompt release" of a detained vessel and crew. It remains to be tested whether cost recovery for such a long distance pursuit will qualify as a "reasonable bond" under the LOSC. Traditionally the International Tribunal for the Law of the Sea (ITLOS) has been quite conservative in its estimation of a "reasonable bond" 132. Importantly, Australia has recently amended its Fisheries Management Act (1991) significantly, to allow for cost recovery of such surveillance and enforcement operations. The amended Australian Fisheries Management Act, allows for the arrested vessel to be automatically forfeited to the Commonwealth, so long as procedural notice obligations are complied with. There is no independent requirement for one of the crew members or master to be successfully prosecuted 133. The owner's only redress is to bring an action for the release of its vessel with the civil burden of proof resting on the owner's shoulders to prove that the vessel was not involved in the commission of an offence against the Act. The amended Act gives the Australian authorities a power to include the pursuit costs recoverable as part of any bond set for the release of the vessel. These initiatives are a symptom of the frustration of coastal States to the perceived limitations in international law in protecting their sovereign rights from IUU fishing activities. Raising maximum fines payable on conviction, confiscating the vessels and equipment used in an offence, and recovering the costs of pursuit as a penalty are some of the few domestic avenues open to coastal States to directly deter foreign illegal fishing.

Perhaps the most promising development in terms of increasing compliance efforts around the Prince Edward Islands is the development of a draft bilateral compliance agreement between South Africa and Australia on co-operation for surveillance around these nation's Southern Ocean territories¹³⁴ (i.e. Heard & McDonald Islands (Australia); and the Prince Edward Islands (South Africa)). A similar agreement was concluded between recently Australia and France¹³⁵ for the co-operative surveillance of their respective and neighbouring Southern Ocean territories on 24 November 2003. This agreement creates an 'Area of

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¹²⁹ LOSC Article 73 (2)

¹³⁰ Marine Living Resources Act (1998) s58 (1)

¹³¹ Marine Living Resources Act (1998) s62 (2)

Kimpton P (2004) Current Legal Developments Australia: Recent domestic and international law developments. International Journal of Marine and Coastal Law, 19, 537-543; and references therein.
 See Kimpton P (2004) note132 above

Baird R (2004) Coastal State Fisheries Management: A review of Australian Enforcement Action in the Heard and McDonald Islands Australian Fishing Zone. Deakin Law Review, 9, 91-118

Full Title: Treaty between the Government of Australia and the Government of the French Republic on cooperation in the maritime areas adjacent to the French Southern and Antarctic Territories (TAAF), Heard Island and the McDonald Islands(Canberra, 24 November 2003)

Cooperation' that corresponds to the French and Australian EEZs surrounding their island possessions in the Southern Ocean. The principal aims of the Treaty are to enhance cooperative surveillance and scientific research, as well as to establish a framework for collaborative activities like patrol missions, exchange of information and hot pursuit. An interesting provision from an international law perspective is the right of a Party, in Article 4, to continue hot pursuit of a fishing vessel through the territorial sea of the other Party, provided that the other Party is informed and no physical law enforcement is taken by the pursuing Party during that phase of the pursuit. The signing of this Treaty is an encouraging development in international law and the battle against IUU fishing in a region where surveillance and enforcement is extremely difficult. Furthermore, the Treaty text leaves the possibility open for Australia and France to explore other avenues of increasing cooperation through establishing collaborative enforcement regimes under Article 2 of Annex III.

Clearly it would make sense for South Africa to conclude its own bilateral Treaty with Australia as soon as possible. However, given the proximity of the Crozet Islands (France) and Bouvet Island (Norway) it would make sense that South Africa concludes similar Agreements with these States as well. This is especially pertinent in the case of 'hot pursuit' of transgressing vessels in terms of Article 111 (2) of the LOSC, which requires the pursuing Party to break off 'hot pursuit' as soon as the vessel enters the territorial waters of a third State. Although no formal treaties exist at present, South African compliance authorities have a good co-operative working relationship with the relevant authorities in Australia and France and have in the recent past co-operated with both governments in the arrest of suspected IUU vessels (the arrests of the *South Tomi* and *Viarsa* with Australia, and the *Apache* with France).

9. CONCLUSIONS AND RECOMMENDATIONS

9.1 Meeting international obligations and commitments

South Africa's participation in the CBD and the LOSC, as well as its public commitment to various widely accepted international policy statements (e.g. the Jakarta Mandate, WSSD plan of implementation, and the World Parks Congress Recommendations), places it under a legal obligation to develop a representative network of MPAs in the maritime zones under its jurisdiction. These legal instruments together highlight the need for such networks of MPAs to conform to three main criteria:

- 1. be consistent with international law,
- 2. be science-based, and
- 3. be representative of all marine habitats.

Overall, it can be said that South Africa has performed well in terms of meeting these international commitments. Almost 20% of our coastline is now protected within MPAs. However in the past, little specific planning was put into ensuring that this network is representative of all marine habitats (aside from a reasonably broad bio-geographic representation). The recent conclusion of the marine component of the National Spatial Biodiversity Component and subsequent fine-scale plans being developed under this planning framework, have added a new dimension to this work and will ensure that future MPA declarations are based on these explicit requirements. The marine conservation plan developed for the Prince Edward Islands and the proposed MPA delineation (see Figure 2) is therefore consistent with these international requirements (of being science-based and representative of all marine habitats) and will contribute greatly to the South African government meeting its international commitments. The proposed MPA delineation is shown in Figure 2. It is important to note that the plan proposes four IUCN category 1a reserves, which will be strict 'sanctuary areas' (no-extractive activities allowed). These four category 1a reserves are linked by a conservation zone in which controlled fishing activity will be permitted.

Over and above the obvious marine biodiversity benefits, the MPA will also contribute to South Africa's duty under the LOSC to protect and restore overexploited fish stocks (in this case Patagonian Toothfish) to levels that can produce a maximum sustainable yield. The Prince Edward MPA plan also takes into account the migration routes and foraging areas of albatrosses breeding on the islands and as such seeks to fulfill South Africa's commitment under the ACAP to protect these marine habitats.

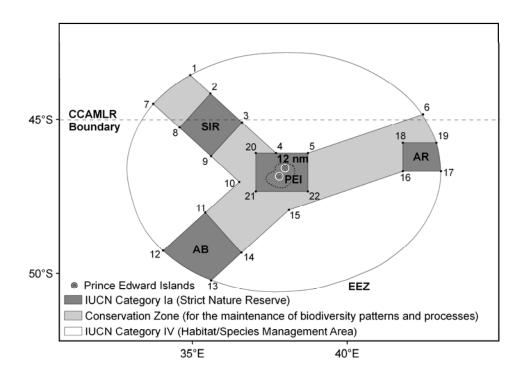


Figure 2. The proposed boundaries for the Prince Edward Islands MPA. The four Category 1a reserves are: Southwest Indian Ridge (SIR); Prince Edward Islands (PEI); Africana II Rise (AR); and Abyss (AB).

From Lombard *et al.* (2006)

9.2 Harmonisation with regional arrangements

Although nothing can derogate from South Africa's sovereign rights to "explore and exploit" and "conserve and manage" the natural resources of its EEZ surrounding the Prince Edward Islands, both the LOSC and the UNFSA convey an obligation for South Africa to harmonise its management and conservation efforts with those of CCAMLR in the adjacent waters.

Recent developments within CCAMLR have established that it is the Commission's view that MPAs can play an important role in furthering the objectives of CCAMLR. The Commission has also endorsed a workplan for the development of a science-based approach towards the identification and development of a representative network of MPAs within the Convention area.

It can be concluded that South African efforts to establish a MPA in the Prince Edward Islands EEZ are completely consistent with the objectives of CCAMLR as well as recent developments under the CCAMLR regime. In fact the science-based approach adopted by South Africa was specifically commended by the Scientific Committee.

9.3 World heritage site nomination

Aside from elevating the conservation responsibility of this area to an international duty, it is doubtful whether a successful World Heritage Site nomination that includes the territorial sea will afford any extra protection to the marine areas on its own. It is also unclear whether the World Heritage system will be able to practically assist (financially, technically or otherwise) in marine conservation matters in this area, which are so heavily dominated by fisheries threats. This is the realm of regional fisheries organizations. However, the mere status that a World heritage Site brings along with it may afford certain secondary benefits to the area as a whole.

9.4 Options under South African domestic law

An extension of the existing Special Nature Reserve to include the 12 nautical mile territorial sea, as one component of a larger MPA, has significant legal and practical management implications.

The main difficulty with Special Nature Reserve Status for the territorial sea is that it will restrict access to the area almost exclusively to scientific research and environmental monitoring purposes. This will have an effect of excluding all vessels (including and especially fishing vessels) from the territorial sea, other than those involved directly in the management of the islands or engaged in scientific research or environmental monitoring. This presents some difficulty from the legal perspective and from a practical management perspective. From a legal perspective, these are not insurmountable; however, practically this may not be the best option.

From a legal perspective, at first there may seem to be a conflict between these stringent access conditions for a Special Nature Reserve and the rights of passage for local and foreign vessels. Firstly in terms of local fishing vessels, we have noted that in both South African and Australian domestic fisheries law there is precedent for excluding vessels completely from designated areas (irrespective of whether they are fishing or not). Secondly in term of both local merchant ships and foreign vessels (merchant or fishing), we have seen that coastal States have sovereign rights within their territorial seas to declare routeing measures, including 'areas to be avoided'. These measures are not contingent on IMO approval and South Africa only needs to take into consideration the recommendations of this body. Therefore from a legal perspective it appears that South Africa could impose a strict 'area to be avoided' by shipping traffic that corresponded with the limits of the territorial sea. However, from a practical point of view South African quota holders fishing for Patagonian Toothfish in the area, often need to use the lee of the islands to shelter from fierce storms in this area. A Special Nature Reserve Status including the Territorial Sea would preclude this option in most circumstances, and vessels could only justify seeking shelter in the case of force majeur. Given the key role that the legal South African fishery has played in keeping a

surveillance presence around the islands over the past years, this course of action would seem excessive.

It would therefore seem that from a practical implementation point of view the more flexible structure provided by section 43 of the Marine Living Resources Act would be more preferable. The question is whether a proclamation under section 43 of the Marine Living Resources Act can afford a similar level of comprehensive protection from a wide range of threats, as afforded a Special Nature Reserve Status under NEMPA. It appears that the provisions of section 43 have been used to control a wide range of potential impacts including fishing, extraction, mining, disturbance, pollution, and construction. Furthermore, State practice appears to indicate the 'catch-all' provision that asserts the Minister right to prohibit "any activity that may adversely impact on the ecosystems of the area," has been used to good effect to control a wide range of activities, including the passage of fishing vessels. Section 43 of the Marine Living Resources Act, however, has the advantage of possessing the necessary flexibility to allow legally permitted fishing vessels to shelter in the lee of the islands under prescribed conditions. Such conditions could include a requirement to stow all fishing gear whilst within the MPA and to inform the officer-in- charge at the scientific station on the islands of the vessels intended movements.

It is therefore concluded that extension of the present Prince Edward Islands Special Nature Reserve to include the territorial sea would not be appropriate due to stringent and inflexible nature of this legislation. Section 43 of the Marine Living Resources Act, if used in conjunction with complementary legislation (e.g. to regulate marine traffic; see next section) can afford a similar level of protection to this area, while maintaining the necessary flexibility to manage the practicalities of an active fishery in the area.

9.5 Regulation of shipping activity

Despite the longstanding navigational rights of seagoing vessels, modern international law affords coastal States with considerable rights to regulate international shipping traffic within its territorial sea and EEZ for the specific objective of conserving the marine resources of this area. Within the territorial sea surrounding the Prince Edward Islands, South Africa has sovereign rights to regulate traffic through measures that include mandatory reporting and routing measures and mandatory 'areas to be avoided'. For these purposes, South Africa merely needs to take into account the recommendations of IMO. It would therefore be possible to declare the entire territorial sea surrounding the Prince Edward Islands as an 'area to be avoided' with designated sea lanes leading to and from designated anchoring sites. Such anchoring sites would be positioned so as to ensure maximum safety of vessels (especially vessels that are not familiar with the islands) and thus avoid any situations which could lead to vessels floundering and consequent pollution threats to the wildlife of the islands. Although the threat of pollution would be a major reason for these regulations, international legal practice allows marine traffic measures to be taken for environmental reasons other than the threat of pollution. At the Prince Edward Islands there is one such

reason to regulate the minimum distance at which vessels may anchor from the islands. Possibly the greatest threat to the terrestrial ecosystems of the islands and the millions of seabirds that breed here is the accidental introduction of rats from ships. Rats have wreaked havoc on several sub-Antarctic and temperate islands to which they have been introduced. As rats are known to be able to swim considerable distances, it seems prudent that a minimum anchoring distance be enforced.

For the parts of the Prince Edward Islands MPA that fall outside of the territorial sea but within the EEZ, it is recommended that mandatory reporting requirements are imposed for all vessels. The reasons for this are mainly related to enhancing fisheries compliance and enforcement efforts (see later discussion). These measures will be subject to approval from the IMO, however, given the low levels of marine traffic in the vicinity of the Prince Edward Islands, it is unlikely that such a proposal should pose a problem.

As with World Heritage Site status, pursuing a PSSA status for the Prince Edward Islands MPA will not afford the area any extra protection on its own. Protective regulations will still need to be developed seperately to the PSSA approval by IMO, adding an extra administrative hurdle to the process. However, as South Africa is in the process of submitting a PSSA proposal for its continental EEZ, it seems logical that this proposal is expanded to include the Prince Edward Islands.

9.6 Protection of ecosystem process on the high seas

The Prince Edward Islands MPA planning process revealed that two important and spatially defined ecosystem processes are located adjacent to the Prince Edward Islands EEZ. Ensuring comprehensive protection for the marine ecosystems of the Prince Edward Islands EEZ would therefore ideally include protection of these processes which occur on the high seas, but within the jurisdiction of CCAMLR. Fortuitously, both these areas also occur in the areas where South Africa is proposing to claim extended continental shelf rights under the LOSC. This claim will certainly increase South Africa's international legal standing to afford higher protection to the biodiversity and ecosystem processes of these areas. However, more comprehensive protection will need to be facilitated through CCAMLR. Both these areas are currently closed to the main fishing activity in this area (that for Patagonian Toothfish) under CCAMLR Conservation Measures. Furthermore, the Commission has endorsed the role that MPAs can play in furthering the objectives of CCAMLR. A proposal by South Africa for the protection of these areas adjacent to its EEZ in order to secure the wellbeing of the ecosystems occurring within its EEZ, should receive due consideration from the Commission. This process would be consistent with international law and would not infringe on the rights of non-contracting parties to CCAMLR. This position is held mainly because of the growing acceptance of the UNFSA and the effect is has had on clarifying the provisions of the LOSC¹³⁶ with regard to co-operation between coastal States and States harvesting stocks that straddle the coastal States EEZ.

9.7 Enforcement options

The requirement for all vessels operating within the Prince Edward Islands EEZ and within CCAMLR waters to be fitted with satellite-based VMS and carry scientific observers, has greatly increased the ability of CCAMLR parties to monitor and control the movements and activities of their own fishing vessels. Efforts within the CCAMLR system, such those to widen the membership and to enhance co-operation with non-contracting parties, as well as growing acceptance of reciprocal inspection and compliance procedures under the UNFSA, have also had an effect of increasing the potential level of control over vessels flagged to non-contracting parties operating within the CCAMLR area. Although, improvements have been evident in this area, it would be naïve to think that the battle has been won. There are still significant problems with political will, from both non-contracting parties and some contracting parties, in exercising proper and responsible flag State control over their fishing vessels. This is not a problem that is unique to CCAMLR and subject global concern and attention.

It is the opinion of Millar et al. 137 that "it is probably true to say that deterrence of toothfish IUU fishing in the CCAMLR Area has been most effectively prosecuted through coastal State action in respect of waters under their national jurisdiction, rather than via direct application of specific CCAMLR conservation measures". The reasons for this are two fold. Firstly, the levels of fines being imposed by coastal States now present a real deterrent. This is evident by the fines being imposed by Australia (e.g. in the case of the Volga). In addition to making provision for substantial fines, South African domestic law allows for the recovery of any costs the State may have incurred in making the arrest. In the case of illegal fishing within the Prince Edward Islands, this could amount to a considerable financial deterrent for any would-be poacher. Secondly, there is a growing political will to combat IUU fishing by coastal States in the Southern Ocean. This is evident in the acquisition of purpose built patrol vessels by South Africa and the developments towards bilateral co-operative surveillance agreements between Australia, France and South Africa. These developments will have an immense effect on South Africa's ability to monitor and manage an MPA around its Prince Edward Islands. Co-operation between these nations in costly surveillance exercises in the Southern Ocean makes absolute political, logistical and economic sense and will greatly enhance compliance efforts in this area. It is recommended that South Africa conclude its negotiations towards compliance agreements with both Australia and France with great urgency. However, it is also urged that a similar agreement be struck with Norway with regards to its neighbouring Bouvet Island. The Norwegian territorial sea around Bouvet, situated less than 1000km from the Prince Edward Islands could prove to be a geographical

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¹³⁶ With regard to the obligation for States to co-operate in harvesting the living resources on the high seas. LOSC Article 118; UNFSA Article 8

See Millar *et al.* note 51 above

and legal loophole in the case of a "hot pursuit" of an IUU vessel sighted fishing within the Prince Edward Islands MPA.

In terms of the regulations pertaining to the Prince Edward Islands MPA declaration, it is recommended that four category 1a reserves be declared a fishing vessel 'exclusion zones' under the Marine Living Resources Act except for designated approach lanes and anchoring locations in the category 1a reserve immediately around the islands (PEI in Figure 2). These 'exclusion zones' will play an important enforcement role. Firstly, in terms of effecting a successful prosecution of illegal vessels sighted within the MPA, the State will not need to prove that the vessel was actually fishing (this can be difficult at times) and the mere presence of the vessel in the MPA is enough to prosecute. Evidence of fishing activity can however be used to argue for a heavier sentence. Secondly, should South Africa ever wish to avail itself of remote-sensed satellite surveillance imagery, such a no-vessel area will greatly enhance the ability to detect illegal fishing activity.

Furthermore, it is recommended that the entire MPA, outside of the territorial waters is subject to mandatory reporting measures. For South African flagged vessels, this can be regulated through the Marine Traffic Act and the Marine Living Resources Act. However, for application to foreign flagged vessels, such a measure will be subject to the endorsement of the IMO. Such measures will once again greatly ease compliance and enforcement activities in the area. In other words, should a vessel be sighted within the MPA, that had not reported its passage, it would immediately be liable for prosecution without having to prove that the vessel was indeed fishing. Secondly, reporting by vessels that are legally passing through the area will greatly assist in detecting other vessels that are there illegally (via remote sensed imagery or other surveillance). Finally, mandatory reporting by all vessels entering these zones can facilitate voluntary surveillance efforts. In other words, all vessels entering these zones can be asked to report any fishing activity (vessels or fishing lines) that is observed. This can then be validated or investigated by the South African fishing authorities.

9.8 Concluding remarks and summary of recommendations

In summary, it is submitted that the development of a MPA around the Prince Edward Islands will greatly advance South Africa's progress towards meeting its international legal obligations and policy commitments, including the:

- development of representative networks of MPAs in its waters, and
- sound conservation and management of the marine resources under its jurisdiction.

It is also held that, taking into account the arguments and recommendations put forward in this report, the development of such an MPA is:

- consistent with international and national law.
- feasible to implement, manage and enforce using current international, regional, bilateral and national legal and policy instruments.

Based on this legal analysis, the following recommendations are made for ensuring comprehensive legal protection for the marine biodiversity and resources of the Prince Edward Islands:

- The proclamation of a multi-zoned MPA around the Prince Edward Islands (as illustrated in Figure 2) should be pursued entirely under section 43 of the Marine Living Resources Act. All extractive activities should be prohibited from the four IUCN Category 1a reserves, whilst controlled fishing should be permitted in the conservation zone.
- Passage of all fishing vessels should be prohibited within all four category 1a
 reserves within the Prince Edward Islands MPA (see figure 2); under section 43 of the
 Marine Living Resources Act.
- 3. Passage of all fishing vessels through other parts of the MPA (i.e. conservation zones) should be subject to mandatory reporting; under section 43 of the Marine Living Resources Act.
- 4. The 12 nautical mile territorial sea surrounding the islands, should be designated as an 'area to be avoided' by all shipping, with specific designated approach sea lanes and anchoring sites for vessels wishing to approach the island or fishing vessels wishing to seek shelter from storms. A minimum approach and anchoring distance should also be stipulated. Whilst such measures are not contingent on IMO approval, this proposal will need to be sent to IMO for its recommendations. These regulations can be passed under Marine Traffic Act as amended by section 25 (a) of the General Shipping Amendment Act.
- The parts of the MPA falling outside of the territorial sea should be proposed as a mandatory reporting zone for foreign vessels, through the appropriate IMO channels.
 For South African vessels, the Marine Traffic Act can be used to legislate such measures.
- 6. The Prince Edward Islands MPA should be added to the South African PSSA proposal
- 7. Bilateral surveillance co-operation agreements need to be concluded with Australia, France and Norway as soon as possible.
- South Africa should put forward a proposal to CCAMLR to justify the protection of important ecosystem processes in areas adjacent to the South African EEZ, but within the CCAMLR area.

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- 9. South Africa should pursue the delimitation of its extended continental shelf claim in this area with urgency, as it is held that this claim can afford added to protection to these areas adjacent to the South African EEZ.
- 10. Whilst World Heritage Site status will probably not add any extra protection to the marine resources of this area on its own, such status could have a secondary effect of increased conservation and precautionary management in this area. If South Africa is to proceed with the nomination process, careful consideration should be given to not create a situation of overlapping legislative and institutional authority.

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11. REFERENCES

- Baird R (2004) Coastal State Fisheries Management: A review of Australian Enforcement Action in the Heard and McDonald Islands Australian Fishing Zone. *Deakin Law Review*, 9, 91-118
- Bialek D (2003) Sink or Swim: Measures Under International Law for the Conservation of the Patagonian Toothfish in the Southern Ocean. *Ocean Development and International Law*, 34: 105-137
- CCAMLR-XXIII (2004) Report of the 23rd meeting of the Commission. CCAMLR, Hobart, Australia. www.ccamlr.org
- CCAMLR-XXIV (2005) Report of the 23rd meeting of the Commission. CCAMLR, Hobart, Australia. www.ccamlr.org
- CCAMLR-WS-MPA-05/9 (2005) Improving the process of declaring Marine Protected Areas by CCAMLR and Antarctic Treaty Parties. Delegation of Australia, CCAMLR MPA Workshop 29 August 1 September 2005, Washington.
- Driver A, Maze K, Rouget M, Lombard AT, Nel JL, Turpie JK, Cowling RM, Desmet P, Goodman P, Harris J, Jonas Z, Reyers B, Sink K, Strauss T (2005) National spatial biodiversity assessment 2004: priorities for biodiversity conservation in South Africa. *Strelitzia*, 17, 45 pp.
- Gjerde K (2005) Editors note: Moving from Words to Actions. *International Journal of Marine and Coastal Law*, 20, 323-344
- Gjerde M, Breide C (2003) Towards a Strategy for High Seas Marine Protected Areas. Proceedings of the IUCN, WCPA and WWF Workshop on High Seas Marine Protected Areas. 15-17 January 2003, Malaga, Spain
- Howard M (1989) The Convention on the Conservation of Antarctic Living Marine Resources: A five year review. *International and Comparative Law Quarterly*, 38, 104-149
- Johnson LS (2004), Coastal State Regulation of International Shipping. Oceana Publications
- Kimpton P (2004) Current Legal Developments Australia: Recent domestic and international law developments. *International Journal of Marine and Coastal Law*, 19, 537-543
- Lombard AT, Strauss T, Harris J, Sink K, Attwood C, Hutchings L (2004) South African National Spatial Biodiversity Assessment 2004: Technical Report. Volume 4: Marine Component. Pretoria: South African National Biodiversity Institute, 26–37.
- Lombard AT, Reyers B, Schonegevel L, Cooper J, Smith-Adoa L, Nel DC, Froneman W, Ansorge I, Bester M, Tosh C, Strauss T, Akkers T, Gon O, Leslie R, Chown S (2006) Conserving pattern and process in the Southern Ocean: Designing a Marine Protected Area for the Prince Edward Islands. WWF South Africa report, Stellenbosch, South Africa. www.wwf.org.za/marine

An Analysis of Legal Obligations, Options and Opportunities

- Millar D, Sabourenkov EN and Ramm D (2004) Managing Antarctic Marine Living Resources: The CCAMLR Approach. *International Journal of Marine and Coastal Law*, 19, 317-359.
- Molenaar EJ (2000) Satellite Based Vessel Monitoring Systems for Fisheries Management: International Legal Aspects. *International Journal of Marine and Coastal Law*, 15, 65-109
- Nel DC, Nel JL, Ryan PG, Klages NTW, Wilson RW, Robertson G. (2000) Foraging ecology of Greyheaded Mollymawks at Marion Island, southern Indian Ocean, in relation to longline fishing activity. *Biological Conservation*, 96, 219–231.
- Nel DC, Ryan PG, Watkins B (2002). Population trends of albatrosses and petrels at sub-Antarctic Marion Island. *Polar Biology*, 25, 81–89.
- Nel DC, Ryan PG, Nel JL, Klages NTW, Wilson RP, Robertson G, Tuck, G.N (2002) Foraging interaction between Wandering Albatrosses *Diomedea exulans* breeding on Marion Island and long-line fisheries in the southern Indian Ocean. *Ibis*, 144 (on-line), E141–E154.
- Peet G (1994) Particularly Sensitive Sea Areas—A Documentary History. *International Journal of Marine and Coastal Law*, 9, 469.
- Roberts CM, Bohnsack JA, Gell FR, Hawkins JP and Goodridge R (2002) Marine reserves and fisheries management. *Science*, 295, 1233-1235.
- Roberts J (2005) Protecting Sensitive Marine Environments: The Role and Application of Ships Routeing Measures. *International Journal of Marine and Coastal Law*, 20, 135-159
- SC-CCAMLR-XXIV (2005) Report of the Scientific Committee. CCAMLR, Hobart, Australia. www.ccamlr.org
- Scovazzi T (2003) Marine Protected Areas on the High Seas: Some Legal and Policy Considerations. Paper presented at the World Parks Congresss, Durban South Africa
- Scovazzi T (2004) Marine Protected Areas on the High Seas: Some Legal and Policy Considerations. International Journal of Marine and Coastal Law, 19, No 1.

PART 4

DRAFT MANAGEMENT PLAN FOR THE PRINCE EDWARD ISLANDS MARINE PROTECTED AREA



DRAFT MANAGEMENT PLAN FOR THE PRINCE EDWARD ISLANDS MARINE PROTECTED AREA

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1. INTRODUCTION

The management of marine living resources in South Africa is a national responsibility, and marine protected areas (MPA's) are declared under the *Marine Living Resources Act (No. 18 of 1998)* (MLRA). The Prince Edward Islands themselves (i.e. the terrestrial land above the high water mark) are currently declared as a Special Nature Reserve under the National Environmental Management: Protected Areas Act 57 of 2003 (NEMPA). The reserve is currently managed in terms of a management plan (PEI-MPWG 1996), soon to be replaced by a revised version – the Prince Edward Islands Environmental Management Plan - that takes account of the provisions and requirements of NEMPA. The plan set out here, the "Prince Edward Islands Marine Protected Area Management Plan" describes how the Department of Environmental Affairs and Tourism (DEAT) intends managing the Prince Edward Islands Marine Protected Area primarily through its Branch: Marine and Coastal Management (MCM).

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The territorial waters and Exclusive Economic Zone (EEZ) surrounding the Prince Edward Islands are located in the Southern Ocean (42°45′-50°45′S, and 32°45′-43°E) and are home to unique marine biodiversity not found elsewhere within South Africa's marine jurisdiction. Unfortunately, the Prince Edward Islands' territorial waters and EEZ have also been subjected to significant impacts during the last decade, mostly as a result of Illegal Unreported and Unregulated (IUU) fishing activity during the late 1990s. The development of a Marine Protected Area (MPA) surrounding the Prince Edward Islands has been strongly advocated by the Minister of Environmental Affairs and Tourism as a means of conserving and protecting these unique biodiversity assets and restoring some of the damage to the ecosystem that has occurred from 1990 onwards. The final delineation of the Prince Edward Islands MPA is the result of a thorough science-based planning exercise (Lombard *et al.* 2007) and consultative process (Nel *et al.* 2006). Further, the rationale for establishing a MPA around the Prince Edward Islands includes the following:

a) The International Status, Uniqueness, Pristine Nature, and High Level of Endemism of the Island Group

In an assessment of the status of Southern Ocean islands, Chown et al. (2001) demonstrated that Prince Edward Island is one of the most pristine islands in the Southern Ocean, emphasising the need to limit future human intervention as far as possible. The Special Nature Reserve status accorded the Island Group represents South Africa's highest form of protected status, equivalent to a World Conservation Union (IUCN) Category 1a reserve, dedicated to science. Commercial tourism is not allowed within a Special Nature Reserve in terms of the NEMPA. An original proposal made in 2000 by the Prince Edward Islands Management Committee, South Africa has recently recognised the exceptional value of the Prince Edward Islands by nominating the islands and their territorial waters for inscription in the 1972 Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage Convention¹) (Fischer et al. 2006) with a decision by the World Heritage Convention expected to be made by mid 2007 (Appendix 2). Further, in May 2007 the Prince Edward Islands received international recognition by being registered with the Ramsar Convention on the Conservation of Wetlands of International Importance. This development is highly significant in as much as the Prince Edward Islands have become the very first Ramsar Wetland of International Importance in the sub-Antarctic region, making South Africa a world leader in this regard. The Prince Edward Islands' Ramsar Wetland extends 500 m offshore so as to include the inshore shallow waters and their kelp beds and rich benthic life, as well as the various land-based inshore predators, such as several species of penguins.

¹ Note: World Heritage Convention – South Africa has submitted the Prince Edwards Islands for recognition as a World Heritage Site. The World Heritage List includes 830 properties forming part of the cultural and natural heritage which the World Heritage Committee considers as having outstanding universal value. Ref: http://whc.unesco.org/en/tentativelists/1923/

b) The Inseparable Relationship between the Marine and Terrestrial Environments

Terrestrial nutrient input (and thus ecosystem functioning) is strongly driven by birds and seals that forage in the marine environment, and then provide nutrients to the ocean via run-off from the land (Frost 1979, Froneman & McQuaid in press, Smith & Froneman in press). Protection of the terrestrial environment is thus reliant on a healthy marine environment.

c) The Foraging Requirements of the Top Predators

Many bird and seal species breed on the Islands (e.g. Williams et al. 1979, Condy 1981, Hofmeyr & Bester 1997, Chown et al. 1998a, Pistorius et al. 1999a, Crawford & Cooper 2003), and forage either close to the Islands within 12-nautical mile territorial waters (inshore feeders), or within and beyond the 12-200-nm EEZ (offshore feeders). The birds especially are affected both indirectly (competition for resources), and directly (incidental mortality), by fishing activities in the area. Many of these bird species are globally threatened (Crawford & Cooper 2003).

d) Impact of Global Climate Change

There is evidence that the Islands are being rapidly impacted by climate change (Smith 1991, Bergstrom & Chown 1999, Pakhomov & Chown 2003). Any anthropogenic reduction in the resilience of species occurring within the EEZ may render them locally extinct, for example, if sea surface temperatures change drastically (Mélice *et al.* 2003), or if the position of the oceanic fronts moves farther south (Lutjeharms *et al.* 2002). There is evidence that many birds and seals forage in the vicinity of these fronts (Jonker & Bester 1998, Nel *et al.* 2001).

e) The Precautionary Approach

Benthic surveys have been conducted only on the shelf between the two islands (Beckley & Branch 1992, Branch et al. 1993), and very little is known about the benthic habitats within the EEZ. Un-described species, as well as major geological features (such as hydrothermal vents on the Southwest Indian Ridge), are all likely to occur within the EEZ. Given that there is potential for oil and gas exploration in the area as well as an interest in ship-based tourism (especially if World Heritage Status is obtained), representative habitats need to be set aside to mitigate future threats. A number of shipping-related processes threatens the marine (and therefore terrestrial) environments. These include the introduction of alien species, via ballast water or on hulls (Frenot et al. 2005); pollution such as from oil spills (Cooper & Condy 1988) and other wastes; light pollution leading to bird strikes on vessels; and the discarding of fishery-related gear leading to harmful effects on both seals and birds (Nel & Nel 1999, Hofmeyr et al. 2002). At present fishing vessels are permitted to use the lee of the island to shelter from storms, although no fishing is currently allowed within 12 nautical miles (territorial waters) of the Island Group, creating a de facto marine reserve.

f) A National and Regional Network of MPAs

The creation of a Marine Protected Area around the Prince Edward Islands will complement the existing and planned network of South African MPAs, all of which are situated along the continental coastline, thus ensuring that all South African biomes, including the sub-Antarctic, have significant portions being within legal protection. Further, a South African MPA within its sub-Antarctic territorial waters/EEZ will match and complement the two Marine Parks (equivalent to MPAs) recently declared by Australia in the territorial waters/EEZs of its sub-Antarctic island groups: Macquarie, and Heard and McDonald (Environment Australia 2001, 2005) and by New Zealand in the territorial waters around its Auckland Island Group (New Zealand Department of Conservation, 2007), thus contributing to a developing network of MPAs both within the Southern Ocean and globally. It will also lend support to ongoing efforts by international bodies such as the Antarctic Treaty through its Committee on Environmental Protection, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and the World Conservation Union (IUCN) (e.g. Kelleher 1999, Gjerde & Breide 2003, ATCM 2005, CCAMLR 2005, CCAMLR-XXIV 2005).

1.1 Objectives and goals of the Prince Edward Islands MPA

The overall objectives of the Prince Edward Islands MPA are²:

- 1) To contribute to a national and global representative system of Marine Protected Areas, by providing protection for endemic and rare species, species with globally significant populations, habitats and ecosystem processes,
- 2) To serve as a scientific reference point that can inform the future management of the area,
- 3) To contribute to the recovery of the overexploited Patagonian toothfish Dissostichus eleginoides population,
- 4) To reduce the incidental mortality of particularly albatrosses and petrels in the Patagonian toothfish fishery (Nel & Nel 1999, Nel et al. 2002c) as well as controlling the by-catch of fish and other marine species other than Patagonian toothfish in the commercial fishery

Further, implementation must also address four strategic components, these being : biophysical, socio-economic, governance and compliance objectives as outlined in the Section 4 herein.

² Noting that these objectives were accepted following a thorough consultative process

1.2 Development of the PEI-MPA Management Plan

In June 2004 the Minister of Environmental Affairs and Tourism announced his intention to declare one of the largest MPAs in the world around the Prince Edward Islands. Following this, DEAT, with support from the WWF Sanlam Marine Programme, put together a process to develop a spatial marine biodiversity conservation plan that would inform the delineation of the proposed MPA. This plan was developed with extensive consultation with stakeholders (including the fishing industry and interested civil society groups). The plan was finalised in January 2006 and has been published as a paper in the peer-reviewed international scientific journal *Antarctic Science*, as a testimony of the scientific integrity of the process (Lombard *et al.* 2007). Furthermore, the proposed regulations pertaining to the MPA were developed as a result of a series of workshops and consultations with all stakeholders during the period March to May 2006 (Nel *et al.* 2007).

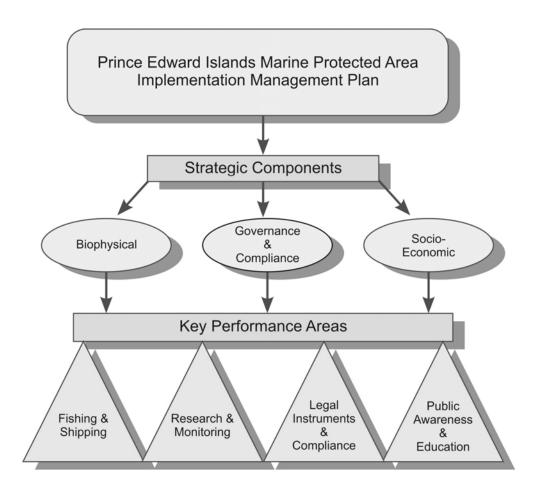


Figure 1. Key Components of the Prince Edwards Island Marine Protected Area Management Plan

The current plan (structure shown in Figure 1) draws on international experience of MPA management and relevant guidelines published by the World Conservation Union, and incorporates legal and institutional requirements. An annual review of the management plan and regulations is prescribed for the first three years from adoption and thereafter reviews will be required every five years. The implementation of the MPA incorporates strategic components, which outline overarching strategies that are essential if the objectives are to be met, many of which will need to be conducted in collaboration with Marine and Coastal Management. Also, key performance areas have been determined which are the ongoing requirements that managers must address to meet or maintain the goals. There are also sections devoted to Compliance, Education and Awareness, Research and Monitoring. These are activities with specific requirements that must be fulfilled if all the objectives of the Prince Edward Islands MPA are to be met.

2. DESCRIPTION OF THE AREA

2.1 Geography, habitat and history

The territorial waters and EEZ of the Prince Edward Islands extending 200 nautical miles from the islands cover 528 020 km² and lie in the Southern Ocean between 42°45′-50°45′S, and 32°45′-43°E and comprise four broad habitats: the Southwest Indian Ridge in the northwest, a plateau area with seamounts and rises in the northern half; an abyssal area in the southern half; and the islands and the shallow waters between them in the centre (Figure 2). The two islands, Marion and Prince Edward, which have a combined terrestrial area of 339 km², represent the peaks of a volcano that had its last minor eruption on the south side of Marion Island in 2004. The suggested age of the islands is approximately 0.5 to 1 million years old.

The earliest evidence of the existence of the Prince Edward Islands can be dated back to the 4th March 1663 when the 1 210-ton Maerseveen passed the islands *en route* to Java (Cooper & Headland 1991, Cooper in press). One hundred years later the Islands were "rediscovered" by Marion du Fresne in 1772 who never landed on the Islands due to bad weather. He eventually realized the land he thought was the Southern Continent was actually only islands, and named the group the Frigid Islands and left. Five years later Captain James Cook came across the islands. His chart did not give the names bestowed by du Fresne and so he renamed them both the Prince Edward Islands (after the fourth son of King George III). At a later stage the larger island of the group was named Marion (in honour of du Fresne). Cook and other southern explorers essentially sparked the economic interest in the islands after they reported a wealth of animal life on and around them. Visits by whalers and sealers increased rapidly, and the whalers were believed to have used the islands as temporary shelter for their ships. The sealers on the other hand went ashore to specifically obtain skins and oil from the seals.

One of the first documented biological records were observations and collections of seabirds during a British sealing exhibition in 1830-1831. Later, in April 1840, the HMS Erebus of Captain James Clark Ross' expedition made dredges at the Prince Edward Islands to collect marine animals and in 1873, a British corvette, the HMS Challenger, arrived at the islands as part of a scientific research expedition that circumnavigated the globe. A landing was made on Marion Island and the day was spent exploring and collecting samples and specimens. During this time the captain dredged and trawled in the channel between the two islands and around their coastline and made topographical surveys of the area. Soundings were also made that were carefully plotted and the chart that was compiled from their few days' stay remained the only reliable graphic source of information available since the first discovery of the islands (in 1663) and the time of annexation (in 1947). No landing was then made on Prince Edward Island and therefore no biological information could be gathered. Prince Edward Island remained untouched by scientists until after the islands' annexation in 1948 with the first scheduled research visits only carried out in 1965. At least eight vessels have floundered off the Prince Edward Islands between the time of their discovery in 1663 and annexation in 1947. Of these eight, five were wrecked in the vicinity of Prince Edward and three at Marion Island (the sites of all but one wreck at Marion Island remains unknown and no evidence of them have been discovered).

2.2 Annexation and occupation

South Africa became increasingly aware of the islands' strategic position after the Second World War, both for defence and navigation, and set about annexing the islands in December 1947. Marion Island was annexed on the 29th of December 1947 and Prince Edward Island on the 4th of January 1948. The first team to occupy Marion was a meteorological team in February 1948 and the first scheduled research visit to both islands took place in January 1965. The research expedition in 1965 was also the first "official" visit to Prince Edward Island since the annexation³. The only visits to Prince Edward Island since then have been strictly of a scientific nature with all visits being of short duration during relief voyages to Marion Island.

South Africa's scientific base is situated on Marion Island at Transvaal Cove⁴. Initially, the meteorological station set up after annexation was the primary reason for the continued staffing and occupation of the Marion base. Scientific work (mainly biological research), now forms one of the major reasons for the maintenance of the scientific base on Prince Edward Island. The information gained from nearly half a century of near-continuous biological research has resulted in an almost unparalleled understanding of the islands' animals, plants and ecosystems, both in a South African and in a global context. This has set the stage for addressing many of the Island Group's environmental management challenges and for advancing our understanding of the Island Group's ecosystem. Examples of the former include the very successful feral cat eradication programme that took place in the late 1980s,

³ Noting that Prince Edward island is not occupied permanently and there is no established weather station

and the current studies on the effects of fishing in the Southern Ocean on bird and mammal species. Because of their unique location in the world, understanding the effects of climate change on the islands ecology is likely to provide a baseline for helping understand the global impacts of climate change.

2.3 Climate

The Island Group is situated in the "Roaring Forties" and is subjected to westerly to north-westerly winds approximately 60% of the time. Gale force (>55km/h) winds lasting at least one hour are experienced for an average of 107 days a year. Gales usually exceed this speed and duration, however, and can reach 200 km/h. Winds exceeding 70km/h often continue unabated for more than 24 hours. The climate of the Prince Edwards Islands is therefore cool with an annual mean air temperature of 5.9°C. The maximum and minimum temperatures recorded at the base are 23.8°C and - 6.8°C, respectively. Although minimum temperatures below zero occur every month of the year, winter temperatures rarely fall below -4°C because of the moderating influence of the ocean. The mean surface air temperature has increased by 0.93°C from 1951 to 1988 and is believed to be as a result of changing oceanic and atmospheric circulation (Chown *et al.* 2001).

The Island Group experiences an average of 25 days of precipitation a month (308 days average a year). Rainfall is relatively high with an average of 2,500 mm a year, mainly in the form of rain, which is distributed fairly evenly throughout the year. Most of the rain falls as light showers with heavy falls of over 25mm/day occurring on average, twice a month. Marion Island research base experiences an average of 95 days of snow and 46 days of fog a year. Snow is more frequent in winter, particularly from July to September and sometimes covers the whole of Marion Island. In low-lying areas the snow usually melts within a few days. Marion Island also experiences high cloud cover with only a 30% estimate of direct (cloud free) sunshine annually. On average, no days with more than 90% of possible sunshine are encountered including an annual average of 130 days with a cloud base below 300 m above sea level.

2.4 Marine environment

The Island Group, along with many other islands (Figure 2) is in the path of one of the world's widest current systems, the Antarctic Circumpolar Current (ACC), which flows clockwise around the Antarctic Continent at a surface speed of 0.5-2km/h. Consequently the Island Group has an upstream (westerly-facing) and a downstream (easterly or sheltered) side. The importance of this is that the land-based vertebrate predators depend on the sea for food with the availability of food dependent upon oceanographic conditions. The ACC carries the primary food supply, in the form of plankton, to the Island Group from the west.

The marine environment around the islands is complex due to their position within the Indian sector of the Polar Frontal Zone (PFZ), which is delimited by two of the main frontal systems of the Southern Ocean, the Sub-Antarctic Front (SAF) to the north and the Antarctic Polar Front (APF) to the south. These fronts separate major water bodies with different chemical and physical properties that act as strong bio-geographical boundaries with different suites of marine species to the north and south of each front. These fronts are areas of enhanced biological activity and their location is dynamic, changing with wind direction and intensity as well as being affected by the oceanic topography which may result in deviations of the frontal flow patterns. In the Antarctic region, the PFZ is characterised by numerous small islands that seasonally are home to an abundance of predators including flying seabirds, penguins and seals. These islands (which include the Prince Edward Island Group) are also important feeding grounds for land-based predators further underpinning their importance in the ecosystem. Importantly, all the vertebrate predators that are found on these islands are reliant directly or indirectly on the surrounding ocean for their food encompassing the whole marine food chain including zooplankton, fish and squid.

The Prince Edwards Islands have relatively unstable and hostile littoral environments, resulting in a generally low biodiversity and low density of littoral organisms. Due to the predominantly westerly winds, the shores around the islands are exposed, especially those with a westerly aspect. Weathering from large swells and unstable substrates (e.g. boulders) has resulted in abrasion that further contributes to the harsh environmental conditions. The Prince Edward Islands also form the highest point of a shallow oceanic plateau, approximately 200 to 500 m deep, that drops off very rapidly into much deeper waters (ca 3 000 m). This plateau supports a rich seabed community of approximately 550 species, dominated by filter feeders, which are largely supported by local phytoplankton production. The swimming prawn *Nauticaris marionis* is the primary link between this community and seabirds. Adult prawns feed on the fauna on the seabed and themselves are an important component in the diets of most birds with short foraging ranges, especially the Gentoo (*Pygoscelis papua*), Macaroni (*Eudyptes chrysolophus*) and Rockhopper (*Eudyptes chrysocome*) penguins as well as the Imperial cormorant, *Phalacrocorax [atriceps melanogenis.* (also known as the Crozet Shaq).

Figure 2/...

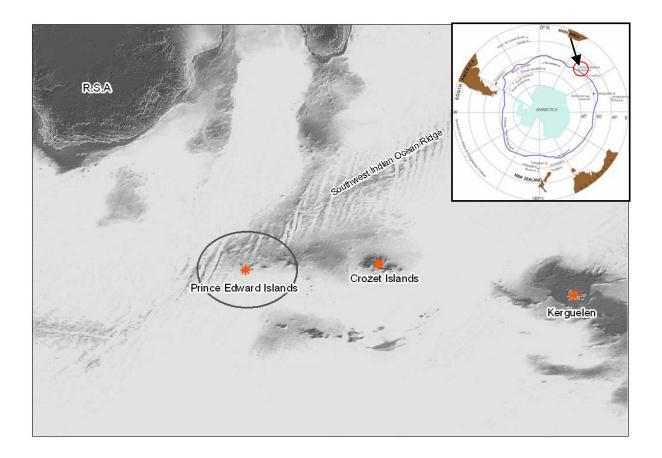


Figure 2. The location of Marion and Prince Edward Islands, 1,000 km southeast of South Africa, in the Southwest Indian Ocean. The nearest eastward islands to the Prince Edward group are the French Crozet Islands. The inset shows the relative position of the Prince Edward Islands in the Antarctic to the continental masses to the north as well as the approximate position of the Antarctic Polar Front.

2.4.1 Marine Flora and Fauna

Marine mammals, fish, birds (bird breeding/roosting sites), invertebrates (including corals), plants and habitats are all vital components of the Prince Edward Islands' ecology that will benefit from a Marine Protected Area.

Mammals

Three seal species breed on the Island Group: the southern elephant seal *Mirounga leonina*, Antarctic fur seal *Arctocephalus gazella*, and sub-Antarctic fur seal *A. tropicalis*. Leopard seals *Hydrurga leptonyx*, Weddell seals *Leptonychotes weddelui* and South African (Cape) fur seals *A. pusillus* are occasional non-breeding visitors. Pods of killer whales *Orcinus orca* frequent both islands in summer. Other cetaceans sighted around the islands include Longfinned pilot whales *Globicephala melas*, Southern Right whales *Eubalaena australis* and Humpback whales *Megaptera novaeangliae*. Sperm whale *Physeter macrocephalus*,

Bryde's whale *Balaenoptera edeni*, Minke whale *B. acutorostrata*, Heaviside's dolphin *Cephalorhynchus heavisidii*, Dusky dolphin *Lagenorhynchus obscurus* and Southern bottlenosed whale *Hyperoodon planifrons* are some of the other cetacean species that have been sighted farther offshore. Both Killer Whales and Sperm Whales have been reported to interact with longline fishing vessels targeting Patagonian toothfish, taking fish off the lines when being hauled. There are no indigenous land mammals on the Island Group. Introduced house mice *Mus musculus* are present on Marion Island but do not occur on Prince Edward Island⁵.

Avian Fauna

The Island Group supports 29 species of breeding birds as well as 22 species of vagrant seabirds and 28 species of non-marine vagrant species have been recorded. Four orders of seabirds are present on the Island Group: Sphenisciformes (penguins), Procellariiformes (albatrosses and petrels), Charadriiformes (skuas, gulls and terns) and Pelecaniformes (cormorant). Several of the surface-breeding seabirds constitute substantial proportions of their global populations (Crawford & Cooper 2003). Populations of most of these have decreased at the islands since the 1980s and 12 of the 29 species are regarded as Threatened or Near-Threatened regionally or internationally. The main causes of population decreases are thought to be incidental mortality⁶ of albatrosses and giant petrels in longline fisheries, and environmental change influencing availability of prey to penguins and the Crozet shaq. Although the breeding bird species include only one endemic taxon (the Lesser Sheathbill Chionis minor marionenis) most species have a very limited breeding area that is restricted to a handful of Sub-Antarctic islands. Furthermore, the large distances between breeding sites and the high philopatry (natal site fidelity) characteristic of these species has led to limited genetic interchange and hence considerable geographical variation within species.

Most of these avian species are wholly or predominantly dependant on the marine environment for their primary energy needs and are capable of foraging great distances away from the Islands. They only use the Islands as bases for breeding and moulting (in the case of penguins). Outside their breeding seasons they disperse away from the islands to more productive foraging areas. The large numbers of seabirds that breed on the Prince Edward Islands are an important vehicle for the transfer of essential nutrients from the marine environment to the terrestrial (island) environment, primarily in the form of guano. Most of the seabirds found on the Islands are long-lived and only breed after a prolonged juvenile stage. Almost all seabird species found in the area breed only once a year and only lay one or two eggs. The chick-rearing period is prolonged with moderate breeding success. Some albatross species for example, only lay one egg every second year. Seabird populations in the area are therefore extremely vulnerable to adult mortality, and will take a

⁵ The introduced feral cat *Felis catus* was exterminated from Marion Island in 1991

⁶ Incidental mortality differs from "by-catch". Whereas the hooking of seabirds on longlines is "incidental", by-catch in fisheries is often directed or a recognized component of e.g. directed targeting on Patagonian toothfish

long time to recover from any negative impact on the population structure (e.g. a decrease in adult survival).

Fish and Fisheries

Thirty three species of fish from 13 families are known from the oceans around the Island Group (Gon & Heemstra 1990). This is more than has been recorded at the Crozet Islands (25 species) to the east, but fewer than the number found off Kerguelen Island (59 species), another sub-Antarctic island to the east of the Prince Edward Islands. A formal South African fishery for Patagonian toothfish *Dissostichus eleginoides* within the South African territorial waters and EEZ at the Prince Edward Islands was commenced in October 1996 (fishing is no longer permitted within territorial waters). Intelligence reports indicated however that Illegal, Unreported and Unregulated (IUU) vessels were already operating in the area by 1995 and possibly from 1994. Since the start of the licensed fishery, the estimated IUU catch has exceeded the reported catch for most years.

Marine Flora and Invertebrates

The various marine plant species and invertebrates around Marion Island are closely associated with the demand for nutrients and water as well as other environmental and physical characteristics such as gradient, aspect and temperature. Most flora on the Islands can be grouped into characteristic communities that are easily distinguished. The marine niche forms one of these characteristic communities that is dominated by the giant kelp *Macrocystis pyrifera* (giant kelp beds), found up to –1000 m offshore in protected coves, as well as in water 10 - 20 m deep. *Lithothamnion sp.* (encrusting algae) are also found in the intertidal zone, *Durvillaea antarctica* (Bull kelp) at shoreline cliffs and *Porphyra sp.* on spray zone boulders.

The distribution and density of many invertebrates is strongly influenced by manuring by birds and seals. High densities and biomass of invertebrates accompany high plant densities, soil nutrient content and plant nutrient content in heavily manured areas. Both islands in the Island Group have relatively unstable and hostile littoral environments, which results in a generally low biodiversity and low density of littoral organisms. All the shores around the islands are exposed (those with a westerly aspect severely so) due to the predominantly westerly winds. Large swells and unstable substrates (e.g. boulders) that result in abrasion also contribute to unfavourable conditions. Some 147 species of indigenous and introduced invertebrates are known from Marion Island. This includes 19 alien species that have become naturalised and 13 introduced species that have not, as yet, established themselves. Thirty nine species of soil ciliates have been found on Marion Island and seven endemic invertebrate species identifed. The endemic species include two springtails (*Isotoma marionensis* and *Katianna n, sp.*), three beetles (*Bothrometopus elongatus, Ectemnorfrinus marioni and E. similis*) and two moths (*Pringleophage marioni* and *P. kerguelensis*).

3. THE MARINE PROTECTED AREA - Boundaries and Zoning

The Prince Edward Islands MPA (PEI-MPA) encompasses three principle zones, each of which has specific objectives and different levels of protection. This follows international practice where MPAs are zoned according to a range of requirements, the level of exposure to anthropogenic impacts, commercial exploitation, biodiversity, habitat type and numerous other criteria⁷. The PEI-MPA will further be managed in accordance with relevant international obligations, conventions and agreements.

The PEI-MPA therefore is zoned as follows:

- a) a Territorial "Sanctuary Zone" (12 nm) around the islands
- b) a "Restricted Zone", and
- c) a "Conservation Zone"

All vessels fishing within any of the zones where fishing is permitted must carry a scientific observer. A compliance strategy for the effective enforcement of the MPA will be developed by DEAT within six months of the promulgation of the PEI-MPA. The PEI-MPA zones are delineated as shown in Figure 3 with the exact co-ordinates of this delineation given in Table 1⁸.

Table 1. The exact geographic coordinates (WGS 84 spheroid) of points 1-22 in Figure 3

Point	Latitude	Longitude	Point	Latitude	Longitude
1	43° 34' S	34° 56' E	12	49° 16' S	34 ⁰ 03' E
2	44 ⁰ 10 S	35° 35' E	13	50° 14' S	35° 36' E
3	45° 06' S	36° 36' E	14	49° 20' S	36° 35' E
4	46° 06' S	37° 42' E	15	47° 57' S	38° 07' E
5	46° 06' S	38° 44' E	16	46° 42' S	41 ⁰ 48' E
6	44 ⁰ 50' S	42 ⁰ 27' E	17	46° 42' S	43° 02' E
7	44 ⁰ 30' S	33° 44' E	18	45° 46' S	41° 48' E
8	45° 16' S	34° 35' E	19	45° 46' S	42° 53' E
9	46° 12' S	35° 36' E	20	46° 06' S	37° 03' E
10	47 ⁰ 03' S	36° 31' E	21	47° 21' S	37° 03' E
11	48° 02'S	35° 25' E	22	47° 21' S	38° 44' E

⁷ The IUCN Protected Areas Categories have been used as guidelines to define the PEI-MPA zones

⁸ Noting the position of and recognizing the northern limit of the designated areas 58.6 and 58.7 of CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources).

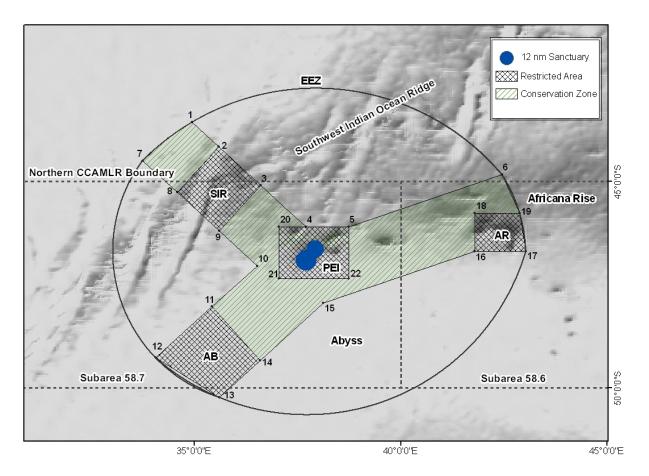


Figure. 3. The proposed boundaries of the Prince Edward Islands MPA. The three zones are shown, including the four IUCN Category 1a (Restricted Zone) reserves: Southwest Indian Ridge (SIR); Prince Edward Islands (PEI); Africana II Rise (AR); and Abyss (AB). Other reference points are the CCAMLR boundaries and sub-areas, the Southwest Indian Ocean Ridge to the north, the Africana Rise (to the east) and the abyss area in the south.

3.1 The 12-nautical mile Sanctuary Zone⁹

Function:

This zone is to be managed as a strict no-take zone for the preservation of the unique island ecosystem and adjacent territorial waters.

Management:

The following activities are prohibited in this zone unless by permit¹⁰:

- (a) Fishing;
- (b) The disturbance, removal, damage to or destruction of any fauna or flora;
- (c) The disturbance of, destruction or alteration of the natural environment, including mining, dredging, extraction of sand or gravel, discharge or depositing of waste or any other polluting matter of any kind;

⁹ Note that this zone extends from the shoreline and includes the littoral and inter-tidal areas to the spring high water marks.

¹⁰ Note: This does not exclude applications to DEAT for approved scientific research-based activity

- (d) The construction and or erection of buildings or other structures on or over any water within the Sanctuary Zone except for such designated structures approved for scientific research;
- (e) To carry out any activity which may be deemed to impact adversely on the ecosystems of that area;
- (f) Maritime activity, including research, fishing merchant and recreational vessels in possession of a prescribed permit, will be restricted to designated shipping lanes and anchorages and fishing vessels will only be permitted in the zone with their fishing gear stowed, and may not have fish or fish products of any nature on board and will be subject to a mandatory reporting protocol. Deck lighting on all vessels to be kept to a minimum to reduced bird strikes;
- (g) Fishing vessels not in possession of the prescribed permit may only enter this zone under conditions of *force majeure*.

3.2 The Restricted Zone

Function:

The four Restricted Zones are designed to protect representative proportions of all habitat types in the Prince Edward Islands Exclusive Economic Zone and aim to specifically contribute to the recovery of the Patagonian toothfish stock(s) in the zone.

Management:

- (a) Resources in these areas to be fully protected with disturbances limited to scientific monitoring activities only;
- (b) Toothfish populations in these areas will be monitored scientifically ¹¹ using standardised commercial or other fishing techniques. The DEAT may enter into an agreement with commercial rights holders to perform these monitoring activities as part of their permit conditions. DEAT scientists, in consultation with the commercial rights holders, will determine the nature and extent of the monitoring effort. The scientific effort level should not exceed the average annual number of hooks set in each of these zones over the period 2002 to 2005 and total effort in the restricted zones should never exceed 40% of the total effort in the EEZ (see Table 2);
- (c) The scientifically-controlled fishing will not exclude the use of alternative fishing methods that might be deemed more appropriate for the area.

¹¹ Noting that only approved research will be permitted in the zone controlled and monitored under strict scientific supervision

Table 2. Average number of commercially deployed longline hooks set in each of the proposed Restricted Zone areas from 2002-2005

Restricted Zone area	Average annual effort in hooks from 2002 to 2005
Prince Edward Islands (PEI)	554 912 hooks
Africana II Rise (AR)	345 671 hooks
Southwest Indian Ridge (SIR)	143 630 hooks
Abyss (AB)	0 hooks (not fished at all)
Total	1,044,213 hooks

Furthermore the following activities will be prohibited:

- (a) Any fishing or attempt to fish, in excess of the effort designated for the scientific monitoring specified in (b) (above)
- (b) Fishing by methods known to cause damage to benthic habitats and biota (e.g. bottom trawling)
- (c) The intentional destruction or removal of any other fauna or flora.
- (d) The disturbance of, destruction or alteration of the natural environment, including mining, dredging, extraction of sand or gravel, discharge or depositing of waste or any other polluting matter.
- (e) To construct or erect any building, offshore platform or other structure anywhere within the Restricted Zone;
- (f) To carry on any other activity which may be deemed to adversely impact on the ecosystems of that area;
- (g) Fishing vessels not in possession of a legal permit and traversing these areas, will do so with fishing gear stowed, and may not have fish or fish products of any nature on board and will be subject to a mandatory reporting protocol.
- (h) Deck lighting on all vessels to be kept to a minimum to reduced bird strikes.

3.3 The Conservation Zone

Function:

This zone is to be managed as a low-impact exploitation zone that links the other protected areas spatially. It aims to protect representative proportions of benthic habitat in the EEZ, to help sustain ecosystem processes, whilst still allowing sustainable utilization of Patagonian toothfish resources.

Management:

- (a) Fishing for Patagonian toothfish by rights holders to have catch and or effort limits using approved fishing methods that minimise the impact on the benthic environment. Fishing effort should be sustainable and should minimise ecologically threatening rates of both non target fauna (incidental mortality) as well as non-target species (bycatch). Specific restrictions include:
 - The prohibition of fishing methods that are known to impact benthic habitats (e.g. bottom trawling);
 - The disturbance, destruction or alteration of the natural environment, including mining, dredging, extraction of sand or gravel, discharge or depositing of waste or any other polluting matter;
- (b) Best currently available seabird mitigation measures, including consideration of those adopted by CCAMLR, must be applied to mimimise the incidental mortality of seabirds. Should seabird mortality exceed a prescribed limit, fishing within the Conservation and Restricted Zones should cease forthwith. It is recommended that the total seabird mortality permitted due to fishing in the Conservation and Restricted Zones collectively, be set at fifty (50) birds annually in total, or thirty (30) birds per vessel. Lighting on vessels to be kept to a minimum with deck lights turned inwards away for lines, hooks and bait.

4. STRATEGIC PLAN – OF THE PEI-MPA

The strategic plan outlined herewith focuses on actions, identifies responsibilities and monitors progress of the implementation of the PEI-MPA in three key areas: a) the Biophysical Environment, b) Socio-economic Requirements, and c) Governance and Compliance.

4.1 Biophysical environment

The aims of the PEI-MPA with respect to the biophysical environment are as follows:

- To protect the endemic and rare species, species with globally significant populations, habitats and marine ecosystem processes representative of this region and to maintain biodiversity and optimal ecological functioning.
- To protect populations of depleted, threatened, rare, globally significant and endemic species as well as the habitats which are important for these species and populations.
- To contribute towards the long-term viability of marine fisheries.

Action	Lead Agency (and partners)	Progress and Indicators
Assess and monitor health and integrity of the unique ecos	systems of the PEI	-MPA
(a) Develop a set of ecosystem indicators of MPA health and facilitate the collection and analysis of these data	MCM, Antarctica & Islands, researchers	 Long term studies of several land-based predators (seabirds & seal) are in place Long term studies of physical oceanography are in place Fisheries catch and effort trends
Develop ecosystem approach to management in the area		
(a) Facilitate the development of approaches and tools to achieve integrated and ecosystem-based management (i.e. manage all the key links in the ecosystem as well as manage human activities and their impacts).	мсм	 Ecosystem Approach being applied to Fisheries through CCAMLR regulations Good progress in implementing Ecosystem Approaches in other SA fisheries

Build capacity to enable effective integration of conservation measures across sectors and with stakeholders.

(a) Provide the fishing industry with clear information on conservation management arrangements in the area (particularly for listed marine species), including compliance requirements.	МСМ	All fishing vessels carry fisheries observers and have good record of contributing to surveillance activities
(b) Enhance coordination between key groups and agencies involved in conservation and resource management, through information sharing, communication and informal reporting.	MCM, Prince Edward Islands Management Committee	Prince Edward Islands Management Committee already functioning

4.2 Socio-economic

The aims of the PEI-MPA with respect to the socio-economic requirements is as follows:

- To promote recovery of over-exploited commercial fish stocks.
- To provide opportunities for research, training of marine scientists and monitoring of environmental effects of human activities on marine ecosystems.
- To promote non-consumptive, ship-based eco-tourism.

Action	Lead Agency	Progress and Indicators
	(and partners)	

Enhance and encourage fishing industry capacity for, and participation in, marine protected area management in the area

(a) Support initiatives that raise fishing industry and community (through NGO's) awareness of the importance of, and build capacity for, their participation in marine ecosystem monitoring of the MPA.	MCM, Fishing Industry, NGO's	 Fishing Industry already plays important MCS role Management plan promotes the use of standardised commercial fishing techniques in the MPA.
(b) Review existing stakeholder consultation mechanisms regarding the MPA to ensure effective and efficient ongoing participation in marine planning and management.	MCM, Fishing Industry	Resource management working groups being established
(c) Build industry support through codes of conduct and other non-regulatory approaches.	MCM, Fishing Industry	Current rights holders are members of the Coalition of Legal Toothfish Operators (COLTO)

Support the development of partnership approaches to marine research and monitoring

(a) Build on existing research partnerships and support the development of new partnerships in the area between researchers and the fishing industry.	MCM, Fishing Industry, PEIs marine research community	 Fishing Industry already plays important MCS role Management plan promotes the use of standardised commercial fishing techniques in the Restricted Zone to monitor recovery of stocks
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Improve access to research, data and expert ecological advice for the management of the MPA

(a) Develop a central data archive of all spatially explicit biodiversity data for the MPA that can inform and refine its management.	МСМ	Such a central data archive has been developed through the MPA planning project and will be housed within the SANBI bioregional planning division
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4.3 Governance and Compliance

The aims of the PEI-MPA with respect to governance and compliance is as follows:

- To ensure appropriate and effective legal structures are developed and maintained to ensure comprehensive protection of MPA biodiversity and exploited resources.
- To fulfil South Africa's international commitment to marine protection in terms of international protocols and conventions.
- To enhance international co-operation for Monitoring, Control and Surveillance (MCS) in the area
- To promote wise spatial use of the territorial waters and EEZ and to reduce potential conflict between users
- To contribute to resource protection, facilitate fishery management, and reduce user conflict arising from competing uses in the MPA.
- To complement other elements of the Management Plan and lead to an increased level of success

	Lead Agency	Progress and Indicators
Action	(and partners)	

Increase efficiencies in enforcement and compliance activities in the MPA

(a) Investigate the enforcement and compliance challenges and opportunities associated with the increasing use of spatial management of marine resources in the MPA.	МСМ	 Initiation of a compliance plan Co-management arrangements with interested and affected parties International agreements
(b) Implement appropriate MPA Permit processes, including database development.	MCM	 Formalise database and management Review fishing permit conditions

Review legislation

(a) Development of MPA-sper revenue generation ability from (e.g. film-making).	9 ,	MCM	 Draft regulations Regulations to be gazetted
(b) Manage impacts of all use and permit requirements/cond	ers in the MPA through zoning litions.	MCM	Permit process developed and gazetted as needed

Promote co-operative governance

(a) Nurture co-operative relationships with national authorities, international agencies and relevant governments and stakeholders	MCM, Defence, SAMSA, CCAMLR, ACAP, Govs. of neighbouring islands	Initiative to be followed through by DEAT at government and foreign affairs levels
(b) Manage trans-boundary impacts between the MPA and adjacent areas including RFMOs	MCM	Compliance and monitoring plan operative

Promote international co-operation for MCS operations in the region

(a) Finalise MCS Agreement with the Government of Australia	DEAT, Gov. of	 Agreement in final draft
	Australia	format
(b) Develop and sign MCS Agreement with the Government of	DEAT, Gov. of	
France	France	

Develop vessel reporting procedure through VMS and Observations

(a) Establish strict Vessel Monitoring Procedure into and out of zones including high seas, CCAMLR, EEZ and MPA zones. Establish synergies with France and Australia	MCM, Navy, Hydrographic office	 Procedures in place and reporting protocol functioning
(b) Develop reporting procedure for all maritime traffic in the area with emphasis on identifying IUU vessels	MCM, Dept of Transport, Navy	Established protocol legislated

Establish random patrolling of area coordinated with MCM and Navy

(a) Conduct routine random patrols using both navy and MCM vessels	MCM, Navy, Hydrographic office	 Procedures in place and reporting protocol functioning
(b) Coordinate area coverage with permitted fishing vessel operators	MCM, Dept of Transport, Navy, fishers	Coordinated vessel planning and surveys

Develop an Oil Spill Mitigation and Contingency Strategy

(a) Ensure that the PEI MPA and surrounds are		Oil Spill contingency plan
accommodated adequately within the National Oil Spill	MCM	specifically dealing with PEI
Contingency strategy and ensure compliance with MARPOL		developed and tested

Review and install alternative technologies for monitoring

(a) Utilisation of satellite technology, radar and other	MCM, Navy,	Introduction of trials on
alternatives	Hydrographic	alternative technology,
	office	establish benefit cost

5. KEY PERFORMANCE AREAS

Key performance areas are activities in which the success of the PEI-MPA can be monitored. Performance areas will be specific to a particular MPA. In the PEI-MPA performance areas will include fishing and shipping, scientific research, legal instruments and enforcement and public awareness. Subsumed into these components will be a range of activities that are critical to the success of the MPA. Due to the remote nature of the area, recreational and tourist programmes are currently only of minor concern for the PEI-MPA¹². Commercial fishing however is a concern and is a key performance indicator of the health of the Prince Edward Islands ecosystem. A proactive approach to the management and control of both legal and illegal (IUU) fishing activity is therefore vital.

Various other issues (apart from fish stocks) have been identified that need to be resolved to protect the values contained in the PEI-MPA. Considerations include minimising the impacts on habitat (substrate primarily) of fishing and other activity, the disturbance to marine mammals, incidental mortality of chondrichthyan species, and birds.

5.1 Fishing and shipping

The longline fishery for Patagonian Toothfish, which started in 1996, was the first commercially viable finfish fishery around the Prince Edward Islands. There are however records of Japanese exploratory fishing in the area in the 1980's and unconfirmed reports of toothfish vessels already operating in the area in 1995. The fishery developed at a rapid pace and South Africa was poorly prepared to manage the distant water fishery effectively. The same year saw an influx of large numbers of Illegal, Unreported and Unregulated (IUU) fishing vessels to the area and within three years these illegal fishing activities had overexploited the toothfish stocks in the area and killed significant proportions of the populations of seabirds breeding on the islands through incidental mortality during fishing operations. The IUU fishery continued largely unchecked due to South Africa's lack of high seas fisheries patrol capabilities. Increased compliance efforts in the neighbouring EEZs of France (Crozet and Kerquelen Islands) and Australia (Heard and McDonald Islands) only served to worsen South Africa's predicament by shifting IUU fishing activity into the unprotected Prince Edward Islands' EEZ. Since the year 2000, IUU activity in the area has decreased, probably due to the low commercial viability of the stocks in this area. Despite this, there has been good co-operation between the governments of South Africa, Australia and France in curbing IUU fishing in this area and several joint compliance operations have resulted in the arrests of IUU vessels. This co-operation has culminated in a joint MCS agreement between Australia and France, and a draft MCS agreement exists between South Africa and Australia.

¹² Noting that ship-based tourism to the islands has occurred only once but is likely to increase with time.

A small legal fishery survives in the area despite the depleted state of the stock. Since the start of the licensed fishery, at the end of 1996, the estimated IUU catch has exceeded the reported catch for most years. A maximum of five operators has been licensed by South Africa to fish in any one year. During recent years only one or two licensed vessels have been active in the fishery operating under a strict set of permit conditions ¹³. In addition to the permit conditions associated with longlining for Patagonian Toothfish, the following shall apply to shipping in the area. The principle objective of these conditions is the protection of biodiversity and the minimisation of pollution risk:

a) Within the 12-nautical mile sanctuary Area

- Commercial shipping and all other maritime activity, including fishing vessels in possession of a legal permit, will be restricted to specified shipping lanes and designated anchorages;
- ii. Fishing gear must be stowed (applies to legal operators and transit vessels).
- iii. Fishing vessels not in possession of a legal permit may only enter this zone under conditions of *force majeure*.
- iv. Marpol conditions to be stringently enforced. In addition dumping of fish waste and discharge of sewage will not be permitted ¹⁴.

b) Within the Restricted Zone

- i. Fishing vessels not in possession of a South African permit to fish in these waters and traversing these areas, must do so with fishing gear stowed, may not have fish on board, and will be subject to mandatory reporting procedures.
- ii. All other vessels traversing the areas of this Zone will also be subject to mandatory reporting procedures.
- iii. Marpol conditions to be stringently enforced. In addition dumping of fish waste and discharge of sewage will not be permitted.

5.2 Scientific research & monitoring

Scientific research and monitoring are strategic components of the PEI-MPA management. Scientific research is applied in specific areas of interest and is aimed at informing managers of biological, environmental and many other processes considered important for the running of the PEI-MPA.

¹³ Authorized operators fish under a strictly controlled set of permit conditions with permanent independent Observes deployed on each vessel. Permit condition available through Marine and Coastal Management.

Noting the CCAMLR conservation measures for e.g. the Ross Sea does not allow ship-borne and fish waste to be discharged in sensitive areas. Waste must be retained on board or incinerated and may only be discharged when vessels are steaming at designated speeds and are outside of designated sensitive areas.

The primary objectives of scientific research and monitoring on the PEI-MPA are:

- To contribute to a national and global representative system of Marine Protected Areas, by providing protection for endemic and rare species, species with globally significant populations, habitats and ecosystem processes,
- To serve as a scientific reference point that can inform the future management of the area,
- *To contribute to the recovery of the overexploited Patagonian toothfish* Dissostichus eleginoides *population,*
- To reduce the incidental mortality of particularly albatrosses and petrels in the Patagonian toothfish fishery (Nel & Nel 1999, Nel et al. 2002c) as well as controlling the by-catch of fish and other marine species other than Patagonian toothfish in the commercial fishery.

In addition to the applied scientific research activities, scientific monitoring is also an essential strategic activity that forms part of important feedback mechanisms that indicate the effectiveness of the MPA in achieving its defined goals. In addition, protected areas are used to support research projects of both academic and commercial interest. All scientific research and monitoring should however be compatible with the PEI-MPA objectives. Published scientific research associated with the marine environment in the vicinity of the Prince Edward Island group is listed in Appendix 3.

5.2.1 Baseline data collection, scientific research and monitoring priorities

The collection of baseline data, scientific research and monitoring requirements for the effective management of the PEI-MPA may either be conducted by (a) the authorised Managing Agency, (b) a contractor, or (c) the management authority may encourage separately-funded research institutions to carry out the necessary work.

The baseline, scientific research and monitoring requirements are separated into three categories:

- a) Biodiversity and ecological processes;
- b) Fisheries; and
- c) Non-consumptive activities.

a) Biodiversity and Ecological Processes

- i. Develop, implement and maintain databases of information relevant to the management of PEI-MPA and develop a meta-database that will provide an interface capable of accessing information from all these databases (in conjunction with MCM).
- ii. Gap Analysis Analyse and compile existing data to facilitate management of the PEI-MPA and to identify critical gaps in our information;

- iii. Develop a spatial database that includes biodiversity information, threats and trends in their status. Describe and map the physical environment (bathymetry) and identify the spatial distribution of habitats and ecosystem characteristics;
- iv. Identify and establish benchmark areas for monitoring and scientific research and investigate the possibility of further zoning to provide enhanced protection for research and monitoring sites;
- v. Conduct surveys aimed at determining the structure, function, extent and biodiversity of the Prince Edward Islands marine ecosystem(s);
- vi. Identify and investigate ecological processes of the PEI-MPA and to relate this to the PEI and global ecosystem functioning;
- vii. Conduct monitoring of episodic events;
- viii. Biodiversity: Determine the status of biodiversity in the PEI area, trends and potential impacts, identify targets and threats to these targets and the magnitude of these threat;
- ix. Measure impacts/change as a result of activities occurring in the PEI-MPA;
- x. Interpret and feed research and monitoring data to management (compliance and educators) and the community;
- xi. Establish protocols and methods to determine threshold limits of acceptable change on a site-specific basis (related to zoning). In particular, determine acceptable levels of use by tourism, recreation and fishing;
- xii. Develop collaborative research and monitoring arrangements with tertiary institutions and other research groups;
- xiii. Ensure information from stranded marine animals is collected, collated and interpreted.

b) Fisheries Management Actions

- i. Analyse and compile existing data to facilitate management of fisheries in the PEI-MPA and to identify critical gaps in our information;
- ii. Quantify and describe marine resource use and determine trends;
- iii. Develop a specific PEI-MPA fisheries database incorporating the MCM and CCAMLR databases. Consolidate these data with any other available data e.g. information on alternative ecosystem processes and habitat types, flora and fauna;
- iv. Maintain 100% independent scientific observer coverage of all commercial fishing operations;
- v. Where practical, conduct independent scientific biomass assessments using research vessels:
- vi. Conduct an annual fisheries stock assessment, determine catch and effort levels and implement precautionary catch and effort limits to maintain ecosystem functioning;
- vii. Assess impacts of fisheries on biodiversity and ecosystem functioning;
- viii. Collect data on impacts of fishing on non-target fish species and incidental mortality of mammals, seabirds and other affected fauna;
- ix. Conduct ongoing research and monitoring of methods to mitigate ecosystem impacts;
- x. Conduct research on alternative fishery and vessel monitoring methods.

c) Non-consumptive user (socio-economic) activities

- i. Analyse and compile existing data to facilitate management of the PEI-MPA and to identify critical gaps in our information;
- ii. Identify and document activities occurring in the PEI-MPA;
- iii. Quantify user activities and measure trends;
- iv. Determine socio-economic profiles to target education and understand issues leading to the displacement of users;
- V. Develop a spatial database that collates user information (GIS system);
- VI. Identify potential for tourism, particularly ship-based tourism within the PEI-MPA;
- VII. Develop a protocol to regulate future tourism activity 15.

5.3 Legal Instruments and enforcement of the PEI-MPA

Management of the PEI-MPA is the primarily the responsibility of DEAT and their Branch: Marine and Coastal Management. Further, the management of the area will be supported through the formation of a "Prince Edwards Islands Marine Protected Area Implementation and Management Committee" (Appendix 1).

Research and monitoring projects will be designed to determine whether the objectives of the PEI-MPA are being met. Monitoring will be designed accurately to reflect the changes that require a management response and must be integral to the biophysical management and management effectiveness process. The choice of indicators/monitoring must be scientifically credible, easy to understand, easy to monitor regularly, be cost effective, have relevance to policy and management needs and purposely contribute to monitoring of the management plan towards its improvement. An MPA Guidebook (Pomeroy et. al. 2004) offers managers a process and methods to evaluate the effectiveness of their MPA for the purposes of adaptive management. This should be used in conjunction with an extensive list of publications and material available on the management of Marine Protected Areas, as well as specific reports and publications on the Prince Edward Islands (Appendix 3). Marine and Coastal Management has developed a generic list of monitoring that should be conducted at MPAs. This monitoring is focused on a national level rather than at a local level ¹⁶.

¹⁵ This protocol should consider *inter alia* the carrying capacity of the PEI-MPA for tourist programmes, and, if necessary, consideration given to limiting tourist operator numbers, as well as times, days and locations of activities to minimise potential ecosystem impacts. This may require zonation and user group categorisation.

¹⁶ It is envisaged that this monitoring should occur at all South African MPAs to get an overall view of the state of the marine environment in South Africa.

5.3.1 Legislation

For the effective implementation and enforcement of MPAs a legal framework (international and national is required). In this regard South Africa has an established and integrated legal framework that facilitates the implementation and enforcement of the PEI-MPA.

Maritime Zones

South Africa's maritime zones cover territorial waters, contiguous, exclusive economic zone (EEZ), the continental shelf and the Prince Edward Islands. As sovereign territory of South Africa (Prince Edward Islands Act 43 of 1948), South Africa asserts its right under the 1982 United Nations Law of the Sea Convention (LOSC) to a 12-nautical mile territorial sea and a 12-200 nautical mile exclusive economic zone (EEZ), through its Maritime Zones Act 15 of 1994. Most of the EEZ surrounding the islands also falls within the Convention on the Conservation of Antarctic Living Marine Resources (CCAMLR) area of competence, to which South Africa is a member. Although, nothing can derogate from South Africa's sovereign rights in its EEZ, international law (through the LOSC and the 1995 UN Fish Stocks Agreement¹⁷ (UNFSA) requires South Africa to implement management measures that are compatible with those of CCAMLR (Nel, 2006)

Biodiversity

Although the LOSC confers sovereign rights on coastal States to explore and exploit the marine resources of their EEZ, it also places a general obligation on these States to protect and preserve the marine environment through 'proper conservation and management measures' that can include, amongst other, 'fishing area regulations'. South Africa's membership to the 1992 Convention on Biological Diversity (CBD) obligates the State to plan and develop protected area networks. In 2003 South Africa adopted the National Environmental Biodiversity Act (No. 10 of 2004) (NEMBA). Further the CBD's application to the marine environment was developed through the 1995 Jarkarta mandate and culminated in the advice to the 8th Conference of Parties, which set a global goal to develop a representative global network of MPAs by 2012. South Africa has also publicly committed itself to two global policy statements, the 2002 World Summit on Sustainable Development (WSSD) and the 2003 World Parks Congress, that collectively require States to develop representative networks of MPAs that amount to at least 20-30% of each marine habitat. South Africa's membership of the Agreement on the Conservation of Albatrosses and Petrels (ACAP) also obligates the State to protect the foraging and migration habitats of four species of albatross that breed on the Prince Edward Islands.

¹⁷ Full title: Agreement For The Implementation Of The Provisions Of The United Nations Convention On The Law Of The Sea Of 10 December 1982 Relating To The Conservation And Management Of Straddling Fish Stocks And Highly Migratory Fish Stocks

- Sea Birds and Seals Protection Act (No. 46 of 1973)
- Sea Shore Act (No. 21 of 1935)
- Nature and Environmental Conservation Ordinance, (Ordinance 19 of 1974)
- World Heritage Convention Act (No 49 of 1999)

Marine Living Resources

The authority for the establishment of Marine Protected Areas in South Africa is provided by Section 43 of the Marine Living Resources Act 18 of 1998. The Prince Edward Islands themselves are currently declared as a Special Nature Reserve under the National Environmental Management: Protected Areas Act 57 of 2003 (NEMPA) with the boundary set at the high water mark. The MLRA allows the Minister of Environmental Affairs and Tourism to regulate a wide range of activities, including 'any activity that may adversely impact the ecosystems of that area'. This provision has been used widely to regulate inter alia the passage of fishing vessels through MPAs. Such fishing vessel 'exclusion zones' are used internationally for the main purpose of simplifying prosecution of fishing vessels within restricted zones (i.e. the State merely has to prove presence of the vessel in the area, and not actual fishing activity, which is more difficult to prove). Special Nature Reserve status under NEMPA on the other hand invokes a far more restrictive visitation regime, and sets aside protected areas exclusively for scientific purposes and monitoring. Passage of vessels not engaged in these activities would thus be prohibited from such areas.

Maritime Traffic

The Maritime Traffic Act 2 of 1981 allows the Minister of Transport to regulate shipping traffic through inter alia the prescription of designated sea lanes and routeing measures. Although foreign vessels enjoy the right of innocent passage within the territorial seas of coastal States under the LOSC, this right is not unconditional and coastal States may regulate the passage of vessels in respect to a number of issues, including the conservation of living marine resources. When prescribing such measures the coastal State merely needs to take into account the recommendations of the International Maritime Organization (IMO). In the EEZ of coastal States foreign vessels enjoy freedom of navigation. However, these rights are also not unconditional and coastal States can, with the consent of IMO, adopt special measures for specific designated areas. These measures may include mandatory reporting and routeing measures. The IMO also provides for the designation of Particularly Sensitive Sea Areas (PSSAs) for areas that need special protection because of its significance for recognized ecological, socio-economic and scientific reasons. The protective measures for PSSAs are those within the purview of the IMO and include mandatory reporting and routeing measures, and 'areas to be avoided'.

Other Relevant Legislative tools

In addition to the above legislation, the Prince Edward Islands are directly affected by the 1) Sea Birds and Seals Protection Act (No. 46 of 1973), 2) Sea Shore Act (No. 21 of 1935) 3) the Nature and Environmental Conservation Ordinance, (Ordinance 19 of 1974) and 4) the World Heritage Convention Act (No 49 of 1999).

Regulations and Permits

With regard to the measures set out in this plan specific regulations applicable to the Acts specified above would need to be adopted. Marine Protected Area Permits for example, can only be issued under Section 43 of the Marine Living Resources Act (No. 18 of 1998). Until specific permit requirements are promulgated, these permits will authorise activities not covered under Section 13 or Section 81 of the MLRA. A summary of activities permitted in the PEI-MPA given in Table 3.

Legal Requirements to Conduct Scientific Research

Research Permits are issued under Section 81 of the MLRA which states "If in the opinion of the Minister there are sound reasons for doing so, he or she may, subject to conditions that he or she may determine, in writing exempt any person or group of persons or organ of state from a provision of this Act". All permits will be subject to a fee under Section 25 of the Marine Living Resources Act (No. 18 of 1998).

International Agreements

In addition to being a signatory of CCAMLR, South Africa is in the process of developing Memoranda of Understanding (MOUs) with its neighbours in the Southern Ocean, specifically with Australia and France. The purpose of these agreements is to facilitate communications, trans-boundary monitoring (such as hot pursuit) and scientific research. In addition, South Africa is a signatory to UNCLOS, MARPOL (International Marine Pollution Regulations) and the Agreement on the Conservation of Albatrosses and Petrels (ACAP).

Table 3/...

Table 3. Summary of Activities permitted within the Prince Edward Islands Marine Protected Area

PERMITTED ACTIVITY)	SANCTUARY ZONE	RESTRICTED ZONE	CONSERVATION ZONE
Fishing			
Scientific Research	Yes	Yes	Yes
Recreational Fishing	No	No	No
Commercial Fishing (longlining only)	No	No	Yes
Recreational/Tourist Activities			
Tourist Programmes (including marine animal watching, excluding motorised water sports)	No	No	No
Tourist Programmes involving motorised water sports and aircraft use (subject to development)	No	No	No
Diving (scuba or other) subject to permit only or for research	No	No	No
Recreational aircraft use below 1000 ft	No	No	No
Commercial Boat-based whale watching (may be developed)	No	No	No
Maritime Traffic			
Anchoring/Mooring (Subject to Permits excludes Force majeure)	Yes	Yes	Yes
Transit	No	No	No
Research and Compliance Vessels	Yes	Yes	Yes
Photography			
Recreational	No	No	No
Commercial photography (subject to permit)	Yes	Yes	Yes
Scientific Research (subject to permit – includes specialised activities such as biomass surveys, sampling using SCUBA gear and other underwater activities)	Yes	Yes	Yes

5.3.2 Compliance

Clearly the development of an MPA around the Prince Edward Islands would be futile, without the necessary enforcement and compliance measures. Recent developments within CCAMLR will allow better monitoring, control and surveillance of such areas. Firstly, the adoption of a mandatory satellite-based Vessel Monitoring System (VMS) will greatly increase the ability of member States and the Commission to monitor the movements of fishing vessels. Similarly, South Africa's national legislation requires all large fishing vessels (clusters A,B & C) to be fitted with VMS's. South Africa has also acquired a purpose-built fisheries patrol vessel with extended blue-water capabilities, as well as four new navy corvettes. The Marine Living Resources Act allows South Africa to set a minimum financial security for vessels apprehended contravening the Act, which includes the costs incurred by the State in making the arrest. This allows for cost recovery of expensive surveillance exercises. South Africa is also in the process of concluding a MOU compliance agreement (see section 5.3.1) with Australia, which will allow for co-operative surveillance operations in the two States' Southern Ocean EEZs.

The compliance objective for the Prince Edward Islands Marine Protected Area is to enforce the PEI-MPA and in so doing achieve resource protection and to ensure fulfilment of the objectives of the MPA. It is recognised that compliance cannot be one dimensional – it needs to be a composite of many different approaches if it is to be effective in achieving these goals. Because of the remoteness of the PEI-MPA from South Africa, it presents unique challenges for compliance, the difficulty of which has already been demonstrated through the over-exploitation of the Patagonian Toothfish resource in the area by IUU vessels in the 1990s. Nevertheless, resourceful managers do have an array of tools that can enhance compliance of the PEI-MPA. The practical aspects of enforcing obviously need a strong legislative basis which is provided primarily through the MLRA, but also other legislation as indicated in section 5.3.1.

It is also stressed that the implementation of an effective compliance plan for the Prince Edward Islands, should not require commitment of any additional resources, other than those already required for the fulfilment of South Africa's international obligations to manage and protect the marine resources of this area effectively (as required by the Law of the Sea Convention Articles 192 and 194). In fact the MPA is merely a spatial delineation that should facilitate more efficient protection of the most important biodiversity assets of the area. A compliance strategy for the effective enforcement of this MPA would be implemented by MCM in collaboration with other components as needed (e.g. the South African Navy and Air Force). Key elements of such a strategy would include:

- As part of the MPA proclamation, the South African vessel/s in possession of a fishing license will continue to fish in the area and in fact conduct standardised commercial fisheries monitoring within parts of the MPA. This will allow these commercial vessels to perform a surveillance and deterrent function.
- MCM's major environmental patrol vessel (EPV) the Sarah Baartman, is designed specifically to operate in the role of offshore protection. As part of fulfilling South Africa's international obligations under the LOSC to manage and protect the marine resources of this area, this vessel is required to make regular clandestine patrols to the area. The vessel can also be used in a reactive manner in response to other information (e.g. from commercial vessels, information from other States, radio traffic, etc.).
- The recent acquisition of four Navy corvettes was done partly in order to secure South Africa's offshore marine resources. These vessels should therefore be available to assist in MCS operations in the area. However, due to higher running costs of these vessels, it is envisaged that these vessels should only be used to compliment operations headed by the Sarah Baartman or in a reactive manner (i.e. hot pursuit). Operational guidelines for co-operation between MCM and the SA Navy will need to be developed.

- An additional national presence is through research and relief cruises to the area by MCM's major research vessels, the SA Agulhas and Africana, as well as other vessels that may be deployed to undertake research in the region.
- South Africa also has an exceptional track record of co-operation with France and Australia in terms of joint compliance operations in the Southern Ocean, which has resulted in several arrests of IUU vessels. This has resulted in co-operation agreements between France and Australia and a draft agreement between South Africa and Australia. Further, the notification of South Africa's intention to declare an MPA around the Prince Edward Islands has been welcomed by CCAMLR states. This bodes well for future co-operation with these States in order to secure the management of this MPA.
- Finally, the use of complementary technology needs to be investigated. For instance several States (including the United Kingdom and France) have made very successful use of satellite imagery to detect IUU fishing activity in their Southern Ocean EEZs.

The key elements of the PEI-MPA compliance strategy are shown in Figure 4. For the integrated compliance strategy to work effectively the following key components must communicate and support one another:

- MCM should be the lead coordinating agency
- A regular co-ordinated vessel patrolling strategy must be in place that facilitates a near-continuous presence in the area including MCM and Navy vessels, legal fishers, research vessels, ad hoc surveillance flights and coordination with any international patrolling activity in adjacent areas
- 24-hour VMS monitoring with a minimum four-hour reporting schedule
- Established reporting protocol when moving into and out of the EEZ and MPA zones
- Use of alternative technologies for monitoring (e.g. radar and satellite)
- An established and aggressive communication network aimed at identifying activity and vessel movements into and out of the PEI area.
- Legal response to prosecutions should be an effective deterrent prosecutions should be assured and the training of compliance officers specifically for highseas duty is essential.

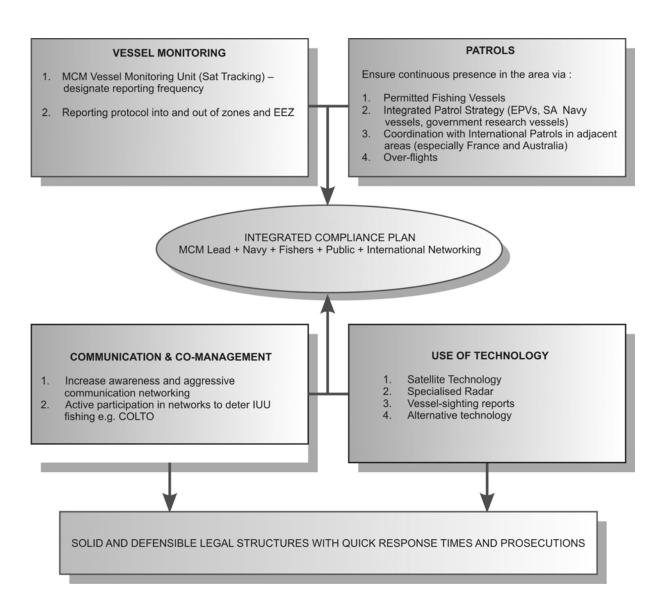


Figure 4. Schematic showing the integrated approach to compliance of the PEI-MPA

5.4 Awareness Plan

DEAT recognises that its proficiency as the manager of South Africa's marine resources depends largely on its ability to inspire public support and participation through awareness. The focus of this awareness plan is to promote an understanding of the importance of healthy ocean ecosystems, the importance of MPAs and the role that the community may play in their care (refer to the Actions in 4.2). Marine protected area management has developed because of the growing recognition of the importance of marine ecosystems to

our communities, economy and environment and is emerging as a national priority due to undesirable and unsustainable impacts on the marine ecosystem¹⁸.

In the case of the Prince Edward Islands, the development of MPAs within South Africa has taken on a new geographical dimension. Whereas MPAs generally have been instituted in the coastal and near-shore areas, the PEI-MPA is offshore and remote. As such the value of such an MPA is less exposed to the public. On the other hand the PEI-MPA is highly significant in the global context. Raising awareness of the PEI-MPA will therefore need to be targeted at both national and international levels. This should include educating and communicating not only the "generic" benefits of MPAs such as have been applied broadly to coastal and inshore waters, but also expanding on the uniqueness (in a South Afican context) of the Prince Edward Islands and the benefits that are likely to accrue to not only South Africans, but also to the global community. Typically such, awareness raising will include participation at appropriate levels, particularly direct stakeholder involvement. The media should also be actively involved using all forms possible. Creating awareness should be one of the tasks of the PEI-MPA Committee. As such a specialized task team should be appointed with the authority to co-opt members with appropriate media and communication skills to help achieve the objectives indicated below.

5.4.1 Awareness objectives

The PEI-MPA awareness strategy should focus on the following key areas:

- a) Protection of marine biodiversity of the Prince Edward Islands MPA;
- b) Provision of opportunities for the multiple use of the area that are consistent with the long-term protection of natural resources;
- c) Addressing conflict between user groups over access to, and use of, the MPA;
- d) Promotion of voluntary compliance with regulations and awareness of the marine ecosystem through education of interested and affected parties;
- e) Encourage opportunities for the involvement and upliftment of historically disadvantaged communities;
- f) Enhance marine protected area management through partnerships at national, and international levels;
- g) Encourage stakeholder participation and voluntary compliance

5.4.2 Awareness strategy

 Achieve public and market awareness of the Prince Edward Islands MPA and the values, services and products offered.

To achieve the awareness objectives as far as possible the following should be included:

¹⁸ Noting that the awareness plan has "generic" components applicable to coastal zone MPA's and as such certain requirements might not apply to the offshore (distant) location of the PEI-MPA

- Provide information and material *on the benefits/importance of Prince Edward Islands MPA. Provide support to educators to implement this information and the material developed and meet with other education stakeholders and interested and affected parties to coordinate and plan education programmes and messages.
- Promote marine conservation through local, national and international media (Internet, newspapers, magazines, TV, etc.).
- Notify media whenever anything is happening.
- Interpret and disseminate the findings of Prince Edward Islands MPA research for use by the non-research community.
- In consultation with user groups, develop user group guidelines, codes of conduct, and environmental briefing standards that allow for use in a manner that protects the environment. Periodic evaluations to monitor their effectiveness should be undertaken to recommend changes when necessary.
- Promote alternative non-consumptive activities in the Prince Edward Islands MPA (such as eco-tourism).
- Conduct a public information campaign on the Prince Edward Islands MPA rules and regulations.
- Target the international scientific community to raise awareness of the work conducted on the PEI-MPA and promote/advance the potential for research in the area and the value therein in the global context.
- At a political level get the support of government and raise the awareness of the significance of the PEI-MPA.
- Raise the awareness of the implications of poor compliance and IUU fishing activities and Promote collaboration with regard to similar activities in adjacent areas (Crozet, Heard and Macdonald Islands)
- Actively canvass for support and the raising of funds to enhance the management, research, governance and compliance of the PEI-MPA.

6. ACKNOWLEDGEMENTS

The formulation of this plan would not have been possible without the collaboration and consultation with interested and affected parties. In particular Marine and Coastal Management and the Patagonian Toothfish rights holders.

The financial support of Sanlam and WWF South Africa is gratefully acknowledged. John Cooper and Marcel Kroese reviewed the plan and provided invaluable input.

7. APPENDICES

Appendix 1

PRINCE EDWARD ISLANDS MARINE PROTECTED AREA IMPLEMENTATION AND MANAGEMENT COMMITTEE (PEI-MPAC)

A Prince Edward Islands MPA Working Committee <u>will be amalgamated</u> with the Prince Edward Islands Nature Reserve Working Committee to discuss management activities, monitoring and research in the MPA. The Prince Edward Islands Management Committee (PEIMC) liases closely with the Biological and Oceanographic Sciences Task Groups and the South African Committee on Antarctic Research (SACAR) of the Department of Environmental Affairs & Tourism. The PEIMC chair has representation at all levels in the Directorate Antarctica & Islands (i.e. in task groups, in SACAR, and within the Antarctic Management Committee). All research at the islands is assessed in light of the requirements of the Management Plan.

This committee will become known as the Prince Edward Islands Nature Reserve and Marine Protected Area Working Committee (PEI-MPAWC). There is no statutory requirement to convene a Working Committee, however, to ensure effective co-management and consultation of the PEI-MPA, it is recommended that a Working Committee be established. The Committee will aim to involve all stakeholders associated with the Prince Edward Islands MPA.

IMPLEMENTATION PROCESS FOR A WORKING COMMITTEE

MCM recognises the importance of co-management of our marine resources. The Committee will be representative of the current stakeholder.

Composition of the Committee

The Committee will be formalised as soon as possible. A formal letter of invitation and advertisements placed in local newspapers calling for nominations to participate will be forwarded to appropriate groups. Each group will nominate in writing a representative and also an alternative representative, who will represent their constituency only when the nominee is unavailable, and forward this name to MCM. The committee should have representation from the following competencies:

Integrated Coastal Management (ICM), Compliance, Resource Management, recognised scientific researcher(s) and the commercial fishing industry. These portfolios should subsume the following:

- MPA manager, management representative
- Marine and Coastal Management (MCM)
- Commercial Fishing
- Tourism industry
- Department of Transport (SAMSA)

¹⁹ Noting that amalgamation will include changes to the TOR for the PEI-MPAC

- Maritime surveillance (SAN, MCM compliance)
- NGOs

Chair's role

The Chair will be a MCM staff member. The Chair schedules and sets agendas for the Committee meetings and presides over all meetings of the Committee, and ensures that meetings are run according to accepted meeting practices, signs all correspondence and documents authorised by the Committee, and generally represents the Committee's interests and concerns to the public.

Vice-Chair:

The Vice-Chair will be a MCM staff member, which will serve as Chair in the absence of the Chair and assists as necessary in performing executive duties of the Committee.

Secretary:

Prepares and convenes meetings, circulates notices and takes minutes. The secretariat (secretary plus resources will be supplied by MCM).

Roles of the Working Committee

- 1. Provide input to MCM on PEI-MPA plans and proposals, including those related to research.
- 2. Help identify and resolve issues and conflicts, including emerging issues.
- 3. Serve as a liaison between the Committee and the community, disseminates information about PEI-MPA to the various stakeholders and the public.
- 4. Assist in identifying potential partners and stakeholders with which the PEI-MPA should be working.
- 5. Assist in identifying and securing priority partnerships, with special reference to previously disadvantaged communities.
- 6. Provide technical and background information on issues facing the PEI-MPA.

Committee meetings

It is anticipated that the Working Committee will meet every sixth months. The Chair will develop meeting agendas and make those available to Committee members in advance. Meeting notes will be taken by the secretary and made available to the public upon request.

Financing of the Working Committee

The cost of the secretary, the hiring of venues, paper postage, and miscellaneous items required for meetings will be covered by MCM.

Appendix 2

SOUTH AFRICA'S SUBMISSION FOR "WORLD HERITAGE SITE" STATUS FOR PRINCE EDWARDS ISLANDS

Ref: http://whc.unesco.org/en/tentativelists/1923/

The Prince Edward Islands

Property names are listed in the language in which they have been submitted by the State Party.

South Africa (Africa)

Date of Submission: 24/06/2004

Criteria: (vii)(viii)(ix)(x)
Category: Natural

Submission prepared by:

Department of Environmental Affairs and Tourism

Coordinates:

Marion Island 46°49'30"-46°58'30" S / 37°35'-37°54' E Prince Edward: 46°35'50"-46°39'55" S /

37°52'50"-38°00'45" E

Ref.: 1923

Description

Topography

Marion Island consists of a central highland area that reaches 1,249m ASL at its highest point. There is a 4 - 5. km wide coastal plain (up to 300m ASL) on the northern and. eastern sides of the island that slopes gently up to the highlands. The coastal plain on the western and southern sides of the island is only about 100m in altitude and irregular due to extensive erosion by wave action on these sides of the island. The Island Group is characterised by abundant conical cones of scoria (volcanic cinder). Prince Edward Island rises to 872m ASL at its highest point (Van Zinderen Bakker Peak) and consists of a central highland that slopes gently to the east and drops to the western lowland in the form of a 400m high escarpment. The coastlines of both islands consist mostly of coastal cliffs rising abruptly from the sea, interspersed by small pebble and boulder beaches in protected bays.

Geology and geomorphology

The Island Group is located near the centre of the West Indian Ocean Ridge and represents summits of a volcano of Hawaiian type rising more than 3500m from the ocean floor. The age of the oldest lava flows on Marlon Island are estimated at 450,000 years. Marion Island is regarded as a dormant volcano, since the latest (and only recorded) volcanic eruption occurred on the island's west coast in 1980. This makes Marion Island one of only two sub-Antarctic Islands to have erupted volcanically in recorded history. It is thought that Prince Edward Island is a remnant of a closely associated shield volcano, of which four fifths have since subsided below sea level.

Two stages of volcanic activity can easily be recognised on both islands: older grey lava and younger black lava flows. The grey basalt lavas, which are between 270,000 and 48,000 years old, occur mainly as elevated ridges with a smooth topography and bear extensive marks of glaciation in the form of deep striations, unsorted rocky material and large solitary boulders. Glaciation occurred

between 12,000 and 16,000 years ago, Prince Edward Island does not show signs of glaciation, possibly because the island has never been covered by an ice sheet or because the glaciated sections have since eroded away.

With the retreat of glaciers about 16 000 years ago, Marion Island was subjected to a second wave of lava flows that formed the black basalt lavas. The black lavas form very ragged-flows between and over the grey lavas and mainly occupy intervening valleys between the ridges, As they have never been subject to glaciation, their topography is very uneven. These younger flows are associated with approximately 130 scoria cones on Marion Island. Scoria cones are distinctive features of the geomorphology of both Islands. There is a stationary glacier or "ice plateau" in the central highlands of Marion Island the only glacier on South African territory. The glacier is static and consists mostly of hard blue ice that is partially hidden by large moraines.

Soils

Most of the rock on the island has not weathered sufficiently to form deep, well-developed soils. Many of the higher lying "fjeldmark" or wind desert areas are characterised by desolate wind-swept surfaces covered by loose stones and volcanic ash. Most of the soils consist almost entirely of slowly decomposing organic matter (peat) from plants and fine volcanic ash. Generally, the islands' soils are characterised by Immaturity, negligible influence of parent material on the soil profiles and a marked effect of slight variations in topography and wind exposure. Deeper peat soils occur along the waterlogged coastal plain and. in valleys that are protected from wind. Peat slips are common features of these soils, especially on slopes where they have been disturbed by human trampling or by seats. Soils of low-altitude and vegetated areas are usually peat, containing volcanic ash in varying amounts.

Climate

The Island Group has a cool climate with an annual mean air temperature of 5.9°C. The absolute maximum and minimum temperatures ever recorded at the base are 23.8°C and - 6.8°C, respectively. Absolute minimum temperatures are below zero every month of the year, but even in the winter temperatures rarely fall below -4°C because of the moderating influence of the ocean. The mean surface air temperature has increased by 0.93°C from 1951 to 1988. This is ascribed to changing oceanic and atmospheric circulation patterns at sea level.

The Island Group experiences high precipitation (an average of 2,500 mm per annum), mainly in the form of rain, which is distributed fairly evenly throughout the year. Most of the rain falls as light showers. Heavy falls of over 25mm/day occur about twice a month on average. The Island Group experiences an average of 25 days with precipitation a month and 308 days with precipitation per annum. Snow Is frequent in winter, particularly from July to September. Snow sometimes covers the whole of Marion Island, but in low-lying areas it usually melts within a few days. The base experiences an average of 95 days of snow and 46 days of fog per annum.

Marion Island has a high level of cloudiness (annual sunshine duration ca 30% of the maximum possible. On average, no days with more than 90% of possible sunshine are encountered. An annual average of 130 days with a cloud base below 300m above sea level are encountered. Average annual cloud cover is 79%. The island Group is situated in the "Roaring Forties". Thus the islands are subjected to westerly to northwesterly winds approximately 60% of the time. Gate force (>55km/h) winds lasting at least one hour are experienced for an average of 107 days per annum. Gales usually exceed this speed and duration, however, and can reach speeds of up to. 200km/h. Winds exceeding 70km/h often continue unabated for more than 24 hours.

General Ecology

The features of the sub-Antarctic islands that have combined to produce their particular ecosystem are geographic isolation., wind exposure, temperature, high rainfall, and the strong influence of the marine ecosystem (e.g. manuring by. birds and seals). Two factors in particular have contributed to a relatively low floral and faunal diversity on the sub-Antarctic islands in general and on the Island Group in particular. The first factor is that the Island Group is geologically very young. The second factor is the remoteness of the Islands from continents. A slow process of colonisation has established biota on small "pinpricks" of land across vast expanses of ocean. Thus, there is a low number of species of indigenous flora. Many of these indigenous species have wide ecological amplitudes and occur over a range of habitats. Five percent of the. plant species are endemic to the Island Group and 23% of the plant species are restricted to the South Indian Ocean Biogeographlical Province.

Indigenous species that play a major role in continental ecosystems (e.g. herbivorous and carnivorous land mammals) are absent from the natural terrestrial ecosystem of the Island Group. Combined with the very high primary production of many plant communities, this has a significant effect on ecosystem. structure and function. It means that detritivores like fungi and bacteria, rather than herbivores, control energy flow. Arthropods and other Invertebrates play very important roles as detritivores and invertebrates are by far the most dominant herbivores in the ecosystem.

Nutrient cycling

The ecosystem of the Island Group can be regarded as semi-closed systems with significant interaction between the terrestrial and oceanic systems. The ecosystem is characterised by a significant level of nutrient transfer between the terrestrial environment and the ocean. Seabirds and seals bring nutrients to the islands, mainly in the form of guano. These nutrients support the growth of specific plant communities, particularly In the vicinity of penguin and seal colonies, but also farther inland. An example is the way that tussock grasslands replace fembrake communities where burrowing petrels and prions establish their burrows, These nutrients are further spread through the soils by invertebrates. Nutrients are returned to the oceans when they are washed off the island by rainfall. The nutrients are absorbed by plankton, and are then cycled higher up the food chain and eventually to inshore-foraging seabirds such as Gentoo penguins and cormorants and to seals.

Vegetation

The vegetation of Marion Island is relatively poor in species. This is typical of sub-Antarctic islands due the isolation from other landmasses and rigorous climate_ The Island Group has 22 indigenous vascular plant species and 21 alien plant species, either naturalised or transient. See Appendix A for a species list of vascular plants, Mosses (79 species), liverworts (36 species) and lichens (ca 50 species) are important components of the vegetation. Most of the island's vegetation has a very slow growth rate due to the extreme climate. This, combined with slow reproduction, makes the vegetation very sensitive to external disturbances. Six main plant communities can be distinguished. Vegetation distribution is mainly affected by factors such as the soil-water regime, the influence of salt spray, mechanical damage (e.g. due to trampling) and enrichment by guano deposition.

Invertebrates

Some 147 species of indigenous and introduced invertebrates are known from Marion Island, This includes 19 alien species that have become naturalised and 13 introduced species that have not, as yet, established themselves. 39 Species of soil ciliates have been found on Marion Island. Seven endemic invertebrate species have been identified. The endemic species include two springtails

(Isotoma marionensis and Katianna n, sp.), three beetles (Bothrometopus elongatus, Ectemnorfrinus marioni and E. similis) and two moths (Pringleophage marioni and P. kerguelensis).

The distribution and density of many invertebrates is strongly Influenced by manuring by birds and seals. High densities and biomass of invertebrates accompany high plant densities, soil nutrient content and plant nutrient content in heavily manured areas.

Mammals

There are three seal species on the Island Group. Their numbers are indicated in parentheses: the southern elephant seal *Mirounga leonine* (2,000), Antarctic fur seal *Arctocephalus gazelle* (330), and sub-Antarctic fur seal *A. tropicalis* (44,800). Leopard seals *Hydrurga leptonyx* and Weddell seals *Leptonychotes weddelui* are occasional non-breeding vagrants. There are no indigenous land mammals an the Island Group. Introduced house .mice are present on Marion Island but do not occur on Prince Edward Island. The. introduced feral cat was exterminated in the early 1990s.

Birds

The Island Group supports 29 species of breeding birds as well as 22 species of vagrant seabirds and 28 species of non-marine vagrant species (see Appendix D for a complete list of. species). Although the breeding bird species Include only one endemic taxon (the Lesser Sheathbill *Chionis minor marionenis*) most species have a very limited breeding area that is restricted to a handful of sub-Antarctic islands. Furthermore, the large distances between breeding sites and the high philopatry (natal site fidelity) characteristic of these species have led to limited genetic interchange and hence considerable geographical variation within species.

Most of these species are wholly or predominantly dependant on the marine environment for their energy needs and are capable of foraging great distances away from the Island Group; they only use the Island Group as a platform for breeding and moulting (in the case of penguins). Outside their breeding seasons they disperse away from the islands to more productive foraging areas. The large numbers of seabirds that breed on the Island Group are an important vehicle for importing nutrients from the marine environment to the terrestrial island environment, primarily in the form of guano. The seabirds on the Island Group are generally long lived. They only breed after a prolonged juvenile stage and breed very slowly. Almost all species breed only once a year and only lay one or two eggs. The chick-rearing period is prolonged with moderate breeding success. Some albatross species only lay one egg every second year. Just over half the eggs successfully fledge a chick in a given season. This means that populations are extremely sensitive to adult mortality, and will take a long time to recover from a perturbation to the population demographics (e.g. a decrease in adult survival). Four orders of seabirds are present on the Island Group: Sphenisciformes (penguins), Procel[ariiformes (albatrosses and petrels), Charadriiformes (skuas, gulls and terns) and Pelecaniformes (cormorant).

Freshwater systems

Marion Island has three perennial streams, but it is not known whether Prince Edward Island has any perennial watercourses due to the infrequent visitation of this island. Apart from the flowing water types, there is a range of lentic waters on the Island Group, Including shallow takes, lava-lakelets (primarily on black lava flows), crater lakes (in the craters of scoria cones) and wallows formed by the activity of animals. There are no indigenous fish in the freshwater environments (the introduced brown and rainbow trout are now extinct), and zoopiankton, therefore, represent the highest level in the freshwater food chain. Two species of copepods *Pseudoboeckella vofucris* and *Daphniopsus studeri*

dominate fresh waters and there are also a number of species of mites and a common freshwater midge *Umnophyes minimus*.

Marine environment

The Island Group is in the path of one of the world's widest current systems, the Antarctic Circumpolar Current (ACC), which flows clockwise around' the Antarctic continent at a surface speed of 0.5-2km/h. As a result the Island Group effectively has an upstream (westerly) and a downstream (easterly) side. This is important because all the Island Group's land-based vertebrate predators depend on the sea for food. The availability of food is controlled by oceanographic conditions. The ACC .carries food, in the form of plankton, to the island Group from the west. The Island Group also lies close to two major oceanic frontal systems. These fronts separate major water bodies with different chemical and physical properties and act as strong biogeographical boundaries with different suites of marine species to the north Sand south of each front. In addition, the fronts are areas of enhanced biological activity. They consequently form important feeding grounds for land-based predators.

Both islands in the Island Group have relatively unstable and hostile littoral environments, which results in a generally low biodiversity and low density of littoral organisms, All the shores around the islands are exposed (those with a westerly aspect severely so) due to the predominantly westerly winds. Large swells and unstable substrates (e.g. boulders) that result in abrasion also contribute to unfavourable conditions.

The Island Group forms the highest point of a shallow plateau, approximately 200 to 500 m deep, that drops off very rapidly Into much deeper waters (ca, 3 000 m). This plateau supports a rich seabed community of approximately 550 species, dominated by filter feeders, These are largely supported by local phytoplankton production. The swimming prawn Nauficaris marfonis links this community to the seabirds. Adult prawns feed on the seabed community and are important in the diets of birds with short foraging ranges, especially the Gentoo, Macaroni and Rockhopper penguins and the Imperial cormorant. 33 Species of fish from 13 families are known from the oceans around the Island Group. This Is more than has been recorded at the lies Crozet (25 species) but Inferior to the number at the lies Kerguelen (59 species).

History and development

The Island Group was probably first sighted in March 1663, when a vessel of the Dutch East India Company, the Maerseveen, under command of Barent Barentzoon Ham, went off course en route to Batavia. Commander Ham named the northerly island "Dina" and the southerly island "Maerseveen". The French naval officer Marion du Fresne, who was in command of the vessels Le Mascarin and Marquis du Castries, rediscovered, the Island Group more than 100 years later in January 1772 in ignorance of the first discovery. The next person to sight the Island Group was Captain James Cook. He reached the Island Group on 12 December 1775. Having a chart that did not indicate du Fresne's earlier names for the islands, Cook renamed the Island Group "Prince Edward's Islands' after the fourth son of King George III. It was only by the middle of the 190 century that the larger of the two islands became known as Marion island, presumably due to the notorious vagueness with which sealers named the islands they visited.

'None of the above-mentioned voyagers landed on either of the islands. Although mention is made of sealers having been established on the islands by 1802, the first recorded landing was in December 1803 or January 1804 from the vessel the Catherine. The Commander of the Catherine, John Fanning, however, made no claim to have made the first landing, and the name of the first vessel to

have landed at the Island Group remains a mystery. The Island Group was heavily exploited by the sealing industry in this early part of the 1 P century - so much so that by 1810 the fur seal population had been virtually decimated. Exploitation of elephant seals for blubber and oil continued, but by 1860 this activity had also become uneconomical as elephant seal numbers were declining. Sealing continued until the early 20th century, but had ceased by the 1930s when the industry became uneconomic due to dwindling seal numbers.

There have been several shipwrecks on both Prince Edward island and Marion Island. Few have been well documented, however. Artefacts from sealers and castaways are present at several sites on Marion Island and Prince Edward Island. Some remains of a village of 17 huts constructed by shipwrecked sailors from the Solgiimt (dating from 1908) can still be seen at Ship's Cove close to the Marion Island base. Following in the wake of World War II, the South African government realised the strategic value of the Island Group for navigation and defence. Lieutenant-Commander John Fairbaim, in command of the frigate MHSAS Transvaal, annexed Marion Island and Prince Edward Island on 29 December 1947 and 4 January 1948, respectively, The South African Parliament subsequently passed the Prince Edward Islands Act (Act 43 of 1948) to formalise the annexation of the Island Group. Transvaal Cove, where the Marion Island base is situated, was named after the naval frigate Transvaal.

The first meteorological party started work on the island in February 1948, Since then, an unbroken record of meteorological data has been kept, Research teams were relieved twice a year until 1956, and once a year since then. Research teams are relieved by ship. No fixed wing aircraft has been used on the Island Group apart from emergency aerial drops such as after the burning down of the accommodation and communications building In 1966 and an emergency crash landing of a light aircraft during 2002 on Marion Island. Formal biological research started in 1965 with the first biological and geological expedition led by Prof. Eduard van Zinderen Bakker Sr. of the University of the Orange Free State, Since then ongoing research has yielded a wealth of findings, and has given rise to more than 800 scientific publications and items of popular literature.

Appendix 3

A BIBLIOGRAPHY OF SCIENTIFIC RESEARCH CONDUCTED WITHIN THE TERRITORIAL WATERS AND EXCLUSIVE ECONOMIC ZONE OF SOUTH AFRICA'S SUB-ANTARCTIC PRINCE EDWARD ISLANDS

- ABRAMS, R.W. 1985. Environmental determinants of pelagic seabird distribution in the African sector of the Southern Ocean. *Journal of Biogeography* 12: 473-492.
- ABRAMS, R.W. 1985. Energy and food requirements of pelagic aerial seabirds in different regions of the African Sector of the Southern Ocean. In: Siegfried, W.R., Condy, P.R. & Laws, R.M. (Eds). Antarctic nutrient cycles and food webs. Berlin: Springer-Verlag. pp. 466-472.
- ABRAMS, R.W. 1985. The structure of pelagic seabird assemblages in the African sector of the Southern Ocean. PhD thesis, University of Cape Town.
- ABRAMS, R.W., GRIFFITHS, A.M., HAJEE, Y & SCHOEPPE, E. 1981. A computer-assisted plotting program for analyzing the dispersion of pelagic seabirds and environmental features. *P.S.Z.N.I.: Marine Ecology* 2: 363-368.
- ATCM 2005 (Antarctic Treaty Consultative Meeting). 2005. Final Report of the Twenty-Eight Antarctic Treaty Consultative Meeting. Stockholm, Sweden, 6-7 June 2005. http://www.ats.aq
- ADAMS, N.J. 1987. Foraging range of King Penguins *Aptenodytes patagonicus* during summer at Marion Island. *Journal of Zoology, London* 212: 475-482.
- ADAMS, N.J. 1990. Feeding biology and energetics of King *Aptenodytes patagonicus* and Gentoo *Pygoscelis papua* penguins at sub-Antarctic Marion Island. PhD thesis, University of Cape Town, Rondebosch, South Africa. 246 pp.
- ADAMS, N.J. & BROWN, C.R. 1983. Diving depths of the Gentoo Penguin (*Pygoscelis papua*). Condor 85: 503-504.
- ADAMS, N.J. & BROWN, C.R. 1989. Dietary differentiation and trophic relationships in the sub-Antarctic penguin community at Marion Island, southern Indian Ocean. *Marine Ecology Progress Series* 57: 249-258.
- ADAMS, N.J. & KLAGES, N.T.[W.] 1987. Seasonal variation in the diet of the King Penguin (*Aptenodytes patagonicus*) at sub-Antarctic Marion Island. *Journal of Zoology, London* 212: 303-324.
- ADAMS, N.J. & KLAGES, N.T.[W.] 1989. Temporal variation in the diet of the Gentoo Penguin *Pygoscelis papua* at sub-Antarctic Marion Island. *Colonial Waterbirds* 12: 30-36.
- ADAMS, N.J. & WILSON, M.-P. 1987. Foraging parameters of Gentoo Penguins *Pygoscelis papua* at Marion Island. *Polar Biology* 7: 51-56.
- ADAMS, N.J., BROWN, C.[R.] & KLAGES, N.[T.W.] 1985. Comparison of the diet of four species of penguins breeding on Marion Island, southern Indian Ocean. *South African Journal of Science* 81: 700.

- ADAMS, N.J., BROWN, C.R. & NAGY, K.A. 1986. Energy expenditure of free-ranging Wandering Albatrosses *Diomedea exulans*. *Physiological Zoology* 59: 583-591.
- ADAMS, N.J., MOLONEY, C.[L.] & NAVARRO, R. 1993. Estimated food consumption by penguins at the Prince Edward Islands. *Antarctic Science* 5: 245-252.
- ADAMS, N.J, WILSON, R.P. & BAIN, C.A.R. 1988. The use of thallium as a radioactive source in autoradiographic devices for penguins at sea. *Journal of Field Ornithology* 59: 43-45.
- AKKERS, T. 2002. Research in the Southern Oceans. Research Highlights 2001-2002 11: 78-82.
- ALLANSON, B.R., BODEN, B., PARKER, L. & DUNCOMBE-RAE, C. 1985. A contribution to the oceanology of the Prince Edward Islands. In: Siegfried, W.R., Condy, P.R. & Laws, R.M. (Eds). Antarctic nutrient cycles and food webs. Berlin: Springer-Verlag. pp. 38-45.
- ANDRIASHEV, A.P. 1971. Pisces. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. p. 283.
- ANDRIYASHEV, A.P. 1994. Review of liparid fishes (Scorpaeniformes, Liparidae) form the subantarctic islands of the Indian Ocean and description of a new species of the *Paraliparis* genus. *Voprosy Ikhtiologii* 34: 293-297.
- ANONYMOUS 1996. Conducting research in the Southern Ocean. *Research Highlights* 1995-1996 5: 30-31.
- ANONYMOUS 1997. Conducting research in the Southern Ocean. *Research Highlights* 1996-1997 6: 31-33.
- ANONYMOUS 1998. Research in the Southern Ocean. Research Highlights 1997-1998 7: 51-53.
- ANONYMOUS 1999. Research in the Southern Ocean. Research Highlights 1998-1999 8: 66-69.
- ANONYMOUS 2000. Research in the Southern Ocean. Research Highlights 1999-2000 9: 56-60.
- ANONYMOUS 2001. Southern Ocean. Research Highlights 2000-2001 10: 68-70.
- ANSORGE, I.J. 2000. The hydrography and dynamics of the general ocean environment of the Prince Edward Islands (southern Ocean). PhD thesis, University of Cape Town, Rondebosch, South Africa. xxx pp.
- ANSORGE, I.J. & LUTJEHARMS, J.R.E. 2000. Twenty-five years of physical oceanographic research at the Prince Edward Islands. *South African Journal of Science* 96: 557-565.
- ANSORGE, I.J. & LUTJEHARMS, J.R.E. 2002. The hydrography and dynamics of the ocean environment of the Prince Edward Islands (Southern Ocean). *Journal of Marine Systems* 37: 107-127.
- ANSORGE, I.J. & LUTJEHARMS, J.R.E. 2003. Eddies originating at the South-West Indian Ridge. *Journal of Marine Systems* 39: 1-18.
- ANSORGE, I.J., FRONEMAN, P.W., LUTJEHARMS, J.R.E., BERNARD, K., BERNARD, A., LANGE, L., LUKÁČ, D., BACKEBERG, B., BLAKE, J., BLAND, S., BURLS, N., DAVIES-COLEMAN, M., GERBER, R., GILDENHUYS, S., HAYES-FOLEY, P., LUDFORD, A., MANZONI, T., ROBERTSON, E., SOUTHEY, D., SWART, S., VAN RENSBURG, D. & WYNNE, S. 2004. An interdisciplinary cruise dedicated to understanding ocean eddies upstream of the Prince Edward Islands. *South African Journal of Science* 100: 329-322.

- ANSORGE, I.J., FRONEMAN, P.W., PAKHOMOV, E.A., LUTJEHARMS, J.R.E., PERISSINOTTO, R. & VAN BALLEGOOYEN, R.C. 1999. Physical-biological coupling in the waters surrounding the Prince Edward Islands (Southern Ocean). *Polar Biology* 21: 135-145.
- ANSORGE, I.J., FRONEMAN, P.W., PAKHOMOV, E.A., LUTJEHARMS, J.R.E. & VAN BALLEGOOYEN, R.C. 1999. Physical-biological coupling in the waters surrounding the Prince Edward Islands (Southern Ocean). *Polar Biology* 21: 135-145.
- APPLEYARD, S.A., WILLIAMS, R. & WARD, R.D. 2004. Population genetic structure of Patagonian Toothfish in the west Indian Ocean sector of the Southern Ocean. *CCAMLR Science* 11: 21-32.
- ARNAUD, F. & BRANCH, M.L. 1991. The Pycnogonida of subantarctic Marion and Prince Edward Islands: illustrated keys to the species. *South African Journal of Antarctic Research* 21: 65-71.
- ARNAUD, P.M. & DO-CHI, T. 1979. Resultats preliminaires obtenus sur les lithodes aux lles Crozet, Marion et Prince Edward, pendant la campagne oceanographique MD.08. *Comité National Français des Recherches Antarctiques* 44: 135-136.
- ARNAUD, P.M. & HUREAU, J.-C. 1079. Compte-rendu de la campagne MD.08-benthos (7 Mars-26 Avril 1976): liste des stations et données scientifiques générales. *Comité National Français des Recherches Antarctiques* 44: 1-37.
- ATTWOOD, C.G. & HEARSHAW, K.D. 1992. Lipid content and composition of sub-Antarctic euphausiids and copepods from the Prince Edward Islands. *South African Journal of Antarctic Research* 22: 3-13.
- ATTWOOD, C.G., LUCAS, M.I., PROBYN, T.A., McQUAID, C.D. & FIELDING, P.J. 1991. Production and standing stocks of the kelp *Macrocystis laevis* Hay at the Prince Edward Islands, Sub-Antarctic. *Polar Biology* 11: 129-133.
- BAKER, A. de C., BODEN, B.P. & BRINTON, E. 1990. The euphausiids of the world. London: Natural History Museum Publications.
- BALARIN, M.G. 1999. Size fractionated phytoplankton biomass and primary production in the Southern Ocean. MSc thesis, Rhodes University, Grahamstown, South Africa. 108 pp.
- BARANGE, M., PAKHOMOV, E.A., PERISSINOTTO, R., FRONEMAN, P.W., VERHEYE, H.M., TAUNTON-CLARK, J. & LUCAS, M.I. 1998. Pelagic community of the Subtropical Convergence region south of Africa and in the mid-Atlantic Ocean. *Deep-Sea Research* I 45: 1663-1687.
- BARENDSE, J., MERCER, R.D., MARSHALL, D.J. & CHOWN, S.L. 2002. Habitat specificity of mites on sub-Antarctic Marion Island. *Environmental Entomology* 31: 612-625.
- BECKLEY, L. & BRANCH, G.M. 1992. A quantitative SCUBA-diving survey of the sublittoral macrobenthos at sub-Antarctic Marion Island. *Polar Biology* 11: 553-563.
- BELLAN-SANTINI, D. & LEDOYER, M. 1986. Gammarids (Crustacea: Amphipoda) of Marion and Prince Edward Islands South Africa expedition MD 08 of the M.S. Marion Dufresne in 1976. Bolletino del Museo Civico di Storia Naturale di Verona 13: 349-436.
- BENON, P. & MURAIL, J.F. 1979. Hydrologie des Plateformes periinsulaires des Îles Crozet, Marion et Prince Edward. *Comité National Français des Recherches Antarctiques* 44: 39-60.

- BERGSTROM, D. &. CHOWN, S.L. 1999. Life at the front: history, ecology and change on southern ocean islands. *Trends in Ecology and Evolution*, 14, 472–77.
- BERGH, H.W. & NORTON, I.O. 1976. Prince Edward Fracture Zone and the evolution of the Mozambique Basin. *Journal of Geophysical Research* 81: 5221-5239.
- BERNARD, K.S. & FRONEMAN, P.W. 2002. Mesozooplankton community structure in the Southern Ocean upstream of the Prince Edward Islands. *Polar Biology* 25: 597-604.
- BERNARD, K.S. & FRONEMAN, P.W. 2003. Mesozooplankton community structure and grazing impact in the Frontal Zone, Southern Ocean, during austral autumn 2002. *Polar Biology* 26: 268-275.
- BERNARD, K.S. & FRONEMAN, P.W. IN PRESS. Mesozooplankton community structure and grazing impact in the west-Indian sector of the Polar Frontal Zone, Southern Ocean, during austral autumn 2004. *Polar Biology.*
- BERNASCONI, I. 1968. Equinodermos de las islas Marion y Principe Eduardo con descripcion de una nueva especie de Olfiuroideo. *Physis (Buenos Aires)* 28: 55-58.
- BERNASCONI, I. 1971. Echinodermata. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 284-287.
- BERRUTI, A. & HARCUS, T. 1978. Cephalopod prey of the sooty albatrosses *Phoebetria fusca* and *P. palpebrata* at Marion Island. *South African Journal of Antarctic Research* 8: 99-103.
- BERRUTI, A. & KERLEY, G.I.H. 1985. Carcase competition and diving ability of giant petrels, *Macronectes* spp. *South African Journal of Science* 81: 701.
- BESTER, M.N. 1981. The effect of the Subantarctic environment on aspects of the terrestrial phase of fur seal populations. *Comité National Française des Recherche Antarctiques* 51: 469-478.
- BESTER, M.N. 1983. Motivation for satellite tracking of Southern Elephant Seals *Mirounga leonina* at sea. In: Proceedings of the VIIIth Argos Users' Conference London, September 1983. pp. 216-227.
- BESTER, M.N. 1984. Status of the populations of the fur seals *Arctocephalus tropicalis* and *Arctocephalus gazella* north of the Antarctic Convergence. *South African Journal of Science* 80: 27-28.
- BESTER, M.N. 1989. Movements of Southern Elephant Seals and Subantarctic Fur Seals in relation to Marion Island. *Marine Mammal Science* 5: 257-265.
- BESTER, M.N. & BARTLETT, P.A. 1990. Attendance behaviour of Antarctic and Subantarctic Fur Seal females at Marion Island. *Antarctic Science* 2: 309-312.
- BESTER, M.N. & HOFMEYR, G.J.G. 2005. Numbers of elephant seals at Prince Edward Island, Southern Ocean. *South African Journal of Wildlife Research* 35: 85-88.
- BESTER, M.N. & JOUVENTIN, P. 1984. Rationale and strategy for a collaborative research programme between SASCAR and TAAF on pinnipeds inhabiting South Indian Ocean islands (the Kerguelen Province). *South African Journal of Science* 80: 32-33.
- BESTER, M.N. & PANSEGROUW, H.M. 1992. Ranging behaviour of Southern Elephant Seal cows from Marion Island. *South African Journal of Science* 88: 574-575.

- BESTER, M.N. & SKINNER, J.D. 1991. South African research on Antarctic seals. *South African Journal of Antarctic Research* 21: 165-166.
- BESTER, M.N. & VAN JAARSVELD, A.S. 1997. Growth in Subantarctic Fur Seal pups as a possible indicator of offshore food availability. In: Hindell, M. & Kemper, C.S. (Eds). Marine mammal research in the Southern Hemisphere. Vol 1. Chipping Norton: Surrey Beatty & Sons. pp. 88-91.
- BESTER, M.N. & WILKINSON, I.S. 1994. Population ecology of Southern Elephant Seals *Mirounga leonina* at Marion Island. In: Le Boeuf, B.J. & Laws, R.M. (Eds). Elephant seals; population ecology, behavior, and physiology. Xx: University of California Press. pp. 85-97.
- BESTER, M.N., KEITH, M. & PISTORIUS, P.A. 2002. Killer Whales at Marion Island, Southern Ocean. In: Fourth International Orca Symposium and Workshop, 23-28 September 2002, CEBC-CNRS, Villiers en Bois, France. pp. 35-39.
- BESTER, M.N., KEITH, M., PISTORIUS, P.A. & McMAHON, C. 2003. Killer Whales and elephant seals at Marion Island. In: Current Trends in Zoology and Limnology in Southern Africa. Joint Conference of SASAQS & ZSSA./, 30 June 4 July 2003. Abstracts booklet. p. 23.
- BESTER, M.N., KEITH, M., PISTORIUS, P.A. & McMAHON, C. 2003. Killer Whales and elephant seals at Marion Island, possible effect of predation on a small population. In: Programme and Abstracts 3rd International Wildlife Management Congress, 1-5 December 2003, Christchurch, New Zealand. p. 473.
- BESTER, M.N., RYAN, P.G. & DYER, B.M. 2003. Population numbers of fur seals at Prince Edward Island, Southern Ocean. *African Journal of Marine Science* 25: 549-554.
- BIRDLIFE INTERNATIONAL 2004. Tracking ocean wanderers: the global distribution of albatrosses and petrels. Results from the Global Procellariiform Tracking Workshop. 1-5 September 2003, Gordon's Bay, South Africa. Cambridge: BirdLife International. 100 pp.
- BLANKLEY, W.O. 1981. Marine food of Kelp Gulls, Lesser Sheathbills and Imperial Cormorants at Marion Island (Subantarctic). *Cormorant* 9: 77-84.
- BLANKLEY, W.O. 1982. The intertidal and shallow subtidal food web of sub-Antarctic Marion Island. MSc thesis, University of Cape Town, Rondebosch, South Africa. 128 pp.
- BLANKLEY, W.O. 1982. Feeding ecology of three inshore fish species at Marion Island (Southern Ocean). *South African Journal of Zoology* 17: 146-170.
- BLANKLEY, W.O. 1984. Ecology of the starfish *Anasterias rupicola* (Verrill) (Asteroidea) at Marion Island (S-outhern Ocean). *Marine Ecology Progress Series* 18: 131-137.
- BLANKLEY, W.O. 1984. Co-operative prey capture and unusual brooding habits of *Anasterias* rupicola (Verrill) (Asteroidea) at sub-Antarctic Marion Island. *Marine Ecology Progress Series* 20: 171-176.
- BLANKLEY, W.O. & BRANCH, G.M. 1985. Ecology of the limpet *Nacella delesserti* at Marion Island in the sub-Antarctic Southern Ocean. *Journal of Experimental Marine Biology and Ecology* 92: 259-281.
- BLANKLEY, W.O. & GRINDLEY, J.R. 1985. The intertidal and shallow subtidal food web at Marion Island. In: Siegfried, W.R., Condy, P.R. & Laws, R.M. (Eds). Antarctic nutrient cycles and food webs. Berlin: Springer-Verlag. pp. 630-636.

- BODEN, B.P. 1988. Phytoplankton around the Prince Edward Archipelago and possible island mass effect. *Phycological Society of South Africa* 20: 3.
- BODEN, B.P. 1988. Observations of the island mass effect in the Prince Edward Archipelago. *Polar Biology* 9: 61-68.
- BODEN, B. & PARKER, L. 1986. The plankton of the Prince Edward Islands. *Polar Biology* 5: 81-93.
- BODEN, B.P. & REID, F.M.H. 1989. Marine plankton diatoms between Cape Town and the Prince Edward Islands (SW Indian Ocean). *South African Journal of Antarctic Research* 19: 2-49.
- BODEN, B.P., DUNCOMBE RAE, C.M. & LUTJEHARMS, J.R.E. 1988. The distribution of the diatoms of the south-west Indian Ocean surface waters between Cape Town and the Prince Edward Islands archipelago. *South African Journal of Science* 84: 811-818.
- BOREN, L. J, GEMMEL, N. J. & BARTON, K. J. (2002) Tourist disturbance on New Zealand fur seals, *Arctocephalus forsteri*. Australian Mammalogy 24: 85-95
- BRANCH, G.M. 1985. The impact of predation by Kelp Gulls *Larus dominicanus* on the Sub-Antarctic Limpet *Nacella delesserti*. *Polar Biology* 4: 171-177.
- BRANCH, G.M., ATTWOOD, C.G, GIANAKOURAS, D. & BRANCH, M.L. 1993. Patterns in the benthic communities on the shelf of the subantarctic Prince Edward Islands. *Polar Biology* 13: 23-34.
- BRANCH, M.L. 1994. The Polychaeta of subantarctic Marion and Prince Edward Islands: illustrated keys to the species and results of the 1982-1989 University of Cape Town surveys. *South African Journal of Antarctic Research* 24: 3-52.
- BRANCH, M.L. 1994. The benthic invertebrate fauna of subantarctic Marion and Prince Edward Islands. MSc thesis, University of Cape Town, Rondebosch, South Africa. xxx pp.
- BRANCH, M.L. 1998. Four new species of Polychaeta from subantarctic Marion Island. *Annals of the South African Museum* 105: 249-264.
- BRANCH, G.M., ATTWOOD, C.G, GIANAKOURAS, D. & BRANCH, M.L. 1993. Patterns in the benthic communities on the shelf of the subantarctic Prince Edward Islands. *Polar Biology* 13: 23-34.
- BRANCH, M.L. & WILLIAMS, G.C. 1993. The Hydrozoa, Octocorallia and Scleractina of subantarctic Marion and Prince Edward Islands: illustrated keys to the species and results of the 1982-1989 University of Cape Town surveys. *South African Journal of Antarctic Research* 23: 3-24.
- BRANCH, M.L., ARNAUD, P.M., CANTERA, J. & GIANAKOURAS, D. 1991. The benthic Mollusca and Brachiopoda of subantarctic Marion and Prince Edward Islands: 1) Illustrated keys to the species 2) Records of the 1982-1989 University of Cape Town surveys. *South African Journal of Antarctic Research* 21: 45-64.
- BRANCH, M.L., GRIFFITHS, C.L., KENSLEY, B. & SIEG, J. 1991. The benthic Crustacea of subantarctic Marion and Prince Edward Islands: illustrated keys to the species and results of the 1982-1989 University of Cape Town surveys. *South African Journal of Antarctic Research* 21: 3-44.
- BRANCH, M.L., JANGOUX, M., ALVÁ, V. & STAMPANATO, S. 1993. The Echinodermata of subantarctic Marion and Prince Edward Islands. *South African Journal of Antarctic Research* 23: 37-70.

- BRÃNDAO, A. & BUTTERWORH, D.S 2004. Updated ASPM assessment of the toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands vicinity. CCAMLR-WG-FSA-04/37. 24 pp.
- BRÃNDAO, A., WATKINS, B.P., BUTTERWORTH, D.S. & MILLER, D.G.M. 2002. A first attempt at an assessment of the Patagonian Toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands EEZ. *CCAMLR Science* 9: 11-32.
- BROOKE, M.deL. & KLAGES, N.[T.W.] 1986. Squid beaks regurgitated by Greyheaded and Yellownosed Albatrosses *Diomedea chrysostoma* and *D. chlororhynchos* at the Prince Edward Islands. *Ostrich* 57: 203-206.
- BROWN, C.R. 1987. Ecological energetics of *Eudyptes* penguins at Marion Island. PhD thesis, University of Cape Town, Rondebosch, South Africa. 207 pp.
- BROWN, C.R. 1987. Traveling speed and foraging range of Macaroni and Rockhopper Penguins at Marion Island. *Journal of Field Ornithology* 58: 118-125.
- BROWN, C.R. 1989. Energy requirements and food consumption of *Eudyptes* penguins at the Prince Edward Islands. *Antarctic Science* 1: 15-21.
- BROWN, C.R. & ADAMS, N.J. 1983. The effect of underwater explosions on Rockhopper Penguins *Eudyptes chrysocome. Cormorant* 11: 68.
- BROWN, C.R. & KLAGES, N.T.[W.] 1987. Seasonal and annual variation in diets of Macaroni (*Eudyptes chrysolophus*) and Southern Rockhopper (*Eudyptes chrysocome chrysocome*) Penguins at sub-Antarctic Marion Island. *Journal of Zoology, London* 212: 7-28.
- BROWN, C.R, KLAGES, N.T.[W.] & ADAMS, N.J. 1990. Short and medium-term variation in the diets of penguins at Marion Island. *South African Journal of Antarctic Research* 20: 13-20.
- BURGER, A.E. 1978. Notes on Antarctic Terns at Marion Island. Cormorant 4: 30-32.
- BURGER, A.E. 1981. Food and foraging behaviour of Lesser Sheathbills at Marion Island. *Ardea* 69: 167-180.
- BURTON, H.R., ARNBOM, T., BOYD, I.L., BESTER, M., VERGANI, D. & WILKINSON, I. 1997. Significant differences in weaning mass of Southern Elephant Seals from five sub-Antarctic islands in relation to population declines. In: Battaglia, B., Valencia, J. & Walton, D.W.H. (Eds). Antarctic communities: species, structure and survival. Berlin: Springer-Verlag. pp. 335-338.
- CCAMLR 2005a. *Marine Protected Areas in the context of CCAMLR*. A Management Tool for the Southern Ocean. CCAMLR Marine Protected Areas (MPA) Workshop, Silver Spring, Maryland, USA. 29 August-1 September 2205. WS-MPA-05/4.
- CCAMLR 2005b. Report of the 24th meeting of the Commisssion. Hobart, Austrailia: CCAMLR. www.ccamlr.org
- CHOWN. S.L., & FRONEMAN, P.W. eds. In press. The Prince Edward Archipelago. Land-sea interactions in a changing eco-system. Stellenbosch: Sun Media.
- CHOWN, S.L., RODRIGUES, S.L., GREMMEN, N.J.M. & GASTON, K..J. 2001. World Heritage status and conservation of southern ocean islands. *Conservation Biology*, 15, 550-557.

- CLÉRET, J.J. 1971. Isopoda. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 379-383.
- COETZEE, L. 2000. A new subspecies of *Halozetes belgicae* (Acari, Oribatida, Ameronothridae) from the marine supra-littoral of the sub-Antarctic Marion Island. *Acarologia (Paris)* 40: 439-447.
- CONDY, P.R. 1978. The distribution and abundance of Southern Elephant Seals *Mirounga leonina* (Linn.) on the Prince Edward Islands. *South African Journal of Antarctic Research* 8: 42-48.
- CONDY, P.R. 1978. The distribution, abundance and annual cycle of fur seals *Arctocephalus* spp. on the Prince Edward Islands. *South African Journal of Wildlife Research* 8: 159-168.
- CONDY, P.R. 1981. Annual food consumption and seasonal fluctuations in biomass of seals at Marion Island. *Mammalia* 45: 21-30.
- CONDY, P.R. 1984. The population of Southern Elephant Seals *Mirounga leonina* at Marion Island. *South African Journal of Wildlife Research* 10-: 118-122.
- CONDY, P.R. & BURGER, A.[E.] 1975. A Southern Right Whale at Marion Island. *South African Journal of Science* 71: 349.
- CONDY, P.R., VAN AARDE, R.J. & BESTER, M.N. 1978. The seasonal occurrence and behaviour of Killer Whales *Orcinus orca*, at Marion Island. *Journal of Zoology, London* 184: 449-464.
- COOPER, G.A. 1981. Brachiopoda from the southern Indian Ocean. *Smithsonian Contributions in Paleobiology* 16: 1-43.
- COOPER, J. 1984. Rarely reported seabirds at the Prince Edward Islands, June 1981 November 1983. *Cormorant* 12: 49-54.
- COOPER, J. 1985. Foraging behaviour of nonbreeding Imperial Cormorants at the Prince Edward Islands. *Ostrich* 56: 96-100.
- COOPER. J. 1986. Diving patterns of cormorants Phalacrocoracidae. Ibis 128: 562-570.
- COOPER, J. & BROOKE, R.K. 1981. A bibliography of seabirds in the waters of southern Africa, the Prince Edward and Tristan groups. *South African National Scientific Programmes Report* No. 48. 297 pp.
- COOPER, J. & BROWN, C.R.. 1990. Ornithological research at the sub-Antarctic Prince Edward Islands: a review of achievements. *South African Journal of Antarctic Research* 20: 40-57.
- COOPER, J. & CONDY, P.R. 1988. Environmental conservation at the sub-Antarctic Prince Edward Islands: a review and recommendations. *Environmental Conservation* 15: 317-326.
- COOPER, J. & KLAGES, N.T.W. 1995. The diets and dietary segregation of sooty albatrosses (*Phoebetria* spp.) at subantarctic Marion Island. *Antarctic Science* 7: 15-23.
- COOPER, J. & WEIMERSKIRCH, H. 2003. Exchange of Wandering Albatrosses *Diomedea exulans* between the Prince Edward and Crozet Islands: implications for conservation. *African Journal of Marine Science* 25: 519-523.
- COOPER, J., AVENANT, N.L. & VAN WYK, J.VC.P. 1994. Observations on the Shortsnout Lancetfish *Alepisaurus brevirostris* at sub-Antarctic Marion Island. *South African Journal of Antarctic Research* 24: 126.

- COOPER, J., FOURIE, A. & KLAGES, N.T.W. 1992. The diet of the Whitechinned Petrel *Procellaria aequinoctialis* at sub-Antarctic Marion Island. *Marine Ornithology* 20: 17-24.
- COOPER, J., HENLEY, S.R. & KLAGES, N.T.W. 1992. The diet of the Wandering Albatross *Diomedea exulans* at subantarctic Marion Island. *Polar Biology* 12: 477-484.
- COOPER, J., WILSON, R.P. & ADAMS, N.J. 1993. Timing of foraging by the Wandering Albatross Diomedea exulans. Proceedings of the National Institute of Polar Research Symposium on Polar Biology 6: 55-61.
- COOPER, J., WOLFAARDT, A.C. & CRAWFORD, R.J.M. 1997. Trends in population size and breeding success at colonies of Macaroni and Rockhopper Penguins, Marion Island, 1979/80-1995/96. *CCAMLR Science* 4: 89-103.
- CRAFFORD, J.E. 1984. Life cycle and kelp consumption of *Paractora dreuxi mirabilis* (Diptera: Helcomyzidae): a primary decomposer of stranded kelp at Marion Island. *South African Journal of Antarctic Research* 14: 18-22.
- CRAFFORD. J.E. & SCHOLTZ, C.H. 1987. The phenology of stranded kelp degradation by the Kelp Fly *Paractora dreuxi mirabilis* (Helcomyzidae) at Marion Island. *Polar Biology* 7: 289-294.
- CRAFFORD, J.E., SCHOLTZ, C.H. & CHOWN, S.L. 1986. The insects of sub-Antarctic Marion and Prince Edward Islands, with a bibliography of entomology of the Kerguelen Biogeographical Province. *South African Journal of Antarctic Research* 16: 42-84.
- CRAWFORD, A.B. 1952. The birds of Marion Island, south Indian Ocean. *Emu* 52: 73-85 + three pages of plates.
- CRAWFORD, R.[J.M.] 2004. Seabirds and seals at the Prince Edward Islands. *Research Highlights* 2002-2003 12: 43-45
- CRAWFORD, R.J.M. & COOPER, J. 2003. Conserving surface-nesting seabirds at the Prince Edward Islands: the roles of research, monitoring and legislation. *African Journal of Marine Science* 25: 415-426.
- CRAWFORD, R.J.M., COOPER, J. & DYER, B.M. 2003. Population of the Macaroni Penguin *Eudyptes chrysolophus* at Marion Island, 1994/95-2002/03, with observations on breeding and diet. *African Journal of Marine Science* 25: 475-486.
- CRAWFORD, R.J.M., COOPER, J., DU TOIT, M., GREYLING, M.D., HANISE, B., HOLNESS, C.L., KEITH, D.G., NEL, J.L., PETERSEN, S.L., SPENCER, K., TSHINGANA, D. & WOLFAARDT, A.C. 2003. Population and breeding of the Gentoo Penguin *Pygoscelis papua* at Marion Island, 1994/95-2002/03. *African Journal of Marine Science* 25: 463-474.
- CRAWFORD, R.J.M., COOPER, J., DYER, B.M., GREYLING, M.D., KLAGES, N.T.W., NEL, D.C., NEL, J.L., PETERSEN, S.L. & WOLFAARDT, A.C. 2003. Decrease in numbers of the Eastern Rockhopper Penguin *Eudyptes chrysocome filholi* at Marion Island, 1994/95-2002/03. *African Journal of Marine Science* 25: 487-498.
- CRAWFORD, R.J.M., COOPER, J., DYER, B.M., GREYLING, M.D., KLAGES, N.T.W., RYAN, P.G., PETERSEN, S.L., UNDERHILL, L.G., UPFOLD, L., WILKINSON, W., DE VILLIERS, M.S., DU PLESSIS, S., DU TOIT, M., LESHORO, T.M., MAKHADO, A.B., MASON, M., MERKLE, D., TSHINGANA, D., WARD, V.L. & WHITTINGTON, P.A. 2003. Populations of surface-nesting seabirds at Marion Island, 1994/95-2002/03. *African Journal of Marine Science* 25: 427-440.

- CRAWFORD, R.J.M., COOPER, J., DYER, B.M., WOLFAARDT, A.C., TSHINGANA, D., SPENCER, K., PETERSEN, S.L., NEL, J.L., KEITH, D.G., HOLNESS, C.L., HANISE, B., GREYLING, M.D. & DU TOIT, M. 2003. Population, breeding, diet and conservation of the Crozet Shags *Phalacrocorax [atriceps] melanogenis* at Marion Island, 1994/95-2002/03. *African Journal of Marine Science* 25: 537-547.
- CRAWFORD, R.J.M., DUNCOMBE RAE, C.M., NEL, D.C. & COOPER, J. 2003. Unusual breeding by seabirds at Marion Island during 1997/98. *African Journal of Marine Science* 25: 453-462.
- CRUIKSHANK, R.A. & BROWN, S.G. 1981. Recent observations and some historical records of Southern Right Whale Dolphins *Lissodelphis peronii. Fisheries Bulletin South Africa* 15: 109-122.
- CUTRESS, C.E. 1971. Actinaria.. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 409-410.
- DAVID, P. 1979. Les elements nutitifs des eaux bordant les Îles Marion et Crozet (Sud-Ouest de l'océan Indien). *Comité National Français des Recherches Antarctiques* 44: 61-78.
- DAVIDSON, T. 1880. Report on the Brachiopodea dredged by the HMS Challenger during the years 1873-1876. Reports of the Scientific Results of the Voyage of the Challenger (Zoology) 1: 1-67.
- DAY, J.H. 1971. Polychaeta. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 384-390.
- DE RIDDER, C, DAVID, B. & LARAIN, A. 1993. Antarctic and Subantarctic echinoids from "Marion Dufresne" expeditions MD03, MD04, MD08 and from the "Polarstern" expedition Epos III. Bulletin du Museum National d'Histoire Naturelle Section A Zoologie Biologie et Ecolgie Animales 14: 404-441.
- DE VILLIERS, A.F. 1976. Littoral ecology of Marion and Prince Edward Islands (Southern Ocean). South African Journal of Antarctic Research. Supplement 1: 40 ,pp.
- DE VILLIERS, A.F. & ROSS, G.J.B. 1976. Notes on numbers and distribution of fur seals Arctocephalus tropicalis (Gray), on Marion and Prince Edward Islands, Southern Ocean. Journal of Mammalogy 57: 595-600.
- DICKIE, G. 1877. Algae collected by Mr Moseley at Marion Island in 40 fathoms. *Journal of the Linnean Society (Botany)* 15: 42-43.
- DOLLFUS, R.P. 1971. Hirudinea. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 394-395.
- DREYER, A.J. 1961. Air and sea temperatures for Marion Island. *South African Weather Bureau Newsletter* 151: 162-164.
- DUNCOMBE RAE, C.M. 1989. Data report of the first cruise of the Marion Offshore Ecological Study (MOES-1). South African National Scientific Programmes Report No. 159. 384 pp.
- DUNCOMBE RAE, C.M. 1989. Frontal systems encountered between southern Africa and the Prince Edward Islands during April/May 1987. *South African Journal of Antarctic Research* 19: 21-25.

- DUNCOMBE RAE, C.M. 1989. Physical and chemical marine environment of the Prince Edward Islands during April/May 1987. *South African Journal of Marine Science* 8: 301-311.
- EL-SAYED, S.Z 1976. Biological oceanographic investigations during the "Marion-Dufresne" cruise 08. Antarctic Journal of the United States 11: 184-186.
- EL-SAYED, S.Z. 1979. Recherches sur la productivité primaire au cours de la campagne MD.08. Comité National Française des Recherches Antarctiques 44: 79-82.
- EL-SAYED, S.Z. BENON, P., DAVID, P., GRINDLEY, J.R. & MURAIL, J.F. 1979. Some aspects of the biology of the water column studied during the "Marion-Dufresne" cruise 08. *Comité National Française des Recherches Antarctiques* 44: 127-134.
- EL-SAYED, S.Z., STOCKWELL, D.A., REHEIM, A., TAGUCHY, S. & MEY. M.A. 1979. On the productivity of the southwestern Indian Ocean. *Comité National Française des Recherches Antarctiques* 44: 83-110.
- ENGELBRECHT, C.M. 1974. The genus *Halozetes* (Oribatei: Acari) on Marion Island. *Navorsinge van die Nasionale Museum, Bloemfontein* 3: 1-25.
- ENTICOTT, J.W. 1986. Distribution of penguins at sea in the southeastern Atlantic and southwestern Indian Oceans. *Cormorant* 13: 118-142.
- ENTICOTT, J.W. 1986. Associations between seabirds and cetaceans in the African Sector of the Southern Ocean. *South African Journal of Antarctic Research* 16: 25-28.
- ENVIRONEMNT AUSTRALIA. 2001. *Macquarie Island Marine Park Management Plan.* Canberra: Department of the Environment and Heritage.
- ENVIRONMWENT AUSTRALIA. 2005. Heard Island and McDonald Island Marine Reserve Management Plan. Canberra: Department of the Environment and Heritage.
- ESPITALIER-NOËL, G., ADAMS, N.J. & KLAGES, N.T.[W.] 1988. Diet of the Imperial Cormorant *Phalacrocorax atriceps* at sub-Antarctic Marion Island. *Emu* 88: 43-46.
- FISCHER, D., HEYDENRICH, R., COOPER, J. & BESTER, M.N. 2006. *Prince Edward Islands: World Heritage Nomination.* Pretoria: Department of Environmental Affairs & Tourism.
- FRENOT, Y., CHOWN, S.L., WHINAM, J., SELKIRK, P.M., CONVEY, P., SKOTNICKI, M, & BERGSTROM, D.M. 2005. Biological invasions in the Antarctic: extents, impacts and implications. *Biological Review*, 80, 45-72.
- FRONEMAN, P.W. & ANSORGE, I.J. 1998. The third Marion Island Oceanographic Study (MIOS III) conducted during April and May 1998. *South African Journal of Science* 94: 437-440.
- FRONEMAN, P.W. & BALARIN, M.G. 1998. Structure and grazing impact of the protozooplankton community in the waters surrounding the Prince Edward Islands (Southern Ocean). *Polar Biology* 20: 198-205.
- FRONEMAN, P.W. & PAKHOMOV, E.A. 1998. Biogeographic study of the planktonic communities of the Prince Edward Islands. *Journal of Plankton Research* 20: 653-669.
- FRONEMAN, P.W., PAKHOMOV, E.A. 1998. Trophic importance of the chaetognaths *Eukrohnia hamata* and *Sagitta gazellae* in the pelagic subsystem of the Prince Edward Islands (Southern Ocean). *Polar Biology* 19: 242-249.

- FRONEMAN, P.W. & PAKHOMOV, E.A. 2000. Spatial and temporal variability in chlorophyll-a and diatom distribution in the south-east Indian Ocean. *Vie et Milieu* 50: 275-288.
- FRONEMAN, P.W. & PERISSINOTTO, R. 1996. Microzooplankton grazing in the Southern Ocean: implications for the carbon cycle. *PSZNI: Marine Ecology* 17: 99-15.
- FRONEMAN, P.W., ANSORGE, I.J., PAKHOMOVO, [sic] E.A. & LUTJEHARMS, J.R.E. 1999. Plankton community structure in the physical environment surrounding the Prince Edward Islands (Southern Ocean). *Polar Biology* 22: 145-155.
- FRONEMAN, P.W., ANSORGE, I.J., VUMAZONKE, L. GULEKANA, K., BERNARD, K., WEBB, A.M., LEUKES, W., RISIEN, C.M., THOMALLA, S., HERMES, J., KNOTT, M., ANDERSON, D., HARGEY, N., JENNINGS, M., VEITCH, J., LUTJEHARMS, J.R.E. & McQUAID, C.[D.] 2002. Physical and biological variability in the Antarctic Polar Frontal Zone: report on the research cruise 104 of the M.V. S.A. Agulhas. South African Journal of Science 98: 534-536.
- FRONEMAN, P.W., McQUAID, C.D. & LAUBSCHER, R.K. 1999. Size-fractionated primary production studies in the vicinity of the Subtropical Convergence and an adjacent warm-core eddy. *Journal of Plankton Research* 21: 2109-2035.
- FRONEMAN, P.W, McQUAID, C.D. & PERISSINOTTO, R. 1995. Biogeographic structure of the microphytoplankton assemblages of the south Atlantic and Southern Ocean during austral summer. *Journal of Plankton Research* 17: 1791-1802.
- FRONEMAN, P.W. & McQUAID, C.D. In press. Biology of the oceanographic environment. In CHOWN. S.L. & FRONEMAN, P.W., eds. The Prince Edward Archipelago. Land-sea interactions in a changing eco-system. Stellenbosch: Sun Media.
- FRONEMAN, P.W., PAKHOMOV, E.A., GURNEY, L.J. & HUNT, B.P.V. 2002. Predation impact of carnivorous macrozooplankton in the vicinity of the Prince Edward Island archipelago (Southern Ocean) in austral summer 1998. *Deep-Sea Research* II 49: 3243-3254.
- FRONEMAN, P.W., PAKHOMOV, E.A. & MEATON, V. 1998. Observations on the association between the diatom *Fragilariopsis doliolus* Wallich and the tintinnid *Salpingella subconica* Kafoid. *South African Journal of Science* 94: 202.
- FRONEMAN, P.W., PAKHOMOV, E.A. & MEATON, V. 1998. Surface distribution of microphytoplankton of the south-west Indian Ocean along a repeat transect between Cape Town and the Prince Edward Islands. *South African Journal of Science* 94: 124-129.
- FRONEMAN, P.W., PAKHOMOV, E.A. & TREASURE, A. 2000. Trophic importance of the hyperiid amphipod, *Themisto gaudichaudi*, in the Prince Edward Archipelago (Southern Ocean) ecosystem. *Polar Biology* 23: 429-436.
- FRONEMAN, P.W., PAKHOMOV, E.A., PERISSINOTTO, R. & MEATON, V. 1998. Community structure and predation impact of two chaetognath species, *Eukrohnia hamata* and *Sagitta gazellae*, in the vicinity of Marion Island (Southern Ocean). *Marine Biology* 131: 95-101.
- FRONEMAN, P.W., PERISSINOTTO, R. & McQUAID, C.D. 1996. Seasonal variations in microzooplankton grazing in the region of the Subtropical Convergence. *Marine Biology* 126: 433-442.
- FRONEMAN, P.W., PERISSINOTTO, R. & PAKHOMOV, E.A. 1997. Biogeographical structure of the microphytoplankton assemblages in the region of the Subtropical Convergence and across a warm-core eddy during austral winter. *Journal of Plankton Research* 19: 519-531.

- FROST, P.G.H. 1979. Recherches ornithologiques au cours de la campagne du M/S Marion-Dufresne, Mars-Avril 1976. *Comité National Française des Recherches Antarctiques* 44: 155-157.
- FROST, P.G.H 1979. Seabird distribution and the transport of nutrients from marine to terrestrial ecosystems. *South African Journal of Antarctic Research* 9: 20-27.
- FROST, P.G.H. & BEST, P.B. 1976. Design and application of a coded format for recording observations of cetaceans at sea. South African Journal of Antarctic Research 6: 9-14.
- FROST, P.G.H., GRINDLEY, J.R & WOOLDRIDGE, T.H. 1976. Report on South African participation in cruise MD08 of MS Marion Dufresne, March-April 1976. *South African Journal of Antarctic Research* 6: 28-29.
- FULLER, N.R. 1967. A preliminary report on the littoral ecology of Marion and Prince Edward Islands. *South African Journal of Science* 63: 248-252.
- GAILLARD, J.M. 1971. Mollusca. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 291-300.
- GARTSHORE, N.A. 1987. Rare bird sightings at the Prince Edward Islands, December 1983 May 1987. *Cormorant* 15: 48-58.
- GARTSHORE, N.A., STEELE, W.K. & KALGES, N.T[W.] 1988. Summer diet of the Salvin's Prion at sub-Antarctic Marion Island. *South African Journal of Zoology* 23: 309-313.
- GJERDE, K.& BREIDE, C. eds. 2003. Towards a strategy for High Seas Marine Protected Areas. Proceedings of the IUCN, WCPA and WWF experts Workshop on High Seas Marine Protected Areas 15-17 January 2003, Malaga, Spain. World Conservation Union: Gland.
- GILLET, P. 1991. Biogeography and polychaetes assemblages from sub-Antarctic islands (Indian Ocean) *Marion Dufresne* MD 08 benthos expedition to Marion, Prince Edward and Crozet Islands. *Bulletin of Marine Science* 48: 358-368.
- GILLET, P. 1999. A new species of *Orbiniella* (Orbiniidae: Polychaeta) from Marion Island, Indian Ocean. *Proceedings of the Biological Society of Washington* 112: 592-597.
- GON, O. 1989. Antarctic ichthyology in South Africa: past, present and future. *South African Journal of Science* 85: 39-40.
- GON, O. & HEEMSTRA, P.C. (EDS) 1990. Fishes of the Southern Ocean. Johannesburg: Macmillan South Africa. 462 pp.
- GON, O. & KLAGES. N. [T.W.] 1988. The marine fish fauna of the sub-Antarctic Prince Edward Islands. *South African Journal of Antarctic Research* 18: 32-54.
- GON, O. & MOSTERT, D. 1992. Aspects of the ecology of two nototheniid fish species in the inshore zone of the sub-Antarctic Marion Island. *South African Journal of Antarctic Research* 22: 59-67.
- GON, O., HENDRY, D.A & MOSTERT, D. 1994.Glycoprotein antifreeze in *Notothenia coriiceps* (Pisces: Nototheniidae) from the sub-Antarctic Marion Island. *South African Journal of Antarctic Research* 24: 53-56.
- GRIFFITHS, A.M. 1982. Dispersion of seabirds at sea in the Southern Ocean. MSc thesis, University of Cape Town, Rondebosch, South Africa. 75 pp.

- GRIFFITHS, A.M. 1982. Observations of pelagic seabirds feeding in the African Sector of the Southern Ocean. *Cormorant* 10: 9-14.
- GRIFFITHS, A.M. & SINCLAIR, J.C. 1982. The occurrence of Holarctic seabirds in the African Sector of the Southern Ocean. *Cormorant* 10: 35-44.
- GRIMALDI, S.D., D'ADDABBO, M.G. & PIETANZA, R. 2000. Two new sub-Antarctic Echiniscoididae from Marion Island. *Italian Journal of Zoology* 67: 221-228.
- GRINDLEY, J.R. 1971. *Tigriopus angulatus* Lang. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 273-378.
- GRINDLEY, J.R. 1978. Marine ecosystems of Marion Island. *South African Journal of Antarctic Research* 8: 38-42.
- GRINDLEY, J.R. 1981. Observations of seabirds at Marion and Prince Edward Islands in April and May 1973. In: Cooper, J. (Ed.). Proceedings of the Symposium on Birds of the sea and Shore, 1979. Cape Town: African Seabird Group. pp. 169-188.
- GRINDLEY, J.R. & DAVID, P. 1985. Nutrient upwelling and its effects in the lee of Marion Island. In: Siegfried, W.R., Condy, P.R. & Laws, R.M. (Eds). Antarctic nutrient cycles and food webs. Berlin: Springer-Verlag. pp. 294-303.
- GRINDLEY, J.R. & LANE, S.B. 1979. Zooplankton around Marion and Prince Edward Islands. *Comité National Française des Recherche Antarctiques* 44: 111-125.
- GRÜNDLINGH, M.L. 1994. Surface wave conditions at Marion Island. South African Journal of Antarctic Research 24: 95-101.
- GÜNTHER, A. 1880. Report on the shore fishes. Scientific results of the voyage of H.M.S. *Challenger* during the years 1873-1876. *Challenger Reports Zoology* 1(6): 1-82.
- GURNEY, L.J. 2000. Feeding biology of three euphausiid species in the vicinity of the Prince Edward Archipelago (Southern Ocean). MSc thesis, Rhodes University, Grahamstown, South Africa. 105 pp.
- GURNEY, L.J., FRONEMAN, P.W., PAKHOMOV, E.A. & McQUAID, C.D. 2001. Trophic positions of three euphausiid species from the Prince Edward Islands (Southern Ocean): implications for the pelagic food web structure. *Marine Ecology Progress Series* 217: 167-174.
- GURNEY, L.J., FRONEMAN, P.W., PAKHOMOV, E.A. & McQUAID, C.D. 2002. Diel feeding patterns and daily ration estimates of three subantarctic euphausiids in the vicinity of the Prince Edward Islands (Southern Ocean). *Deep-Sea Research* II 49: 3207-3227.
- HALL, K.J. 1977. Some observations on the former sea levels of Marion Island. *South African Journal of Antarctic Research* 7: 19-22.
- HÄNEL, C. & CHOWN, S.L. 1999. Fifty years at Marion and Prince Edward Islands: a bibliography of scientific and popular literature. *South African Journal of Science* 95: 87-112.
- HAY, C.H. 1986. A new species of *Macrocystis* (Phaeophyta) from Marion Island, southern Indian Ocean. *Phycologia* 25: 241-252.
- HAXEN, P.G. & GRINDLEY, J.R. 1985. *Durvillea antarctica* production in relation to nutrient cycling at Marion Island. In: Siegfried, W.R., Condy, P.R. & Laws, R.M. (Eds). Antarctic nutrient cycles and food webs. Berlin: Springer-Verlag. pp. 637-640.

- HECHT, T. 1987. A guide to the otoliths of Southern Ocean fishes. *South African Journal of Antarctic Research* 17: 2-87.
- HECHT, .T & COOPER, J. 1986. Length-mass relationships, energetic content and the otoliths of Antarctic Cod *Paranotothenia magellanica* (Nototheniidae, Pisces) at sub-Antarctic Marion Island. *South African Journal of Zoology* 21: 294-296.
- HILLER, N. 1994. The biogeographic relationships of the branchiopod fauna from Marion and Prince Edward Islands. *South African Journal of Antarctic Research* 24: 67-74.
- HOFMEYR, G.J.G. & BESTER, M.N. 1993. Predation on King Penguins by Antarctic Fur Seals. South African Journal of Antarctic Research 23: 71-74.
- HOFMEYR, G.J.G. & BESTER, M.N. 2002. Entanglement of pinnipeds at Marion Island. *South African Journal of Marine Science* 24: 383-386.
- HOFMEYR, G.J.G., BESTER, M.N. & JONKER, F.C. 1997. Changes in population sizes and distribution of fur seals at Marion Island. *Polar Biology* 17: 150-158.
- HOFMEYR, G.J.G, DE MAINE, M., BESTER, M.N., KIRKMAN, S.P., PISTORIUS, P.A. & MAKHADO, A.B. 2002. Entanglement of pinnipeds at Marion Island, Southern Ocean: 1991-2001. Australian Mammalogy 24: 141-146.
- HUNT, B.P.V. 2000. Mesozooplankton community structure in the vicinity of the Prince Edward Islands (Southern Ocean), 37° 50'E, 46° 45'E.MSc Thesis, Rhodes University, Grahamstown, S. Africa.180 pp.
- HUNT, B.P.V. & PAKHOMOV, E.A. 2003. Mesozooplankton interactions with the shelf around the sub-Antarctic Prince Edward Islands archipelago. *Journal of Plankton Research* 25: 885-904.
- HUNT, B.P.V., PAKHOMOV, E.A. & McQUAID, C.D. 2001. Short-term variation and long-term changes in the oceanographic environment and zooplankton community in the vicinity of a sub-Antarctic archipelago. *Marine Biology* 138: 369-381.
- HUNT, B.P.V., PAKHOMOV, E.A. & McQUAID, C.D. 2002. Community structure of mesozooplankton in the Antarctic polar frontal zone in the vicinity of the Prince Edward Islands (Southern Ocean): small-scale distribution patterns in relation to physical parameters. *Deep-Sea Research* II 49: 3307-3325.
- HUNTER, S. & BROOKE, M. de L. 1992. The diet of giant petrels *Macronectes* spp. at Marion Island, southern Indian Ocean. *Colonial Waterbirds* 15: 56-65.
- HUNTER, S. & KLAGES, N.T.W. 1989. The diet of Grey-headed Albatrosses *Diomedea chrysostoma* at the Prince Edward Islands. *South African Journal of Antarctic Research* 19: 31-33.
- IMBER, M.J. 1981. Diets of stormpetrels *Pelagodroma* and *Garrodia* and of prions *Pachyptila* (Procellariiformes). In: Cooper, J. (Ed.). Proceedings of the Symposium on Birds of the Sea and Shore, 1979. Cape Town: African Seabird Group. pp. 63-88.
- IMBER, M.J. 1992. Cephalopods eaten by Wandering Albatrosses (*Diomedea exulans* L.) breeding at six circumpolar localities. *Journal of the Royal Society of New Zealand* 22: 243-263.
- ISMAIL, H. 1990 Surface nutrients in the vicinity of the Prince Edward Islands during April/May 1989. South African Journal of Antarctic Research 20: 33-36.
- JONKER, F.C 1997. Ranging and diving behaviour of adult female Southern Elephant Seals from Marion Island. MSc thesis, University of Pretoria, Pretoria, South Africa.. xxx pp.

- JONKER, F.C. & BESTER, M.N. 1994. The diving behaviour of Southern Elephant Seal, *Mirounga leonina*, cows from Marion Island. *South African Journal of Antarctic Research* 24: 75-93.
- JONKER, F.C. & BESTER, M.N. 1998. Seasonal movements and foraging areas of adult female Southern Elephant Seals, *Mirounga leonina*, from Marion Island. *Antarctic Science* 10: 21-30.
- KAEHLER, S. & PAKHOMOV, E.A. 2001. Effects of storage and preservation on the δ^{13} C & δ^{15} N signatures of selected marine organisms. *Marine Ecology Progress Series* 219: 299-304.
- KAEHLER, S., PAKHOMOV, E.A. & McQUAID, C.D. 2000. Trophic structure of the marine food web at the Prince Edward Islands (Southern Ocean) as determined by δ^{13} C and δ^{15} N analysis. *Marine Ecology Progress Series* 208: 13-20.
- KEITH, M., BESTER, M.N., BARTLETT, P.A. & BAKER, D. 2001. Killer Whales (*Orcinus orca*) at Marion Island, Southern Ocean. *African Zoology* 36: 163-175.
- KELLEHER, G., ed. 1999. Guidelines for Marine Protected Areas. World Conservation Union: Gland.
- KENSLEY, B. 1975. Five species of *Jaeropsis* from the southern Indian Ocean (Crustacea, Isopoda, Asselota). *Annals of the South African Museum* 67: 367-380.
- KENSLEY, B. 1980. Marine isopods from Marion Island, Prince Edward Island and Crozet Islands (Crustacea, Isopoda). *Annals of the South African Museum* 82: 155-184.
- KERLEY, G.I.H. 1983. Record for the Cape Fur Seal *Arctocephalus pusillus pusillus* from sub-Antarctic Marion Island. *South African Journal of Zoology* 18: 139-140.
- KERLEY, G.I.H. 1983. Relative population sizes and trends, and hybridisation of fur seals Arctocephalus tropicalis and A. gazella at Prince Edward Islands, Southern Ocean. South African Journal of Zoology 18: 388-392.
- KERLEY, G.I.H. 1987. *Arctocephalus tropicalis* on the Prince Edward Islands. In: Croxall, J.P. & Gentry, R.L. (Eds). Status, biology, and ecology of fur seals. Proceedings of an international symposium and workshop, Cambridge, England, 23-27 April 1984. NOAA Technical Publication Rep. NMFS 51.pp. 61-64.
- KIRKMAN, S.P., BESTER, M.N., HOFMEYR, G.J.G., JONKER, F.C., PISTORIUS, P.A., OWEN, R. & STRYDOM, N. 2004. Variation in the timing of the breeding haulout of female Southern Elephant Seals at Marion Island. *Australian Journal of Zoology* 52: 379-388.
- KIRKMAN, S.P., BESTER, M.N., MAKHADO, A.B. & PISTORIUS, P.A. 2003. Female attendance patterns of Antarctic Fur Seals at Marion Island. *African Zoology* 38: 402-405.
- KLAGES, N.T.W. & BESTER, M.N. 1998. The fish prey of fur seals *Arctocephalus* spp. at subantarctic Marion Island. *Marine Biology* 131: 559-566.
- KLAGES, N.T.W., ADAMS, N.J. & BROWN, C.R. 1985. Comparison of the diet of four species of penguins breeding on Marion Island, southern Indian Ocean. *South African Journal of Science* 81: 700.
- KLAGES, N.T.W., NEL, D.C. & COOPER, J. 1995. Stomach contents of a Greybacked Storm Petrel *Garrodia nereis* from subantarctic Marion Island. *Marine Ornithology* 23: 163-164.
- KUUN, P. 1988. Morphometrics and preliminary biology of the caridean shrimp *Nauticaris marionis*Bate, 1888, at the Prince Edward Islands (Southern Ocean), 37° 50'E, 46° 45'E. MSc Thesis,
 Rhodes University, Grahamstown, South Africa 145 pp.

- KUUN, P., PAKHOMOV, E.A. & McQUAID, C.D. 1999. Morphometric relationships of the caridean shrimp *Nauticaris marionis* Bate, 1888 at the Prince Edward Islands (Southern Ocean). *Polar Biology* 22: 216-218.
- LA COCK, G.D., HECHT, T. & KLAGES, N.[T.W.] 1984. The winter diet of Gentoo Penguins at Marion Island. *Ostrich* 55: 188-191.
- LA GRANGE, J.J. 1962. Notes on the birds and mammals on Marion Island and Antarctica (S.A.N.A.E.) *Journal of the South African Biological Society* 3: 27-84.
- LEDOYER, M. 1979. Caridea (Crustacea, Decapoda) des lles Kerguelen, Crozet, Marion et Prince Edward, et du Sud de Madagascar (Banc Walters) des Campagnes MD.03, MD.04 et MD.08 du M/S 'Marion-Dufresne'. Comité National Française des Recherche Antarctiques 44: 137-149.
- LEMM, S and ATTWOOD, C (2003) State of Marine Protected Area Management in South Africa, WWF-SA.
- LOMBARD, A.T., B. REYERES, L.Y. SCHONEGEVEL, J. COOPER, L.B. SMITH-ADAO, D.C. NEL, P.W. FRONEMAN, I.J. ANSORGE, M.N. BESTER, C.A. TOSH, T. STRAUSS, T. AKKERS, O. GON, R.W. LESLIE and S.L. CHOWN. 2007. Conserving pattern and process in the Southern Ocean: designing a Marine Protected Area for the Prince Edward Islands. *Antarctic Science* 19 (1), 39-54.
- LIPINSKI, M.R. & JACKSON, S. 1989. Surface-feeding on cephalopods by procellariiform seabirds in the Southern Benguela region, South Africa. *Journal of Zoology, London* 218: 549-563.
- LUCAS, M.I., LUTJEHARMS, J.R.E., FIELD, J.G. & McQUAID, C.D. 1993. A new South African research programme in the Southern Ocean. *South African Journal of Science* 89: 61-67.
- LUTJEHARMS, J.R.E. 1985. Location of frontal systems between Africa and Antarctica: some preliminary results. *Deep-Sea Research* 32: 1499-1509.
- LUTJEHARMS, J.R.E 1985. The South African SIBEX I Cruise to the Prydz Bay region, 1984: III. Detail of the upper thermal structure of the Southern Ocean between South Africa and Prydz Bay during March-May 1984. *South African Journal of Antarctic Research* 15: 12-18.
- LUTJEHARMS, J.R.E 1990. Temperatuurstruktuur van die oseaanbolaag tussen Kaapstad en Marioneiland. South African Journal of Antarctic Research 20: 21-32.
- LUTJEHARMS, J.R.E. 1991. A history of recent South African marine research in the Southern Ocean. South African Journal of Antarctic Research 21: 159-164.
- LUTJEHARMS, J.R.E. & VALENTINE, H.R. 1984. Southern Ocean thermal fronts south of Africa. *Deep-Sea Research* 31: 1461-1476.
- LUTJEHARMS, J.R.E., JAMALOODIEN, S. & ANSORGE, I.J. 2002. The temporal displacement of ocean fronts south-east of Africa. *South African Journal of Science* 98: 304-306.
- LUTJEHARMS, J.R.E., LUCAS, M.I., PERISSINOTTO, R., VAN BALLEGOOYEN, R.C. & ROUAULT, M. 1994. Oceanic processes at the Subtropical Convergence; report of research cruise SAAMES III. *South African Journal of Science* 90: 367-370.
- LUTJEHARMS, J.R.E., VALENTINE, H.R. & BOTHMA, J. 1987. See-oppervlaktemperature by enkele subantarktiese elande. *Newsletter of the South African Weather Bureau* 461: 4-7.

- LUTJEHARMS, J.R.E., VALENTINE, H.R., WALKER, N.D. & BOTHMA, J. 1988. Sea surface temperature records at subantarctic islands. In: MacDonald, I.A.W. & Crawford, R.J.M. (Eds). Long-term data series relating to southern Africa's renewable natural resources. *South African National Scientific Programmes Report* No.157. pp. 38-40.
- MAKHADO, A.B. 2002. The diet of two fur seal species (*Arctocephalus gazella* and *A. tropicalis*) at Marion Island. MSc thesis, University of Pretoria, Pretoria, South Africa. xxx p.
- MAKHADO, A.B., BESTER, M.N., KIRKMAN, S.P., PISTORIUS, P.A., FERGUSON, J.W.H. & KLAGES, N.T.W. IN PRESS. Prey of the Antarctic Fur Seal *Arctocephalus gazella* at Marion Island. *Polar Biology*.
- MASSIN, C. 1992. Holothurians (Echinodermata) from Marion and Prince Edward Islands: new and little-known species. *Zoologica Scripta* 21: 311-324.
- MATTHYSEN, C.P. 1987. Detail of the thermal structure of ocean fronts in the Southern Ocean south of Africa. MSc thesis, University of Cape Town, Rondebosch, South Africa. xxx pp.
- McMAHON, C.R., BESTER, M.N., BURTON, H.R., HINDELL, M.A., & BRADSHAW, C.J.A. 2005. Population status and trends of a wide-ranging marine predator, the Southern Elephant Seal: re-examining the decline to advance conservation strategies. *Journal of Mammalogy*.
- McMAHON, C.R., BURTON, H.R. & BESTER, M.N. 2003. A demographic comparison of two Southern Elephant Seal populations. *Journal of Animal Ecology* 72: 61-74.
- McMAHON, C.R., HINDELL, M.A., BURTON, H.R. & BESTER, M.N. 2005. Comparison of Southern Elephant Seal populations, and observations of a population on a demographic knife edge. *Marine Ecology Progress Series* 288: 273-283.
- McQUAID, C.D. & FRONEMANN, P.W. IN PRESS. Biology in the oceanographic environment. In: Chown. S.L. & Froneman, P.W. (Eds). The Prince Edward Archipelago. Land-sea interactions in a changing ecosystem. Cambridge: Cambridge University Press(?).
- MÉLICE, J.-L., LUTJEHARMS, J.R.E. & ANSORGE, I.J. 2003. Sea-surface temperatures at the sub-Antarctic islands Marion and Gough during the last 50 years. *South African Journal of Science* 99: 363-366.
- MÉLICE, J.-L., LUTJEHARMS, J.R.E., ROUAULT, M., REASON, C.J.C., GOOSSE, H. & FICHEFET, T. in press[?]. Evidence for the Antarctic Circumpolar Wave in the Subantarctic during the past 50 years. *Geophysical Research Letters*.
- MENDELSOHN, J. 1981. Movements of prions *Pachyptila* spp. and low pressure systems at Marion Island. . In: Cooper, J. (Ed.). Proceedings of the Symposium on Birds of the Sea and Shore, 1979. Cape Town: African Seabird Group. pp. 223-231.
- MERCER, R.D., CHOWN, S.L. & MARSHALL, D.J. 2000. Mite and insect zonation on a Marion Island rocky shore: a quantitative approach. *Polar Biology* 23: 775-784.
- MILLARD, N.A.H. 1971. Hydrozoa.. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition 1965-1966. Cape Town: A.A. Balkema. pp. 396-408.
- MILLER, D.G.M. 1982. Results of a combined hydroacoustic and midwater trawling survey of the Prince Edward Island group. *South African Journal of Antarctic Research* 12: 3-10.

- MILLER, D.G.M. 1985. Marine microplankton of two sub-Antarctic islands. In: Siegfried, W.R., Condy, P.R. & Laws, R.M. (Eds). Antarctic nutrient cycles and food webs. Berlin: Springer-Verlag. pp. 335-361.
- MILLER, D.G.M., BODEN, B.P. & PARKER, L. 1984. Hydrology and bio-oceanography of the Prince Edward Islands (south-west Indian Ocean). *South African Journal of Antarctic Research* 14: 29-31.
- MILLS, M.S.L. & RYAN, P.G. 2005. Modelling impacts of long-line fishing: what are the effects of pair-bond disruption and sex-biased mortality on albatross fecundity? *Animal Conservation* 8: 359-367.
- MILLER, R.G. 1993. History and atlas of the fishes of the Southern Ocean. Carson City: Foresta Institute. 795 pp.
- MITCHELL-INNES, B.A. 1967. Primary production studies in the south-west Indian Ocean, 1961-1963. *Investigational Report of the Oceanographic Research Institute* No. 14. 20 pp.
- MONTEIRO, P.M.S. 1982. The distribution of copper, zinc and cadmium in the Southern Ocean south of South Africa. MSc thesis, University of Cape Town.
- MONTEIRO, P.M.S. 1987. Marion and Prince Edward Islands: the legal regime of adjacent maritime zones. *Sea Changes* 5: 63-109.
- MONTEIRO, P.M.S. & ORREN, M.J. 1985. Trace metals in the Southern Ocean; on the geochemistry of copper. *Marine Chemistry* 15: 345-355.
- NEL, D.C. & NEL, J.C. 1999. Marine debris and fishing gear associated with seabirds at sub-Antarctic Marion Island, 1996/097 and 1997/98: in relation to longline fishing activity. *CCAMLR Science* 6: 85-96.
- NEL, D.C. 2002. The impact of longline fishing on the seabirds breeding on Marion Island. PhD thesis, University of Cape Town. 202 pp.
- NEL, D.C., LOMBARD, A.T., AKKERS, T., COOPER, J., & REYERS, B. 2005. Progress towards a declaration of a large Marine Protected Area around South Africa's sub-Antarctic Prince Edwards Islands. CCAMLR Marine Protected Areas (MPA) Workshop, Silver Spring, Maryland, USA. 29 August – 1 September 2005. WS-MPA-05/15
- NEL, D.C., LUTJEHARMS, J.R.E., PAKHOMOV, E.A., ANSORGE, I.J., RYAN, P.G. & KLAGES, N.T.W. 2001. Exploitation of mesoscale oceanographic features by Grey-headed Albatross *Thalassarche chrysostoma* in the southern Indian Ocean. *Marine Ecology Progress Series* 217: 15-26.
- NEL, D.C., NEL, J.C., RYAN, P.G., KLAGES, N.T.W., WILSON, R.W. & ROBERTSON, G. 2000. Foraging ecology of Grey-headed Mollymawks at Marion Island, southern Indian Ocean, in relation to longline fishing activity. *Biological Conservation* 96: 219-231.
- NEL, D.C., RYAN, P.G., CRAWFORD, R.J.M., COOPER, J. & HUYSER, O.A.W. 2002. Population trends of albatrosses and petrels at sub-Antarctic Marion Island. *Polar Biology* 25: 81-89.
- NEL, D.C., RYAN, P.G., NEL, J.L., KLAGES, N.T.W., WILSON, R.P., ROBERTOSN, G. & TUCK, G.N. 2002. Foraging interactions between Wandering Albatrosses *Diomedea exulans* breeding on Marion Island and long-line fisheries in the southern Indian Ocean. *Ibis* E141-E154.

- NEL, D.C., RYAN, P.G. & WATKINS, B.P. 2002c. Seabird mortality in the Patagonian Toothfish longline fishery around the Prince Edward Islands, 1996-2000. *Antarctic Science* 14: 151-161.
- NEL, D.C., TAYLOR, F.[E.], RYAN, P.G. & COOPER, J. 2003. Population dynamics of the Wandering Albatross *Diomedea exulans* at Marion Island: longline fishing and environmental influences. *African Journal of Marine Science* 25: 503-517.
- NEL. E.A. 1968. Diatoms in the aphotic zone of the south-west Indian Ocean. *Fisheries Bulletin South Africa* 5: 11-31.
- NEL, E.A. 1968. The microplankton of the south-west Indian Ocean. *Investigational Report of the Division of Sea Fisheries of South Africa* No. 62. 106 pp. + 9 tables.
- NEW ZEALAND DEPARTMENT OF CONSERVATION, 2007. http://www.parks.it/world/nz/
- NONDULA, M., MARSHALL, D.J., BAXTER, R., SINCLAIR, B.J. & CHOWN, S.L. 2004. Life history and osomoregulatory ability of *Telematogoton amphibius* (Diptera, Chironomidae) at Marion Island. *Polar Biology* 27: 629-635.
- ORREN, M.J. & MONTEIRO, P.M.S. 1985. Trace element geochemistry in the Southern Ocean. In: Siegfried, W.R., Condy, P.R. & Laws, R.M. (Eds). Antarctic nutrient cycles and food webs. Berlin: Springer-Verlag. pp. 30-37.
- PAKHOMOV, E.A. 1998. Diet of two Antarctic dragonfish (Pisces: Bathydraconidae) from the Indian sector of the Southern Ocean. *Antarctic Science* 10: 55-61.
- PAKHOMOV, E.A. 1998. Feeding plasticity of the Antarctic fish *Trematomus hansoni* Boulenger, 1902 (Pisces: Nototheniidae): the influence of fishery waste on the diet. *Polar Biology* 19: 289-292.
- PAKHOMOV, E.A. & CHOWN, S.L. 2003. The Prince Edward Islands: Southern Ocean oasis. *Ocean Yearbook* 17: 348-379.
- PAKHOMOV, E.A. & FRONEMAN, P.W. 1999. The Prince Edward Islands pelagic ecosystem, south Indian Ocean: a review of achievements, 1976-1990. *Journal of Marine Systems* 18: 355-367.
- PAKHOMOV, E.A. & FRONEMAN, P.W. 1999. Macroplankton/micronekton dynamics in the vicinity of the Prince Edward Islands (Southern Ocean). *Marine Biology* 134: 501-515.
- PAKHOMOV, E.A. & FRONEMAN, P.W. 2000. Composition and spatial variability of macroplamkton and micronekton within the Antarctic Polar Frontal Zone of the Indian Ocean during austral autumn 1997. *Polar Biology* 23: 410-419.
- PAKHOMOV, E.A. & McQUAID, C.D. 1996. Distribution of surface zooplankton and seabirds across the Southern Ocean. *Polar Biology* 16: 271-286.
- PAKHOMOV, E.A. & R PERISSINOTTO, R. 1997. Mesozooplankton community structure and grazing impact in the region of the Subtropical Convergence south of Africa. *Journal of Plankton Research* 19: 675-691.
- PAKHOMOV, E.A., ANSORGE, I.J. & FRONEMAN, P.W. 2000. Variability in the inter-island environment of the Prince Edward Islands (Southern Ocean) *Polar Biology* 23: 593-603.
- PAKHOMOV, E.A., ANSORGE, I.J., KAEHLER, S., VUMAZONKE, L.U., GULEKANA, K., BUSHULA, T., BALT, C., PAUL, D., HARGEY, N., STEWART, H., CHANG, N., FURNO, L., MKATSHWA, S., VISSER, C., LUTJEHARMS, J.R.E. & HAYES-FOLEY, P. 2003. Studying the impact of ocean eddies on the ecosystem of the Prince Edward Islands: DEIMEC II. *South African Journal of Science* 99: 187-190.

- PAKHOMOV, E.A., ANSORGE, I.J., McQUAID, C.D., KOHRS, S., WALDRON, H., HUNT, B., GURNEY, L., KAEHLER, S., LAWRIE, S., HELD, C. & MACHU, E. 1999. The fourth cruise of the Marion Island Oceanographic Survey (MIOS IV), April to May 1999. *South African Journal of Science*. 95: 420-422.
- PAKHOMOV, E.A., BUSHULA, T., KAEHLER, S., WATKINS, B.P. & LESLIE, R.W. ms. Structure and distribution of the slope fish community in the vicinity of the sub-Antarctic Prince Edward Archipelago. Submitted to *Journal of Fish Biology* 68 pp.
- PAKHOMOV, E.A., FRONEMAN, P.W. & ANSORGE, I.[J.] 1998. Prince Edward Island offshore oceanographic study: report on research cruise April-May 1997. *South African Journal of Science* 94: 153-157.
- PAKHOMOV, E.A., FRONEMAN, P.W., ANSORGE, I.J. & LUTJEHARMS, J.R.E. 2000. Temporal variability in the physico-biological environment of the Prince Edward Islands (Southern Ocean). *Journal of Marine Systems* 26: 75-95.
- PAKHOMOV, E.A., FRONEMAN, P.W., KUUN, P.J. & BALARIN, M.G. 1999. Feeding dynamics and respiration of the bottom-dwelling caridean shrimp *Nauticaris marionis* Bate, 1888 (Crustacea: Decapoda) in the vicinity of Marion Island (Southern Ocean). *Polar Biology* 21: 112-121.
- PAKHOMOV, E.A., FRONEMAN, P.W. & PERISSINOTTO, R. 2002. Salp/krill interactions in the Southern Ocean: spatial segregation and implications for the carbon flux. *Deep-Sea Research* II 49: 1881-1907.
- PAKHOMOV, E.A., HUNT, B.P.V. & GURNEY, L.J. 2000. The fifth cruise of the Marion Island Oceanographic Survey (MIOS-V), April to May 2000. *South African Journal of Science* 96: 541-543.
- PAKHOMOV, E.A., KAEHLER, S. & McQUAID, C.D. 2002. Zooplankton community structure in the kelp beds of the sub-Antarctic Prince Edward Archipelago: are they a refuge for larval stages? *Polar Biology* 25: 778-788.
- PAKHOMOV, E.A., KUUN, P. & McQUAID, C.D. 2000. Biology of the bottom-dwelling shrimp *Nauticaris marionis* Bate, 1888 at the sub-Antarctic Prince Edward Islands. *Polar Biology* 23: 522-530.
- PAKHOMOV, E.A., McCLELLAND, J.W., BERNARD, K., KAEHLER, S. & MONTOYA, J.P. 2004. Spatial and temporal shifts in stable isotope values of the bottom-dwelling shrimp *Nauticaris marionis* at the sub-Antarctic archipelago. *Marine Biology* 144: 317-325.
- PAKHOMOV, E.A., PERISSINOTTO, R. & McQUAID, C.D. 1994. The comparative structure of the macrozooplankton, micronekton communities of the Sub-tropical and Antarctic Polar Fronts. *Marine Ecology Progress Series* 111: 155-169.
- PAKHOMOV, E.A., PERISSINOTTO, R. & McQUAID, C.D. 1996. Prey composition and daily rations of myctophid fishes in the Southern Ocean. *Marine Ecology Progress Series* 134: 1-14.
- PANAGIS, K. 1981. Local movement of Southern Elephant Seal pups *Mirounga leonina* (Linn.) at Marion Island. *South African Journal of Antarctic Research* 10/11: 28-31.
- PARKER, L.D. 1984. A contribution to the oceanology of the Prince Edward Islands. MSc thesis, Rhodes University, Grahamstown, South Africa. 97 pp.

- PAWSON, D.L. 1971. Holothuroidea. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition 1965-1966. Cape Town: A.A. Balkema. pp. 288-290.
- PERISSINOTTO, R. 1989. The structure and diurnal variations of the zooplankton of the Prince Edward Islands: implications for the biomass build-up of higher trophic levels. *Polar Biology* 9: 505-510.
- PERISSINOTTO, R 1990. Physical control and biological productivity of the seas around the Prince Edward archipelago, Southern Ocean. PhD thesis, Dalhousie University, Halifax, Canada. xxx pp..
- PERISSINOTTO, R. 1992. Mesozooplankton size-selectivity and grazing impact on the phytoplankton community of the Prince Edward Archipelago (Southern Ocean). *Marine Ecology Progress Series* 79: 243-258.
- PERISSINOTTO, R. & BODEN, B.P. 1989. Zooplankton-phytoplankton relationships at the Prince Edward Islands during April/May 1985 and 1986. *South African Journal of Antarctic Research* 19: 26-30.
- PERISSINOTTO, R. & DUNCOMBE RAE, C.M. 1990. Occurrence of anti-cyclonic eddies on the Prince Edward plateau (Southern Ocean): effects on phytoplankton productivity and biomass. *Deep-Sea Research* 37: 777-793.
- PERISSINOTTO, R. & McQUAID, C.D. 1990. Role of the sub-Antarctic shrimp, *Nauticaris marionis* in coupling benthic and pelagic food webs. *Marine Ecology Progress Series* 64: 81-87.
- PERISSINOTTO, R. & McQUAID, C.D. 1992. Land-based predator impact on vertically migrating zooplankton and micronekton advected to a Southern Ocean archipelago. *Marine Ecology Progress Series* 80: 15-27.
- PERISSINOTTO, R. & McQUAID, C.D. 1992. Deep occurrence of the giant kelp *Macrocystis laevis* in the Southern Ocean. *Marine Ecology Progress Series* 81: 85-95.
- PERISSINOTTO, R. & PAKHOMOV, E.A. 1997. Feeding association of the copepod *Rhincalanus gigas* with the tunicate *Salpa thompsoni* in the Southern Ocean. *Marine Biology* 127: 479-483.
- PERISSINOTTO, R., ALLANSON, B.R. & BODEN, B.P. 1990. Trophic relations within the island seas of the Prince Edward Archipelago (Southern Ocean). In: Barnes, M. & Gibson, R.N. (Eds) Trophic relationships in the marine environment. Proceedings of the 24th European Marine Biology Symposium. Aberdeen: Aberdeen University Press. pp. 296-314.
- PERISSINOTTO, R., DUNCOMBE RAE, C.M., BODEN, B.P. & ALLANSON, B.R. 1990. Vertical stability as a controlling factor of the marine phytoplankton production at the Prince Edward Archipelago (Southern Ocean). *Marine Ecology Progress Series* 60: 205-209.
- PERISSINOTTO, R., LUTJEHARMS, J.R.E & VAN BALLEGOOYEN, R.C. 2000. Biological-physical interactions and pelagic productivity at the Prince Edward Islands, Southern Ocean. *Journal of Marine Systems* 24: 327-341.
- PISTORIUS, P.A., BESTER, M.N. & KIRKMAN, S.P. 1999. Dynamic age-distributions in a declining population of Southern Elephant Seals. *Antarctic Science*. 11: 446-451.
- PISTORIUS, P.A. & BESTER, M.N. 2002. A longitudinal study of senescence in a pinniped. *Canadian Journal of Zoology* 80: 395-401.

- PISTORIUS, P.A. & BESTER, M.N. 2002. Juvenile survival and population regulation in Southern Elephant Seals at Marion Island. *African Zoology* 37: 35-41.
- PISTORIUS, P.A., BESTER, M.N. & KIRKMAN, S.P. 1999. Dynamic age-distributions in a declining population of Southern Elephant Seals. *Antarctic Science*. 11: 446-451.
- PISTORIUS, P.A., BESTER, M.N. & KIRKMAN, S.P. 1999. Survivorship of a declining population of Southern Elephant Seals, *Mirounga leonina*, in relation to age, sex and cohort. *Oecologia* 121: 201-211.
- PISTORIUS, P.A., BESTER, M.N., LEWIS, M.N., TAYLOR, F.E., CAMPAGNA, C. & KIRKMAN, S.P. 2004. Adult female survival, population trend, and the implications of early primiparity in a capital breeder, the Southern Elephant Seal (*Mirounga leonina*). *Journal of Zoology, London* 263: 107-119.
- PISTORIUS, P.A., TAYLOR, F.E., LOUW, C., HANISE, B., BESTER, M.N., DE WET, C., DU PLOOY, A., GREEN, N., KLASEN, S., PODILE, S. & SCHOEMAN, J. 2002. Distribution, movement, and estimated population size of Killer Whales (*Orcinus orca*) at Marion Island, December 2000. *South African Journal of Wildlife Research* 32: 86-92.
- POMEROY,R.S., PARKS, J.E. & WATSON, L.M. (2004) How is your MPA doing? A Guidebook of Natural and Social Indicators for Evaluating MPA Management Effectiveness, *IUCN, Gland*, Switzerland & Cambridge, UK.
- PRINCE EDWARD ISLANDS MANAGEMENT PLAN WORKING GROUP 1996. Prince Edward Islands Management Plan. Pretoria: Department of Environmental Affairs & Tourism. 64 pp.
- PUGH, P.J.A 1993. A synonomic catalogue of the Acari from Antarctica, the sub-Antarctic islands and the Southern Ocean. *Journal of Natural History* 27: 323-421.
- PUGH, P.J.A. & MERCER, R.D. 2001. Littoral Acari of Marion Island: ecology and extreme wave action. *Polar Biology* 24: 239-243.
- RAND, R.W. 1954. Notes on the birds of Marion Island. Ibis 96: 173-206.
- RAND, R.W 1956. Notes on the Marion Island fur seal. *Proceedings of the Royal Society, London* 126: 65-82.
- RAND, R.W. 1962. Elephant seals on Marion Island. African Wildlife 16: 191-198.
- RAND, R.W. 1963. Seabirds in the southern Indian Ocean. Ostrich 34: 121-128.
- ROUAULT, M. & LEE-THORP, A.M. 1996. Fine-time resolution measurements of atmospheric boundary layer properties between Cape Town and Marion Island. *South African Journal of Marine Science* 17: 281-296.
- ROUAULT, M., MÉLICE, J.-L., REASON, C.J.C. & LUTJEHARMS, J.R.E 2005. Climate variability at marion Island, Southern Ocean, since 1960. *Journal of Geophysical Research* 110: C05007. 9 pp.
- ROWE, F.W.E. & CLARKE, A.M. 1975. Notes on some echinoderms from Marion Island. *Bulletin of the British Museum of Natural History (D: Zoology)* 28: 187-190.
- RYAN, P.G. 1986. The incidence and effects of ingested plastic in seabirds. MSc thesis, University of Cape Town, Rondebosch, South Africa. 151 pp.

- RYAN, P.G. 1987. The origin and fate of artefacts stranded on islands in the African sector of the Southern Ocean. *Environmental Conservation* 14: 341-346.
- RYAN, P.G. 1987. The incidence and characteristics of plastic pellets ingested by seabirds. *Marine Environmental Research* 23: 175-206.
- RYAN, P.G. 1987. The distribution, population size and foraging behaviour of Kerguelen Terns at the Prince Edward Islands. *South African Journal of Antarctic Research* 17: 163-166.
- RYAN, P.G. 1988. Intraspecific variation in plastic ingestion by seabirds and the flux of plastic through seabird populations. *Condor* 90: 446-452.
- RYAN, P.G. 1999. Sexual dimorphism, moult and body condition of seabirds killed by longline vessels around the Prince Edward Islands, 1996-97. *Ostrich* 70: 187-192.
- RYAN, P.G. & BESTER, M.N. IN PRESS. Pelagic predators. In: Chown. S.L. & Froneman, P.W. (Eds). The Prince Edward Archipelago. Land-sea interactions in a changing ecosystem. Cambridge: Cambridge University Press(?).
- RYAN, P.G. & BOIX-HINZEN, C. 1999. Consistent male-biased mortality in the Patagonian Toothfish fishery. *Auk* 116: 851-854.
- RYAN, P.G. & NEL, D.C 1999. Foraging behaviour of diving petrels *Pelecanoides*. *Emu* 99: 72-74.
- RYAN, P.G. & WATKINS, B.P. 2002. Reducing incidental mortality of seabirds with an underwater longline setting funnel. *Biological Conservation* 104: 127-131.
- RYAN, P.G., COOPER, J., DYER, B.M., UNDERHILL, L.G., CRAWFORD, R.J.M. & BESTER, M. N. 2003. Counts of surface-nesting seabirds breeding at subantarctic Prince Edward Island, summer 2001/02. *African Journal of Marine Science* 25: 441-451.
- SANCOR 1979. The Southern Ocean South African Cooperative Research Programme. *South African National Scientific Programmes Report* No. 28. 26 pp.
- SASCAR 1987. South African Southern Ocean Research Programme. South African National Scientific Programmes Report No. 134. 58 pp.
- SAWYER, R.T. 1972. A new species of 'tentacled' marine fish leech parasite on *Notothenia* from the sub-Antarctic Marion and Crozet islands. *Hydrobiologia* 40: 345-354.
- SAWYER, R.T. & DE VILLIERS, A.F. 1976. Notes on two marine leeches Annelida: Hirudinea from subantarctic Marion Island including a new record. *Hydrobiologia* 48: 267-268.
- SCHULZE, B.R. 1971. The climate of Marion Island. In: van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds) 1971. Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 16-31.
- SHANNON, L.V. 1970. Oceanic circulation off South Africa. Fisheries Bulletin South Africa 6: 27-33.
- SHIRIHAI, H. 2002. A complete guide to Antarctic wildlife. The birds and marine mammals of the Antarctic Continent and the Southern Ocean. Degerby: Alula Press. 510 pp.
- SIEGFRIED, W.R., FORBES, P.F. & CONDY, P.R. 1979. Scientific research at the Prince Edward Islands, 1847-1979: a bibliography. *South African Journal of Antarctic Research* 9: 35-41.
- SINCLAIR, J.C. 1981. Eight previously unreported seabirds at Marion Island, Indian Ocean. *Ardea* 69: 217-218.

- SKINNER, J.D., CONDY, P.R., VAN AARDE, R.J., BESTER M.N. & ROBINSON, T.J. 1978. The mammals of Marion Island: a review. *South African Journal of Antarctic Research* 8: 35-38.
- SKINNER, J.D. & SMITHERS, R.H.N. 1990. The mammals of the southern African subregion. Pretoria: University of Pretoria. 769 pp.
- SMITH, V.R. 1991. Climate change and its ecological consequences at Marion and Prince Edward Islands. South African Journal of Antarctic Research, 21, 223-24.
- SMITH, V.R. 2002. Climate change in the sub-Antarctic: an illustration from Marion Island. *Climatic Change* 52: 345-357.
- SMITH, V.R. & FRONEMAN, P.W. In press. Nutrient cycles and land-sea interactions. In CHOWN. S.L. & FRONEMAN, P.W., eds. The Prince Edward Archipelago. Land-sea interactions in a changing eco-system. Stellenbosch: Sun Media.
- STAMPANATO, S. & JANGOUX, M. 2004. The asteroid fauna (Echinodermata) of Marion and Prince Edward Islands. *Annals of the South African Museum* 112: 1-16.
- STEELE, W.K. & CRAFFORD, J.E. 1987. Insects in the diet of the Blue Petrel *Halobaena caerulea* at Marion Island. *Cormorant* 15: 93-94.
- STEELE, W.K. & KLAGES, N.T.[W.] 1986. Diet of the Blue Petrel *Halobaena caerulea* at sub-Antarctic Marion Island. *South African Journal of Zoology* 21: 253-256.
- VAN AS, L., BASSON, L. & VAN AS, J.G. 1998. Two new species of *Mantoscyphidia* Jankowski, 1980 (Ciliophora: Peritrichia) gill symbionts of limpets, from South Africa and the sub-Antarctic island, Marion. *Acta Protozoologica* 37: 101-111.
- VAN BALLEGOOYEN, R., PERISSINOTTO, R., ISMAEL, H., BODEN, B., ALLANSON, B., LUCAS, M. & LUTJEHARMS, J.R.E. 1989. Data Report on the second cruise of the Marion Off-shore Ecological Study (MOES II). CSIR Report EMA-D 8910. 16 pp. + figures + tables.
- VAN PLETZEN, R. & KOK. D.J. 1971. Oribatei. In: Van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds). Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 314-334.
- VAN WAEREBEEK, K., VAN BREE, PJ.H. & BEST, P.B. 1995. On the identity of *Prodelphinus petersii* Lütken, 1889 and records of Dusky Dolphin *Lagenorhynchus obscurus* (Gray, 1828) from the southern Indian and Atlantic Oceans. *South African Journal of Marine Science* 16: 25-35.
- VAN WYK, J.C.P. 1996. Fearsome reputation unfounded. Killer Whales at Marion Island in the Southern Ocean, *African Wildlife* 50(2): 7-9.
- VAN ZINDEREN BAKKER, JR, E.M. 1971. Comparative avian ecology. In: van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds) 1971. Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 161-172.
- VAN ZINDEREN BAKKER, JR, E.M. 1971. Birds observed at sea. In: van Zinderen Bakker Sr, E.M., Winterbottom, J.M. & Dyer, R.A. (Eds) 1971. Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. pp. 249-250.

- VAN ZINDEREN BAKKER SR, E.M., WINTERBOTTOM, J.M. & DYER, R.A. (EDS) 1971. Marion and Prince Edward Islands. Report on the South African Biological & Geological Expedition / 1965-1966. Cape Town: A.A. Balkema. 427 pp.
- VISSER, G.A. & VAN NIEKERK, M.M. 1965. Ocean currents and water masses at 1.000, 1,500 and 3,000 metres in the south-west Indian Ocean. *Investigational Report Division of Sea Fisheries South Africa* No. 52 46 pp.
- VUMAZONKE, L.U. 2004. Growth, feeding and sex change in the sequential protandric shrimp *Nauticaris marionis* at the Prince Edward Islands. MSc thesis, Rhodes University, Grahamstown, South Africa. 88 pp.
- VUMAZONKE, L.U., PAKHOMOV, E.A., FRONEMAN, P.W. & McQUAID, C.D. 2003. Diet and daily ration of male and female caridean shrimp *Nauticaris marionis* at the Prince Edward Archipelago. *Polar Biology* 26: 420-422.
- WANLESS, R. 1998. Toothfish goldrush. The longlining hazard. *Africa Environment & Wildlife* 6(1): 57-60.
- WARD, V.L. 1998. Antarctic Petrel *Thalassoica antarctica* records from the Prince Edward Islands and South Africa. *Marine Ornithology* 26: 86-87.
- WATKINS, B.P. 1987. Population sizes of King, Rockhopper and Macaroni Penguins and Wandering Albatrosses at the Prince Edward Islands and Gough Island, 1951-1986. *South African Journal of Antarctic Research* 17: 166-162.
- WATKINS. B.[P.] 2000. Killer Whale group attacks Sperm Whales. *African Environment and Wildlife* 8(1): 16-17.
- WILLIAMS, A.J. 1981. Factors affecting time of breeding of Gentoo Penguins *Pygoscelis papua* at Marion Island. In: Cooper, J. (Ed.). Proceedings of the Symposium on Birds of the sea and Shore, 1979. Cape Town: African Seabird Group. pp. 451-459.
- WILLIAMS, A.J. 1984. The status and conservation of seabirds on some islands in the African Sector of the Southern Ocean. *International Council for Bird Preservation Technical Publication* 2: 627-635.
- WILLIAMS, G.C. 1988. Underwater in Subantarctic seas. A subtidal look at Marion Island. *Sagittarius* 3(2): 20-23.
- WILKINSON, I.S. & BESTER, M.N. 1990. Continued population increase in fur seals, *Arctocephalus tropicalis* and *A. gazella*, at the Prince Edward Islands. *South African Journal of Antarctic Research* 20: 58-63.
- WILLIAMS, A.J. & BURGER, A.E. 1978. Notes on nonbreeding seabirds at the Prince Edward Islands. *Cormorant* 5: 11-14.
- WILLIAMS, A.J., BURGER, A.E., BERRUTI, A. & SIEGRIED, W.R. 1975. Ornithological; research on Marion Island, 1974-75. *South African Journal of Antarctic Research* 5: 48-50.
- WILLIAMS, A.J., SIEGFRIED, W.R., BURGER, A.E. & BERRUTI, A. 1979. The Prince Edward Islands: a sanctuary for seabirds in the Southern Ocean. *Biological Conservation* 15: 59-71.
- WILLIAMS, A.J. & LAYCOCK, P.A. 1981. Euphausiids in the diet of some sub-Antarctic *Eudyptes* penguins. *South African Journal of Antarctic Research* 10/11: 27-28.

- WILLIAMS, A.J. & SIEGFRIED, W.R. 1980. Foraging ranges of krill-eating penguins. *Polar Record* 20: 159-175.
- WILLIAMS, A.J., SIEGFRIED, W.R., BURGER, A.E. & BERRUTI, A. 1979. The Prince Edward Islands: a sanctuary for seabirds in the Southern Ocean. *Biological Conservation* 15: 59-71.
- WILKINSON, I.S. & BESTER, M.N. 1990. Duration of post-weaning fast and local dispersion in the Southern Elephant Seal, *Mirounga leonina*, at Marion Island. *Journal of Zoology, London* 222: 591-600.
- WILSON, R.P. NAGY, K.A & OBST, B.S. 1989. Foraging ranges of penguins. *Polar Record* 25: 303-307.
- WILSON, R.P., PÜTZ, K., GRÉMILLET, D., CULIK, B.M., KIERSPEL, M., REGEL, J., BOST, C.A, LAGE, J. & COOPER. J. 1995. Reliability of stomach temperature changes in determining feeding characteristics of seabirds. *Journal of Experimental Biology* 198: 1115-1135.
- WYNEN, L.P., GOLDSWORTHY, S.D., GUINET, C., BESTER, M.N., BOYD, I.L., GJERTZ, I., HOFMEYR, G.J.G., WHITE, R.W.G. & SLADE, R. 2000. Post-sealing genetic variation and population structure of two species of fur seal (*Arctocephalus gazella* and *A. tropicalis*). *Molecular Ecology* 9: 299-314.

APPENDIX 4

DEFINITIONS OF TERMS USED IN THE MANAGEMENT PLAN

AIRCRAFT – Any craft capable of self-sustained movement through the atmosphere, excluding hovercraft.

BIOPROSPECTING – In relation to indigenous resources, means any research on, or development or application of, indigenous biological resources for commercial or industrial exploitation, and includes: the systematic search, collection or gathering of such resources or making extractions from such resources for purposes or such research, development or application;

the utilisation for purposes of such research or development of any information regarding any traditional uses of indigenous biological resources by indigenous communities; or

research on, or the application, development or modification of, any such traditional uses, for commercial or industrial exploitation (as taken from *National Environmental Management: Biodiversity Act 2004*).

COASTCARE – An educational programme developed by Marine and Coastal Management to promote voluntary compliance and public awareness.

COMMERCIAL ACTIVITY – An activity conducted for financial gain.

COMMERCIAL BOAT BASED WHALE WATCHING – May only occur with a permit issued under Section 58 of the Regulations in terms of the *Marine Living Resources Act 1998*.

COMMERCIAL FISHING – Fishing for any of the species that have been determined by the Minister in terms of section 14 to be subject to the allowable commercial catch or total applied effort or parts of both. (as taken from the MLRA, 1998).

COMMERCIAL PHOTOGRAPHY – The use of still, video or cine camera equipment for the recording of images and these images are used for financial gain.

DESIGNATED AREA – means an area within a zone or zones set aside for the purposes for special management.

EDUCATION PROGRAMME – An activity that is:

component of a course conducted by a school or tertiary institution that is recognised by a provincial or national department responsible for education; or

conducted by an overseas institution that is accredited by the national body responsible for education in the country in which the institution is established and is recognised in South Africa by a provincial or national department responsible for education.

EEZ – ``exclusive economic zone" means the exclusive economic zone as defined in section 7 of the Maritime Zones Act, 1994 (Act No. 15 of 1994); (x)

FISH – The marine living resources of the sea and the seashore, including any aquatic plant or animal whether piscine or not, and any mollusc, crustacean, coral, sponge, holothurian or other echinoderm, reptile and marine mammal and includes their eggs, larvae and all juvenile stages, but does not include sea birds and seals. (MLRA, 1998)

MARINE LIFE – includes any aquatic plant or animal whether piscine or not, and any mollusc, crustacean, coral, sponge, holothurian, echinoderm, reptile and marine mammal and includes their eggs, larvae and all juvenile stages, and includes sea birds and seals.

the MINISTER - means the Minister of Environmental Affairs and Tourism

NETS – Includes beach-seine net, bottom trawl-net, cast-net, drag-net, hoop-net, purse-seine-net, shove-net and set-net.

PRECAUTIONARY APPROACH -

RECREATIONAL DIVING - An individual or group who undertake scuba diving activities without financial gain.

RECREATIONAL FISHING – means any fishing done for leisure or sport and not for sale, barter, earnings, or gain. (MLRA, 1998).

RECREATIONAL PHOTOGRAPHY - The use of still, video or cine camera equipment for the recording of images and these images are not used for financial gain.

RESTRICTED ZONES – the Zone where fishing is prohibited.

RISK ASSESSMENT – A process that involves identifying the valued attributes of the marine protected area that are considered to be at risk and determining when an impact is deemed to be significant on these values.

SCIENTIFIC RESEARCH - means research carried out by a recognised institute established for the purposes of research, or research carried on by a recognised institute of higher learning, provided that to undertake such scientific research the recognised institute requires its staff, students or contractors to enter the Marine Protected Area (as taken from *MLRA Regulations*).

SCUBA DIVING - means swimming below the surface of the sea with the aid of compressed or pumped air or other gases (as taken from *MLRA Regulations*).

STOWED – secured in such a way that it is not available for immediate use.

TERRITORIAL SEA - ``territorial waters" means the territorial waters as defined in section 4 of the Maritime Zones Act, 1994; (xiv)

TOURIST - A person who is in the marine protected area for recreation, including, for example, recreational fishing or sight seeing.

TOURIST PROGRAMME – An activity conducted for financial gain that includes the provision of transport, accommodation or services for tourists, advertising or promoting the use of a marine protected area as part of the programme, advertising or promoting the use of a marine protected area as a feature associated with a resort or tourist facility on land adjoining the area and includes traversing the Prince Edward Islands Marine Protected Area to conduct tourist programmes outside of the MPA.

TRAVERSING – a vessel entering the MPA for the purpose of accessing another area outside of the MPA.

PART 5

PROPOSAL FOR THE PROCLAMATION OF THE PRINCE EDWARD ISLANDS MARINE PROTECTED AREA



PROPOSAL FOR THE PROCLAMATION OF THE PRINCE EDWARD ISLANDS MARINE PROTECTED AREA

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1. INTRODUCTION

This document culminates 18 months of planning towards the delineation of the proposed MPA around South Africa's Prince Edward Islands in the Southern Ocean.

This initiative followed the Minister of Environmental Affairs and Tourism, Marthinus van Schalkwyk's announcement in June 2004 that it was his department's intention to declare one of the largest MPAs in the world around the Prince Edward Islands. In November 2004, Department of Environmental Affairs and Tourism's (DEAT) Marine & Coastal Management branch, teamed up with WWF South Africa (and funding from Sanlam) to develop a spatial marine biodiversity conservation plan that would inform the delineation of this proposed MPA. The plan was developed by the CSIR with extensive consultation with stakeholders and experts. Please see Appendix 1 for a summary of these meetings.

In January 2006 the project team produced the final spatial conservation plan, included in this report (Part 1). This final plan was workshopped with the fishing industry and other stakeholders in March 2006 and May 2006. This document summarizes the agreed outcomes of these meetings and is now in a form for DEAT approval before being drafted as a government gazette.

Citation: D.C. Nel, T. Akkers & A. Boyd. 2008. Proposal for the proclamation of the Prince Edward Islands Marine Protected Area. *In:* Nel D. & Omardien A. (eds). *Towards the Development of a Marine Protected Area at the Prince Edwards Islands.* WWF South Africa Report Series - 2008/Marine/001.

2. OBJECTIVES OF THE PRINCE EDWARD ISLANDS MPA:

The MPA zonation around the Prince Edward Islands seeks to contribute to the following four major objectives:

- 1) To contribute to a national and global representative system of Marine Protected Areas, by providing protection for unique species, habitats and ecosystem processes (e.g. foraging grounds, shelf areas with increased nutrients, etc.)
- 2) To provide scientific reference points that can inform the future management of the area
- 3) To contribute to integrated and ecologically sustainable management of marine resources of the area
- 4) To reduce the ecological impacts of fisheries and other extractive industries (e.g. bycatch of the toothfish fishery, particularly of albatrosses and petrels)

It is proposed that:

1 The MPA should follow the delineation shown in Figure 1. The exact co-ordinates of the delineation are given in Table 1.

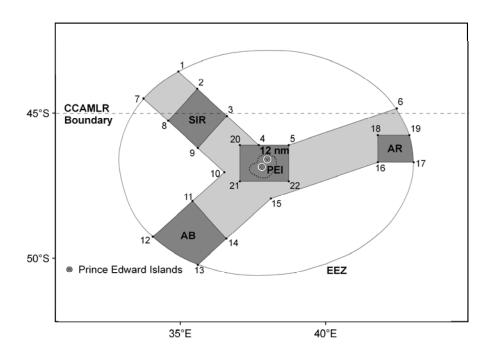


Fig. 1. The proposed boundaries for the Prince Edward Islands MPA. The four Category 1a reserves are: Southwest Indian Ridge (SIR); Prince Edward Islands (PEI); Africana II Rise (AR); and Abyss (AB).

Table 1. The exact geographic coordinates (WGS 84 spheroid) of points 1-22 in Fig. 1

Point	Latitude Degrees	Minutes	Longitude Degrees	Minutes	Point	Latitude Degrees	Minutes	Longitude Degrees	Minutes
1	43	34	34	56	12	49	16	34	3
2	44	10	35	35	13	50	14	35	36
3	45	6	36	36	14	49	20	36	35
4	46	6	37	42	15	47	57	38	7
5	46	6	38	44	16	46	42	41	48
6	44	50	42	27	17	46	42	43	2
7	44	30	33	44	18	45	46	41	48
8	45	16	34	35	19	45	46	42	53
9	46	12	35	36	20	46	6	37	3
10	47	3	36	31	21	47	21	37	3
11	48	2	35	25	22	47	21	38	44

- 2 The MPA will be comprised of three types of zones:
 - 2.1 A 12 nautical mile sanctuary (no-take) zone covering the area extending 12 nautical miles from the low water mark of the islands (i.e. the entire extent of the territorial sea)
 - 2.2 Four restricted zones, indicated as PEI, SIR, AR, and AB in figure 1.
 - 2.3 A conservation zone, linking the four strict nature reserves
- 3 These areas should be managed as follows:
 - 3.1 The 12nautical mile Sanctuary Zone:

Purpose:

3.1.1 This zone is to be managed as a strict no-take zone for the preservation of the unique island ecosystem.

Management:

- 3.1.2 The following activities are prohibited in this zone:
 - 3.1.2.1 Fishing or attempting to fish
 - 3.1.2.2 To destroy or remove any other fauna or flora
 - 3.1.2.3 To mine, dredge, extract sand or gravel, discharge or deposit waste or any other polluting matter, or in any way disturb, alter or destroy the natural environment;
 - 3.1.2.4 To construct or erect any building or other structure on or over any land or water within such a marine protected area; or
 - 3.1.2.5 To carry on any activity which may adversely impact on the ecosystems of that area.

- 3.1.2.6 Non-government shipping activities, including fishing vessels in possession of a legal permit, will be restricted to shipping lanes and designated anchoring zones.
- 3.1.2.7 Fishing vessels not in possession of a legal permit may only enter this zone under conditions of force majeur.

3.2 The Restricted Areas:

Purpose:

3.2.1 These areas are designed to protect representative proportions all habitat types in the Prince Edward Islands EEZ and to contribute towards the ecologically sustainable management of marine resources.

Management:

- 3.2.2 Resources in these areas to be fully protected with disturbances limited to scientific monitoring activities.
- 3.2.3 Toothfish populations in these areas will be monitored using standardized commercial fishing techniques. The DEAT shall enter into an agreement with permitted commercial rights holders to perform these monitoring activities as part of their permit conditions. The design of the monitoring effort will be determined by DEAT scientists in consultation with the commercial rights holders. The monitoring effort should be set at the average annual number of hooks set in each of these zones over the period 2002 to 2005 and total effort in the restricted zones should never exceed 40% of the total effort in the EEZ (see Table 2).

Table 2. Average number of hooks set in each of the proposed Scientifically Monitored Nature Reserves from 2002 to 2005

Scientifically Monitored Nature Reserve	Average effort in hooks from 2002 to 2005
PEIs	554,912 hooks
AR	345,671 hooks
SIR	143,630 hooks
AB	0 hooks (not fished at all)
Total	1,044,213 hooks

- 3.2.4 Furthermore the following activities will be prohibited:
 - 3.2.4.1 Any fishing or attempt to fish, over and above that required for the scientific monitoring required in 3.2.2 (above)
 - 3.2.4.2 Fishing by methods known to cause damage to benthic habitats and biota (e.g. bottom trawling)
 - 3.2.4.3 To destroy or remove any other fauna or flora.
 - 3.2.4.4 To mine, dredge, extract sand or gravel, discharge or deposit waste or any other polluting matter, or in any way disturb, alter or destroy the natural environment;
 - 3.2.4.5 To construct or erect any building or other structure anywhere within this zone; or

- 3.2.4.6 To carry on any other activity which may adversely impact on the ecosystems of that area.
- 3.2.4.7 Fishing vessels not in possession of a legal permit and traversing these areas, will do so with fishing g ear stowed, may not carry fish and will be subject to mandatory reporting procedures.

3.3 The Conservation Zone

Purpose:

3.3.1 This zone is to be managed as a low impact zone that links the other zones spatially, protects representative proportions of benthic habitats, and sustains ecosystem processes, whilst still allowing sustainable utilization of Patagonian toothfish resources.

Management:

- 3.3.2 Fishing for Patagonian toothfish subject to catch or effort limits by rights holders will be allowed here, but will not involve methods that impact on the benthic environment or that result in unsustainable or ecologically threatening rates of bycatch. The following activities will be prohibited:
 - 3.3.2.1 Fishing method that is known to impact benthic habitats (e.g. bottom trawling)
 - 3.3.2.2 To mine, dredge, extract sand or gravel, discharge or deposit waste or any other polluting matter, or in any way disturb, alter or destroy the natural environment (e.g. through mining)
 - 3.3.2.3 Best currently available seabird mitigation measures must be applied to mimimise seabird bycatch. Should seabird bycatch exceed a prescribed limit, fishing within the conservation and restricted zones should cease. It is provisionally recommended that the total seabird bycatch limit for the conservation and restricted zones collectively, be set at 50 birds annually in total, or 30 birds per vessel.
- 4 The MPA will be managed in accordance with relevant international obligations, conventions and agreements
- 5 All vessels fishing in any of the above zones should carry a scientific observer
- A compliance strategy for the effective enforcement of this MPA will be developed by DEAT, within six months of its promulgation.

Appendix 1: Summary of meetings

Date	Purpose	Attendees
15 June 2005	Expert and stakeholder consultation	Theressa Akkers (DEAT), Dr Isabelle Ansorge (UCT), Richard Ball (Ziyabuya Fishing), Prof Maarthan Bester (UP), Prof George Branch (UCT), John Cooper (UCT), Dr Rob Crawford (DEAT), Heidi Currie (Feike), Sarah Davies (Univ Stellenbosch), Brian Flanagan (Fishing Industry), Prof William Froneman (Rhodes Univ), Niekie Kock (Suidor Fishing), Dr Mandy Lombard (Conservation Systems), Pheobius Mullins (DEAT), Dr Deon Nel (WWF), Samantha Petersen (BirdLife &WWF), Dr Belinda Reyers (CSIR), Lindie Smith-Adao (CSIR), Frances Taylor and Barry Watkins (UCT)
06 October 2005	Expert input	John Cooper (UCT), Prof Maarthan Bester (Univ Pretoria), Sarah Davies (Univ Stellenbosch), Dr Mandy Lombard (Conservation Systems), Dr Belinda Reyers (CSIR), Dr Deon Nel (WWF), Prof William Froneman (Rhodes), Dr Isabelle Ansorge (UCT)
03 March 2006	Stakeholder consultation	John Cooper (UCT), Jan Glazewski (UCT), Heidi Currie (Fieke), Samantha Petersen (BirdLife), Estelle van der Merwe (ASOC), Henry Valentine (DEAT), Daniel Bailey (Bato Fishing), Richard Ball (Ziyabuya Fishing), Dr Isabelle Ansorge (UCT), Theressa Akkers (DEAT), Niekie Kock (Suidor Fishing), Barry Watkins (UCT), Dr Mandy Lombard (Conservation systems), Dr Deon Nel (WWF), Aaniyah Omardien (WWF)
16 May 2006	Fishing industry consultation and implementation planning	Theressa Akkers (DEAT), Dr Colin Attwood (DEAT), Dr Alan Boyd (DEAT), Richard Ball (Ziyabuya Fishing), Daniel Bailey (Bato Fishing), Dr Deon Nel (WWF), Aaniyah Omardien (WWF), Samantha Petersen (WWF), Dr Mandy Lombard (Conservation Systems)
23-26 May 2006	Final Consultations and drafting of recommendations	Dr Alan Boyd (DEAT), Dr Colin Attwood (DEAT), Barry Watkins (UCT), Dr Peter Ryan (UCT), Dr Rob Crawford (DEAT), Richard Ball (Ziyabuya Fishing)
11 October 2007	Consultations on request of the industry to discuss issues raised by Prof Butterworth	Theressa Akkers (DEAT), Dr Colin Attwood (WWF), Dr Alan Boyd (DEAT), Richard Ball (Ziyabuya Fishing), Daniel Bailey (Bato Fishing), Dr Deon Nel (WWF), Aaniyah Omardien (WWF), Samantha Petersen (WWF), Prof Doug Butterworth (UCT), Dr Rob Crawford (DEAT). Dr Kerry Sink (SANBI), Barry Watkins (BirdLife), Brian Flanagan (Arniston fishing), T Samaai (MCM), RN Ruka (Ziyabuya fishing), E Planganyi (UCT), H Oosthuizen (MCM), ME Links (Ziyabuya fishing), AS Johnson (MCM), C Edwards (UCT), A Brandao (UCT), N Kock (Suidor fishing).

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