Project MPA
Marine Protected Areas for the Antarctic

Emperor penguins under the ice by Guillaume Dargend

Mark Gibson
Certificate in Antarctic Studies
University of Canterbury
New Zealand
Table of Contents

1.0 Introduction 2
2.0 Key characteristics of the Southern Ocean 3
3.0 Existing Marine Protection Mechanisms 7
4.0 Why Protect the Antarctic Marine Environment 15
5.0 Significant/Key Issues for Marine Protection in the Antarctic 21
6.0 Possible MPAs in the Ross Sea Region 24
7.0 Conclusions and Recommendations 28
8.0 Acknowledgements 29
9.0 References 30
1.0 Introduction

The marine environment accounts for 71% of the earth's surface (Nybakken, 1997). As water is a three dimensional medium, this makes the entire volume where organisms can live equate to $1370 \times 10^6$ km$^3$, which makes it the single largest habitat stronghold on the planet.

The marine environment is in need of protection. Protection is urgent to conserve marine heritage and life support systems of the globe (Kelleher & Kenchington, 1992). The oceans regulate climate, dissolve harmful gases, provide food and habitats to sustain life on planet earth. The natural state of the marine ecosystems needs preservation.

Oceans of the world have not been respected by humans in the past. Humans have seen them as an inexhaustible source of food, as having an infinite capacity to absorb and purify our wastes, and as a source of all the raw materials to sustain an industrial society (Nybakken, 1997). This has gone on for too long. Humans are adversely effecting the marine environment all the time. Constant destruction of our terrestrial habitat directly effects the marine environment in many ways. For example, domestic sewage entering aquatic systems inevitably ends up in the oceans. Consideration of our impacts needs to take form.

Marine Protected Areas (MPAs) are a possible option. MPAs are areas that are set aside from human use, except for peaceful purposes such as science and education. A global representation of all marine ecosystems is only possible through MPAs. Representation of all marine ecosystems by preserving the naturalness of selected areas will provide leeway to change human attitudes.
The aim of this project is to look at MPAs in the context of the Antarctic and Southern Ocean. It has been divided up to give a systematic argument for MPAs in this region. It intends to inform and educate those wanting to learn more about protecting the Southern Ocean marine environment.

2.0 Key characteristics of the Southern Ocean

The Southern Ocean which surrounds Antarctica makes up approximately 10% of the world's oceans (Fisher and Hureau, 1985), with a volume of $1.37 \times 10^6$ km$^3$. It sustains a number of ecosystems and has a significant impact on the world's oceanic and climatic systems, including:

- the Southern Ocean drives the world's ocean circulation system by providing essential nutrients to all oceans (Valiela, 1995; Christopherson, 1992). High levels of nutrients come from seasonal blooms of primary producers like phytoplankton (free floating, microscopic plant) in the Southern Ocean.

- seasonal sea-ice melt/freeze relationships are crucial in the regulation of the planet's climate (Nichol and Allison, 1997). Sea-ice covers seven percent of the world's oceans (May, 1988) and has been marked as the largest physical change on the planet. If they all melt, sea level would rise between 1-5 metres. This would affect all the highly populated coastal areas of the world.

These two points are significant for the development of MPAs. These are examples of what we know now, but what we learn in the future will depend on what we can save in the most natural state. The natural state of the marine environment depends on how we can protect ecological values.

Ecological values are those expressed by the Antarctic Treaty System. An area dedicated to peace and science like that of the Antarctic has high credibility for protected areas elsewhere. Within the Antarctic and Southern Ocean biological features are so diverse that they need protecting as much as terrestrial areas.
A caption from World Wildlife Fund for Nature (1999) emphasises the need to protect the world’s oceans. This is very applicable to the Southern Ocean.

*In terms of maintaining global climatic stability, oceans are even more important than forests. Yet oceans and coasts are experiencing rapid degradation. Overfishing and pollution lead to an increasing number of marine areas facing total ecological collapse. Government action and international treaties are largely ineffective, while land-based sources of pollution are neglected or badly controlled.*


Climatic stability and rapid degradation relate directly to the Southern Ocean. With the discovery of the “ozone hole” above the Antarctic continent the effects it has had on ecosystems become important (Karentz, 1991). History shows that past human interactions with the Southern Ocean have led to resource depletion. The new extinction of seals and whales from Antarctica and the Southern Ocean is one example (May, 1988).

The marine life in this area includes: whales, penguins, seals, albatross, pelagic fish, bacteria, marine plants and the all important krill (See Drawings throughout this paper) that sustains the Southern Ocean food web (Knox, 1994). One marine organism has become the Antarctic emblem, the emperor penguin (See Photo 1). The Southern Ocean is their home and if humans alter it in any way, we will bear the blame.
Photo 1. The Emperor Penguin, *Aptenodytes forsteri* has become an Antarctic emblem.

The Southern Ocean has a pronounced species diversity due to its large size (Davison, 1999. Personal Communication). To represent all the different habitats (See Table 2), would require a large number of MPAs. The perfect world of marine protection for the Antarctic is to have all habitats protected. Requirements for this would include many areas ranging in size, shape and restrictions (See Key issues section later).


<table>
<thead>
<tr>
<th>Habitat</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epipelagic/Pelagic</td>
<td>open water away from the bottom in the light rich zone</td>
</tr>
<tr>
<td>Mesopelagic</td>
<td>upper part where no light reaches</td>
</tr>
<tr>
<td>Bathypelagic</td>
<td>depths between 700 – 1000m</td>
</tr>
<tr>
<td>Abyssopelagic</td>
<td>zone overlying the major ocean basins</td>
</tr>
<tr>
<td>Benthopelagic</td>
<td>open water near the bottom</td>
</tr>
<tr>
<td>Epibenthic</td>
<td>sediment-water interface</td>
</tr>
<tr>
<td>Benthic</td>
<td>sea floor/bottom</td>
</tr>
<tr>
<td>Cryopelagic</td>
<td>beneath floating sea ice</td>
</tr>
<tr>
<td>Glacial/benthic</td>
<td>glacial ice near sea floor</td>
</tr>
<tr>
<td>Glacial/pelagic</td>
<td>glacial ice interactions with open ocean</td>
</tr>
</tbody>
</table>
This unique marine ecological area has so far been afforded little or no formal protection (Knox, 1999. Personal Communication). Only general protection through the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) and the Protocol on Environmental Protection to the Antarctic Treaty (Environmental Protocol) is given. Unique because we know very little about ecosystem processes and what we do know is based from conceptual models (Hatherton, 1990). The life that inhabits this largely unseen environment is extraordinarily diverse (World Wildlife Fund for Nature, 1999). New Zealand and international commitment should provide protection for Southern Ocean biodiversity.

The need to protect the Antarctic marine environment (Prebble and Hemmings, 1998). A previous emphasis on the terrestrial environment has resulted in a substantial terrestrial protected area system for the Antarctic. The Antarctic Protected Area system has yet to develop or implement any substantial MPA.

3.0 Existing Marine Protection Mechanisms

Cape Royds, Ross Island is the only area that has marine protection. It is a Site of Significant Scientific Interest (SSSI) for the southern-most Adelie penguin Rookery (List of Protected Areas in Antarctica, 1997). This extends 500 metres from the high water mark into the littoral and sub-littoral zones. The marine area that this represents is very small and lacks direct emphasis for ecosystem representation.

This is protected by the old Antarctic Treaty System (ATS). Specially Protected Areas (SPA) and SSSI's have been integrated together under the Environmental Protocol. This means a larger range of protection measures is available.

The Protocol on Environmental Protection to the Antarctic Treaties objective regarding protection states the following.

Parties commit themselves to the comprehensive protection of the Antarctic environment and dependent associated ecosystems and hereby designate Antarctica as a nature reserve, devoted to peace and science.

If the Environmental Protocol under the Antarctic Treaty requires all ecosystems to be represented then marine ecosystems need inclusion. This statement has been around since 1991 when the Antarctic Treaty Parties crafted the Protocol at the Madrid, Antarctic Treaty Consultative Meeting. Yet no proposals for MPAs have appeared. The development of MPAs in the Antarctic should facilitate a new era for protection regimes.

The Environmental Protocol has implemented a protected area system to protect all ecosystems. This Annex includes the protection of marine ecosystems. Development and implementation of MPAs go through the provisions of this annex.
Annex V to the Protocol is the Area Protection and Management article that states:

For the purposes set out in this Annex, any area, including any marine area, may be designated as an Antarctic Specially Protected Area (ASPA) or an Antarctic Specially Managed Area (ASMA). Activities in those Areas should be prohibited, restricted or managed in accordance with Management Plans adopted under the provisions of this Annex.

Davidson, 1999

There is scope to include marine representation in the Antarctic. The legal frameworks enable the appropriate organisation to develop management plans for areas of significant interest (Knox, 1999. Personal Communication). Marine protection for the Southern Ocean will start when the wider Antarctic community accept a MPA management plan. By this I mean all the consultative parties to the Antarctic Treaty and all parties who the MPA plan affects.

Protection under the Environmental Protocol follow two categories, ASPAs and ASMAs. The protection devices outlined in the following sections show how they are to marine protection.

ASPAs

Definition from Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

Any area, including any marine area, may be designated as an ASPA to protect outstanding environmental, scientific, historic, aesthetic, or wilderness values, any combination of those values, or ongoing or planned scientific research.

Davidson, 1999
This type of protection would provide strict protection. It is similar to "no take" reserves that prevent removal or killing of any organism within their boundaries in New Zealand (Ballantine, 1991). The "no take" system would have substantial merit in the Southern Ocean. Although not all of it is fished for commercial purposes the potential benefits of adopting "no take" areas may provide protection for nursery areas and breeding grounds of organisms.

Under the ASPA title, area requirements have to fit within this systematic environmental-geographical framework:

(a) areas kept inviolate from human interference so that future comparisons may be possible with localities that have been affected by human activities;

(b) representative examples of major terrestrial, including glacial and aquatic, ecosystems and marine ecosystems;

(c) areas with important or unusual assemblages of species, including major colonies of breeding native birds or mammals;

(d) the type locality or only known habitat of any species;

(e) areas of particular interest to on-going or planned scientific research;

(f) examples of outstanding geological, glaciological or geomorphological features;

(g) sites or monuments of recognised historic value;

(h) any areas that may fit the ASPA definition above.
From the above (a) -- (f) all have potential to include marine systems. Category (b) even mentions the need to represent the marine ecosystems. ASPAs are an effective way to protect marine ecosystems.

Past management of Sites of Scientific Interest and Specially Protected Areas has proven satisfactory (Njastad, 1998). Now with the combination of the two titles under ASPA, protection should increase in the Treaty Area south of the Antarctic Convergence (See Map 1). The goal to encourage proposals for new ASPAs is the next step for Antarctic Treaty Parties. MPAs will be an important part of these proposals.

ASPA are just one type of protection device. The less protected ASMA will have an equal importance in the establishment of MPAs.

**ASMA**

Definition from Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

> Any area, **including any marine area**, where activities are being conducted or may in the future be conducted, may be designated as an Antarctic Specially Managed Area to assist in the planning and co-ordination of activities, avoid possible conflicts, improve co-operation between parties or minimise environmental impacts.

Davidson, 1999

The definition clearly attempts to minimise environmental impact. How it does this is similar to ASPAs. Selection of areas and proposing management plans are the same for both protection types.
This broader type of protection enables use by many different groups with unrestricted access. ASMAs have potential for application in areas where major human presence occurs. These areas (See proposal's section later) would include parts of the Southern Ocean that have many conflicting uses. Logistics, science and tourism are common in the Southern Ocean. This multiple use is the reason for establishing MPAs under ASMAs of the Environmental Protocol.

Throughout the world multiple use management in MPAs is becoming more apparent (Dixon, 1993). MPAs are being used not just for protection but in some cases to generate profit. Great Barrier Reef Marine Park is an excellent example.

The Southern Ocean is so far from large populations that developing tourism specifically aimed at exploring the marine world is low. However as technology increases and people become more aware of the Southern Oceans significance this may become a reality. Already ship based tour operations include visits to breeding colonies of sea birds (May, 1988). Therefore, accidents such as fuel spills may occur.

Annex IV to the Environmental Protocol is for the prevention of marine pollution. It addresses all the responsibilities that parties have to adhere to whilst in the Antarctic. However, the Article 3, subparagraph 2(a) states that it does not apply to the discharge into the sea of oil or oily mixture resulting from damage to a ship or its equipment. The annex is an innovative management step by the Antarctic Treaty Parties.

Under the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) legislation states “resources are managed for ecological sustainability” (Davidson, 1999). Resource sustainability is
CCAMLRs focus. If we are to conserve the marine environment, we have to look at a wider picture.

CCAMLR has taken a step to develop an entire ecosystem monitoring programme (Agnew, 1997). Monitoring the whole ecosystem for the impact on resource use breaks the past species-specific management practices. It looks at species that are not directly being harvested. This will show whether there is a downstream effect on the entire ecosystem. There is another factor affecting the entire ecosystem, pollution.

Marine birds, mammals and exploitable resources have protection under various treaties and conventions of the Antarctic Treaty System (ATS) (Bonner, 1990).

This creates a gap in the protection system. There is no entire habitat, scientifically interesting, undisturbed or species-rich marine areas protected.

Setting aside areas that have significant value in the marine environment is the next step.

The International Union for the Conservation of Nature (IUCN) has developed the following list for MPA proposals:

**List of appropriate features for a MPA**

- Naturalness the extent to which the area has been protected from, or has not been subject to human-induced change
- Economic importance
- Social importance
- Contains a variety of habitats
- Contains habitat for rare or endangered species
- Contains nursery or juvenile areas
- Contains feeding, breeding or rest areas
contains rare or unique habitat for any species
preserves genetic diversity, that is for species or their abundance
existing or potential contribution to economic value by virtue of its protection e.g. protection of an area for recreation, subsistence, use by traditional inhabitants (not applicable to the Antarctic), appreciation by tourists and others or as a refuge nursery area or source of supply for economically important species
existing or potential value to the local/*, national or international communities* because of its heritage, historical, cultural, traditional aesthetic, educational or recreational qualities
scientific importance value for research and monitoring
International or national -- is or has the potential to be listed on the World or a significance national Heritage List or declared as a Biosphere Reserve or included on a list of areas of international or national importance or is the subject of an international or national conservation agreement.
Practicality/feasibility Degree of insulation from external destructive influences
social and political acceptability, degree of community* support
accessibility for education, tourism, recreation
compatibility with existing uses, particularly by locals*
ease of management, compatibility with existing management regimes

* this term or terms may need modification for appropriateness under the current Antarctic and Southern Ocean situation.

Kelleher & Kenchington, 1992

The list above is an expansion of what is in Annex V of the Environmental Protocol. The Environmental Protocol uses broader terms such as "areas with important or unusual assemblages of species, including major colonies of
breeding birds or mammals" (Annex V, Art 3, subparagraph 2c). The IUCN list refers to "areas containing nursery or juveniles" or "contains habitats for rare or endangered species". Therefore the Environmental Protocol and IUCN guidelines cover similar features but express it in a different style. The Environmental Protocol is broad to cover all options which gives ample scope for MPAs.

The IUCN list includes all the determining factors for setting boundaries of MPAs. Boundaries give humans something to recognise that stands out from the rest of our environment (Ballantine, 1991). It is comprehensive and has potential for application under the Environmental Protocol. Terms such as locals and community may not apply, but the principles are there for adoption by the ATS.

Whether the MPA is large and multiple use or small and highly protected, the desired levels of usage may be achieved through the following.

- establishing area boundaries for specific activities, i.e. zoning;
- enforcing closure during parts of the year critical to life histories of species or for longer periods;
- setting size limits, maximum permitted catches, harvest limits;
- prohibiting or limiting use of unacceptaible equipment;
- licensing or issue of permits to provide specific controls or to limit the number of participants in a form of use; or
- limiting access by setting a carrying capacity which may not be exceeded.

Often, a combination of all of these techniques is appropriate.

(Kelleher & Kenchington, 1992)
Under the Environmental Protocol these features need consideration. They are the key points for establishing a MPA anywhere. The Southern Ocean already has a substantial system in place for dealing with protected areas.

Other marine protective measures from New Zealand include the Marine Reserves Act (1971) and the Department of Conservation, Marine Reserve Guidelines. Both can be drawn upon for more ideas on ways to protect the marine environment. Modification of these ideas into management plans may help New Zealand and the Antarctic MPA systems.

Development of appropriate management plans will be paramount to success. The use of IUCNs key points above could provide a useful starting point for guidelines for establishing MPAs under ASMAAs or ASPAs.

Management plans have to fit criteria under the Environmental Protocol. This procedure requires all Antarctic Treaty Parties to agree on the final protected area. CCAMLR also needs to approve of any protected marine area as it is the commission for marine resource use. Going through all the systems in place will produce well thought out MPAs.

4.0 Why Protect the Antarctic Marine Environment

The Southern Ocean is as remarkable as any other of the worlds' oceans.

The Southern Ocean has at its centre the Antarctic continent (See Map 1). This single feature makes it unique among the worlds' oceans. Furthermore, the continent's distance from any other landmass effectively produces its own eco-region (Kelleher & Kenchington, 1992). This has allowed an incredible array of environmental features to develop. Table 1 summarises these features under
two groupings - the epipelagic (the lighted area of the ocean) zone and the benthic shelf (area of sea bottom on the continental shelf).

**TABLE 1. ENVIRONMENTAL FEATURES OF THE SOUTHERN OCEAN**

<table>
<thead>
<tr>
<th><strong>A. Epipelagic Zone</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. An oceanic ring surrounding a central landmass.</td>
</tr>
<tr>
<td>2. Free connection with the world's major oceans, the Atlantic, Pacific and Indian Ocean.</td>
</tr>
<tr>
<td>4. Temperature between 3-4 °C (summer), 2 °C (winter) at the Antarctic Convergence and approaching -2 °C at the ice shelves.</td>
</tr>
<tr>
<td>5. No dilution of inshore waters by freshwater inflow but surface dilution in summer due to sea ice melting.</td>
</tr>
<tr>
<td>6. No pronounced stratification or vertical stability except at the ice edge during the retreat of the sea ice. Considerable sinking of high salinity water (greater than 34.5%) and low temperature (less than 0.5 °C) near the continent, and upwelling of high salinity (34.7%) and high temperature (1-2 °C) in the region of the Antarctic Divergence.</td>
</tr>
<tr>
<td>7. Continuous high nutrient levels in the euphotic zone.</td>
</tr>
<tr>
<td>8. Variable sea ice cover.</td>
</tr>
<tr>
<td>9. Light intensity providing ample Photosynthetically Available Radiation (PAR) in the summer but very low in the winter and under the ice cover.</td>
</tr>
<tr>
<td>10. High degree of stability of the marine climate over the past 3 million years.</td>
</tr>
</tbody>
</table>
### B. Benthic Shelf habitats.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Continental shelf narrow inmost places, partly under ice shelves. Shelf mostly deeper than in other worlds oceans, 300 -800 m deep.</td>
</tr>
<tr>
<td>2.</td>
<td>Mosaic of glacial marine sediments, including muds, fine and coarse sands and large and small boulders. Sediments generally poorly sorted. No river-borne sediments.</td>
</tr>
<tr>
<td>3.</td>
<td>Depths down to 300-400 m subject to iceberg scour.</td>
</tr>
<tr>
<td>4.</td>
<td>Intertidal and near-shore zone abraded by sea ice and anchor ice.</td>
</tr>
<tr>
<td>5.</td>
<td>Meridional transport by Antarctic Bottom Water, zonal transport by circumpolar currents.</td>
</tr>
<tr>
<td>6.</td>
<td>Temperature low and stable, ranging from c. 2-3 °C near the Antarctic Convergence to -2 °C at the continent.</td>
</tr>
<tr>
<td>7.</td>
<td>Water well-mixed and oxygen levels high.</td>
</tr>
<tr>
<td>8.</td>
<td>Rich supply of phytoplankton and detritus (POM) during the short summer production period.</td>
</tr>
<tr>
<td>9.</td>
<td>Light intensity low in most places due to water depth and ice cover.</td>
</tr>
</tbody>
</table>

From Knox, 1994

A representation of all habitats of the marine environment could succeed in the following ways:

- to maintain essential ecological processes and life support systems;
- to ensure the sustainable utilisation of species and ecosystems; and
- to preserve biotic diversity.

If all the above are met the ‘ideal’ MPA would result. This MPA would have all the features of the Southern Ocean protected. Realistically all MPAs would not meet this ‘ideal’ scenario. A network of MPAs that each has a mixture of the ‘ideal’ situation is more realistic. Diversity of habitats alone, would merit more than one MPA.
Map 1. The Southern Ocean with the Antarctic Continent at the centre and CCAMLR boundary following the Antarctic convergence.

I have focused on the Ross Sea Region, where New Zealand's involvement is greatest. The reason for this is because information that I have gathered has been predominantly from this area. It does not suggest that the Ross Sea Region is the area that needs the most marine protection.
Already important areas are being identified in the Ross Sea Region (Knox, 1999. Personal Communication). Areas are recognised by people with previous knowledge of the Southern Ocean. These show bias to areas that have personal attachment with them. Research and ‘word of mouth’ are possible bias’s.

However, they provide essential information on areas that require protection. Nothing exists that summarises all possibilities. All these ideas would provide a comprehensive summary of important areas. This would produce a catalogue for MPA development that includes all possible options.

If the Antarctic Treaty System is successful at implementing and enforcing MPAs, the oceans will have more protection from humans. Humans have plundered the Southern Ocean for the exploitation of resources since its discovery. ‘Pirate Fishing’ of the Antarctic toothfish is one example of what lengths' humans will go to for greed (Crothers, 1998). Antarctic toothfish are fished for by wealthy, western, developed countries and marketed as an exotic food. Management of our impacts will be the key to conserving resources and ecosystem processes.

MPAs will also provide protection against pollution. The Southern Ocean a large distance from major human settlements. Due to the ocean circulation systems pollutants can be transported to Southern Ocean ecosystems. For example penguin fat and eggs have been found to have high levels of DDT, a potentially toxic substance (May, 1988). While MPAs will not provide direct protection from transportable pollutants like DDT, they should be effective in providing protection from localised pollution. Hydrocarbons in the Southern Ocean are both very limited and localised (Cripps and Priddle, 1991). However, accidents like the shipwreck of Bahia Paraiso near United States of America’s Palmer station illustrates the potential pollution risk.
Non-polluted areas also require protection. Areas that have few pollution problems are most likely to remain that way in the Southern Ocean. Sites that are inaccessible to humans are most likely to be free of pollution. The physical nature of the Southern Ocean, mainly the presence of sea-ice, limits where people can go in the short summer window. Natural protection of this kind has preserved the Southern Ocean for hundreds of years.

Localised protection means that MPAs would prevent any organic or inorganic wastes from being thrown into the sea near them. This will have spin-offs for changing practises in non-protected areas.

5.0 Significant/Key Issues for Marine Protection in the Antarctic

Outlined by Ballantine (1991) are general problems with marine conservation. These are still applicable to any area proposed for MPAs. Urgency to protect the marine ecosystem is the major factor. Marine representation in the Southern Ocean protected area system is paramount; it is a human centred method but one worth analysing.

Ignorance of the effects we are having on the marine system is a thing of the past. Once thought to be almost immune to harm by humankind, we now know that deep-water and coastal ecosystems are under enormous and, often, disregarded threats (World Wide Fund for Nature, 1999). The Southern Ocean has only recently, within 250 years (May, 1988) come under the pressures of the human mindset.

Mental adjustment will have to take place (Crothers, 1998). This is not easy when life under the sea has long been “out of sight” and to human attitudes therefore “out of mind”. (Mark, 1988). Dumping of unwanted human wastes into the sea is pure ignorance. Most do not think about what effects it may have on marine habitats. In front of McMurdo Station, Ross Island, one such dumping ground is described by divers as “essentially dead” because of diesel fuel additives in the sediment (May, 1988; Lenihan et al, 1990).

"Dilution was the solution to pollution" (Nybakken, 1997). This old mentality appears in Southern Ocean matters. Bases near the coast of Antarctica have permission to pump sewage into the ocean under the Environmental Protocol (Davidson, 1999) and while the oceans have a high capacity to dissipate human waste (Barrett, 1999) localised pollution is occurring. This can in turn
impact on organisms such as seals and fish which use this environment.

The attitude of "we do not know enough about the marine environment" is outdated. Common sense tells us that we are having an impact on the under-
sea world (Burke, 1999. Personal Communication). If pollution is effecting our terrestri al habitat then what effects are we having on the marine ecosystems?

Accessibility to the marine environment is a key problem for Antarctica and the world. Humans are terrestrial organisms and have had to develop the technology to survive under water. This inaccessibility is greater in the Antarctic due to the distance from populated areas and presence of sea-ice. This restricts where research by hampering logistical support. The advent of air travel has greatly increased the areas visited in the Antarctic. Also new remote operated deep-sea submersibles and cameras that have given an insight into marine environments under the ice (Dayton et al, 1984).

The wider picture draw ideas from the rest of the world. There is a huge amount of literature worldwide on marine planning, marine legislation, marine management, conflicting marine uses, problems with the exploitation of marine life, and the effects of all this on marine conservation (Ballantine, 1991). The Antarctic protection system needs to use this large knowledge base to sensibly and effectively preserve the marine environment. Neglecting the experience of the rest of the world and not modelling new protection would lead to costly lessons being learnt in the Antarctic and Southern Ocean marine environment.

Consultation is a key issue in dealing with ASPAs and ASMA s. An effective MPA will have the support and the commitment of all interested parties (Sobel, 1993; Kelleher & Kenchington, 1992). Reducing conflict is the idea behind the
management process. The Environmental Protocol allows for this under the Area Protection and Management Annex (Davidson, 1999). To enforce restriction in a MPA may pose a problem.

Complication arises for the enforcement of restrictions in the Southern Ocean (Crothers, 1998; Davidson, 1999). The ATS could adopt a group of committed individuals to provide this sort of protection. However, as Crothers (1998) states "the problem is not of enforcement, it's one of management." This means there is no need for guardians.

The international legal regimes in the Antarctic and Southern Ocean spread the role of guardian and management to all parties. This allows protected areas to conform with the Environmental Protocol objectives that designate the Antarctic as a nature reserve, devoted to peace and science (Davidson, 1999). Under this current system, conformity in protected areas should take place. Problems may arise where this does not take place.

Compliance in protected areas is dependant on management plan strategies (Davidson, 1999). Each management plan has to set out ways of dealing with offences within the area. The appropriate measures, under Article 13 of the Environmental Protocol are determined by each party involved.

Management plans should incorporate as many variables as possible. Boundaries will need allocation, restrictions made clear and information on areas needs publication. These management proposals should involve all parties. Not just those from the ATS but all interested people and organisations. A wide range of objectives will be the result. The applicant for the MPA could use this to create a water-tight plan.

Management of human activities should take many forms and involve innovative ideas to reduce human impact on the Southern Ocean. Marine
degradation in this region will require a variety of protective devices aimed at reducing impacts. This includes the designation of highly protected areas where “no take” areas will prohibit all resource extraction. Rehabilitation, scientifically interesting, low impact, highly used are options for other marine areas.

Drawing 3. Amphipod from the Southern Ocean Zooplankton. From Knox, 1994

6.0 Possible MPAs in the Ross Sea Region

For the purposes of this project I have suggested areas that could have MPAs. Therefore, they are my ideas that have come from talking with people and literature research. These are by no means a stringent list that should be followed in setting MPAs. However, they are ideas that represent possible options for further investigation.
The list focuses on the Ross Sea Region due to New Zealand's involvement in the area and because the area has been extensively studied. This has made finding literature on the area somewhat easier.

This section is split into highly protected and less protected areas. ASPAs and ASMAs under Annex V of the Environmental Protocol do this also, so I continue the separation.

Areas that refer to terrestrial points of reference are for that purpose only. Reference points on land are familiar to humans and the area next to those in the sea have less recognition. The marine area near these points is the possible MPA.

*Highly protected areas (under the ASPA title)*:

- Cape Armitage, Ross Island. An extensive study by Dayton et al. (1986) provides base-line data for future scientific programmes. Under Article 3 Subparagraph 2 (e) of the protected area annex, "areas of particular interest to on-going or planned scientific research" should be included. The on-going potential for research at this site is a substantial reason for protecting it.

- Beaufort Island, McMurdo, Ross Sea. Little is known about the marine life that surrounds this remote island (Davison, 1999. Personal communication). However, studies by DSIR Marine and Freshwater have identified areas with prolific growth of some benthic, marine organisms (Hatherton, 1990). The area is hard to get to and therefore would be an excellent site to gather base line data and use this as a tool to protect it. This area could include the part or all the foraging ranges of the Emperor and Adelie penguin populations. The area contains substantial and varied avifauna (penguin and skua breeding populations),
that makes it one of the most important breeding grounds in the area (Management Plan, undated). The existing terrestrial Specially Protected Area (SPA) would be enhanced if the marine ecosystem was included. Article 3, subparagraph 2 (a) of the Environmental Protocol requires representative examples of major terrestrial, including glacial and aquatic, ecosystems and marine ecosystems be included. Beaufort Island already has the terrestrial protection, if it had a MPA as well, a systematic environmental-geographical framework would be set up in one protected area.

- **Balleny Islands.** This Archipelago of islands have the most diverse variety of breeding bird species in the Ross Sea Region (Hatherton, 1990). This includes Chinstrap penguins, Cape pigeons, Southern fulmar, Antarctic prion, Wilson’s storm petrel and possibly McCormick’s Skua. Marine studies are needed in this area. The Balleny's sit near a commercial fishing ground (Nybakken, 1997). Developing a MPA here would merit a “no take” restriction. This could be developed under Annex V, article 3, subparagraph 2 (a) that represents areas kept inviolate from human interference so that future comparisons may be possible with localities that have been affected by human activities.

- **200 km²** of open ocean above the Ross Bank in the Ross Sea Region. The area would provide the pelagic marine life with a transitory safe haven. The deep sea floor communities would also benefit. The depth of this area is approximately 500 m (Hatherton, 1990). Protection would involve innovative management, using satellite tracking of vessels near the area. It would fit Article 2 (a) of Annex V to the Environmental Protocol representing an area kept inviolate from human interference so that future comparisons may be possible. The area of sea bottom and the volume of water above it are very inaccessible. Future technology may allow easier access to this area which could put pressure on it if it is not protected now.
Less protected areas (under the ASMA title):

- Cape Royds to Hut Point, Ross Island. This is a large area with many unique features. Glacial, island and sea ice communities require some form of restrictions to prevent human impact. The proximity to McMurdo station, Scott Base and tourist landing sites would provide an excellent opportunity to manage protection of the marine ecosystems. Tighter restrictions on all users would provide the area with some form of protection. The area has been extensively studied for Weddell Seal science (Stewart, 1999. Personal communication). ASPAs could be set up for this reason so the large area could have highly protected sites inside its boundaries.

- Pram Point to Hut Point. The focus is a designated rehabilitation area for the marine ecosystem restoration. Management could involve the removal of all pollution (May, 1988). Potential to return the natural environment to a pre-human state is possible.

For any of the proposed MPAs, implementation would require the following:
(a) further research in the marine environment of each area which includes mapping of all the important populations, habitats and organisms;
(b) collaboration of efforts from all parties to formulate comprehensive management plans;
(c) an energetic, innovative proposal or management team;
(d) MPA advocacy among all Antarctic Treaty Parties.

The small list of MPAs for the Ross Sea Region is the building blocks for a substantial protected area system. This will provide the Southern Ocean with representation of all the key factors outlined in the Environmental Protocol.
7.0 Conclusions and Recommendations

The urgent need for MPAs in the Antarctic and in the Ross Sea Region should be recognised by New Zealand. New Zealand has developed rapport in Antarctic matters, so why stop now? Advocacy for MPAs at Antarctic Treaty forums, workshops, consultative, and any other forms Antarctic meetings is needed. Interest of one ATP may have a large effect on all other parties. The need for more information on MPAs will increase.

Gathering information that is appropriate for the Ross Sea Region will be a good step for New Zealand. A substantial amount of information is available but to put that in the context of MPAs requires a lot of research and analysis. The information gathered could then be used to stimulate a co-ordinated effort from Antarctic Treaty Parties to develop MPAs throughout the Southern Ocean. This could identify specific areas, like those suggested here, that require further investigation for MPAs.

Marine life in the Antarctic has fascinated people since the day of its discovery. Only then it was to plunder and reap the benefits of the untouched resources (May, 1988). Now the "Marine Revolution" is here.

8.0 Acknowledgements

I wish to thank Emma Waterhouse for her excellent guidance and support for this project, my family who have enabled me to study the Antarctic and Southern Ocean, my esteemed Antarctic Studies colleagues for moral support and Littleton Port Company who kindly sponsored me for the Certificate in Antarctic Studies.
9.0 References


Management Plan (undated) for Specially Protected Area (SPA) No. 5. Beaufort Island, McMurdo Sound, Ross Sea.


