ANTARCTIC PROTECTED AREAS - FUTURE OPTIONS

A thesis submitted in partial fulfilment
of the requirements for the degree of
Master of Philosophy in Polar Studies.

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Cambridge University.

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28 June 1985
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DECLARATION

I declare that this thesis is between 10 000 and 20 000 words in length, excluding figures, tables, abstract, appendices, acknowledgements and references. It is the result of my own work and includes nothing which is the outcome of work done in collaboration.

Peter Lawson Keage

28 June 1985

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The system of protected sites established for Antarctic terrestrial environments by the Antarctic Treaty is examined - protection of sites is one of the measures available to Contracting Parties to the Treaty for the preservation and conservation of the Antarctic Environment.

Protected sites are categorised: site designations are described and weaknesses are identified in terms of site selection criteria, land-use planning concepts, site management, and logistic and political pressures. Emphasis is given to practical remedies for these deficiencies which can be implemented under the Antarctic Treaty. Four options for the future operation of protected sites are discussed. These are (a) to maintain the status quo, (b) to revise selectively existing Treaty provisions, (c) to declare a 'World Park', and (d) to introduce a new protected site classification based on the Biosphere Reserve concept.

Such options are not mutually exclusive and emphasise the need for Treaty Parties to take a more positive approach to the setting aside of protected sites and to their management. It is concluded that improvements to the protected site system hinge on parallel development of (a) a conservation strategy linking conservation measures for the Antarctic terrestrial environment with those for the marine environment, (b) the establishment of an active Antarctic Treaty Secretariat to oversee the implementation and operation of recommendations on nature conservation, and (c) expansion of the Scientific Committee on Antarctic Research (SCAR) Secretariat to enable it to be more actively involved in site selection, monitoring, and environmental impact assessment.

ABSTRACT

The system of protected sites established for Antarctic terrestrial environments by the Antarctic Treaty is examined - protection of sites is one of the measures available to Contracting Parties to the Treaty for the preservation and conservation of the Antarctic Environment.

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ABBREVIATIONS

ATCM(s)	-	Antarctic Treaty Consultative Meeting(s). Recommendations made by ATCMs (i.e. Recommendation 5 of the ATCM III) are denoted thus: ATCM III-5.
ATCP(s)	-	Antarctic Treaty Contracting Party (Parties).
BAS	-	British Antarctic Survey.
CCAMLR	-	Convention for the Conservation of Antarctic Marine Living Resources.
CMC	-	Conservation Monitoring Centre (IUCN).
GEMS	-	Global Environmental Monitoring System (UNEP).
ICSU	-	International Council of Scientific Unions.
IUCN	-	International Union for the Conservation of Nature and Natural Resources.
MAB	-	Man and the Biosphere Programme (UNESCO).
MSSSI	-	Marine Sites of Special Scientific Interest.
PADU	-	Protected Areas Data Unit (CMC).
SCAR	-	Scientific Committee on Antarctic Research.
SCOPE	-	Scientific Committee on Problems of the Environment (ICSU).
SHI	-	Site of Historic Interest.
SPA	-	Specially protected Area.
SSSI	-	Site of Special Scientific Interest.
UN	-	United Nations Organisation.
UNEP	-	United Nations Environment Programme.
UNESCO	-	United Nations Educational, Scientific and Cultural Organisation.
WMO	-	World Meteorological Organisation.

CHAPTER 1

1. Introduction

> 'It had many imperfections, but contained adequate provisions for amendment in the light of experience.'
>
> Brian Roberts (1977), referring to the Agreed Measures for the Conservation of Antarctic Fauna and Flora.

Measures for the conservation of Antarctic resources are organised differently for the terrestrial (14×10^6 km^2) and marine (35×10^6 km^2) environments. Conservation and preservation measures for the terrestrial environment fall within the Antarctic Treaty, which applies to land and ice shelves south of 60°S. The conservation of marine life, except whales, is provided for by the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), the northern boundary of which approximates the Antarctic Convergence. The Antarctic Treaty and CCAMLR overlap with provisions of the Convention for the Conservation of Antarctic Seals, which applies to the Antarctic Treaty area. Both the Seals Convention and CCAMLR were conceived within the Antarctic Treaty framework and, together with the Treaty, have provision for establishing protected sites. The areas covered by the Antarctic Treaty and CCAMLR are illustrated in Figure 1.

For brevity, the scope of this study has had to be restricted to the examination of the terrestrial protected site system established by the Antarctic Treaty, although the terrestrial environment and the marine environment are mutually dependent to a considerable extent. The primary objective is to identify weaknesses in the protected site system and to propose remedies for them. The emphasis is on practicable improvements which could be implemented under the Antarctic Treaty. The purpose and characteristics of each protected site designation are described in Chapter 2. The effectiveness of

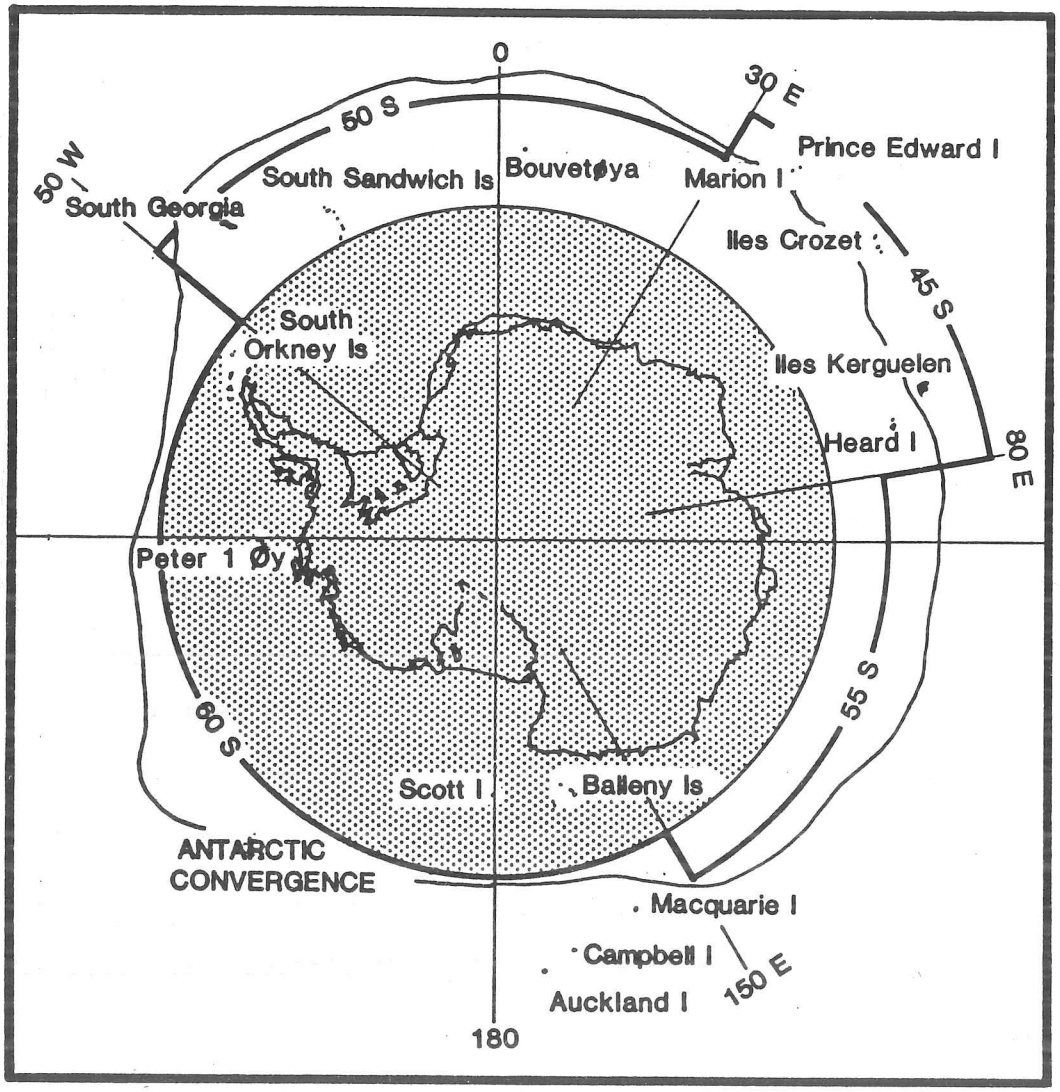

FIGURE 1. Areas covered by the Antarctic Treaty (shaded) and the Convention for the Conservation of Antarctic Marine Living Resources (bold line).

the system is assessed in Chapter 3. Improvements to existing arrangements are covered in Chapters 4 and 5. Appendices include (a) a list of dates and places of Antarctic Treaty Consultative Meetings (ATCMs) and General Assemblies of the Scientific Committee on Antarctic Research (SCAR), (b) a summary of Sites of Historic Interest (SHI), and (c) an outline of existing and proposed Specially Protected Areas (SPAs) and Sites of Special Scientific Interest (SSSI).

There are several motivations for this study.

First, ice-free land and inland lakes account for only about one percent of the continental land area of Antarctica, and support a minor proportion of the total biota of the Antarctic Treaty area. Terrestrial organisms, which are presently gradually colonising geographically dispersed rock outcrops and coasts, are sensitive to disturbance; remote ice-free land exposures may be regarded biogeographically as islands. Bonner (1984) summarises present and future effects on the Antarctic environment arising from (a) commercial exploitation of living resources, (b) casual destruction, (c) habitat destruction and mineral exploitation, (d) the introduction of other organisms, and (e) pollution. Commercial exploitation of living resources is presently the major source of disturbance to the marine environment. The periods and duration of disturbances from former sealing and whaling, and from present krill harvesting and fishing has been episodic and geographically widespread. The abundance and circumpolar distribution of most species together with the high productivity of the Southern Ocean make the Antarctic marine environment comparatively resistant to impact. Disturbance to the terrestrial environment has been caused mainly by habitat destruction. This began with the start of shore operations by sealers and whalers who, from the late 1700s, introduced alien fauna and flora to many

sub-Antarctic islands. From the early 1900s to the late 1950s, human occupancy of the Antarctic terrestrial environment increased only slightly, but has since risen sharply. There are now 36 permanently staffed stations in the Antarctic Treaty area, on islands, around the Antarctic coast and inland. A third of them are in the Antarctic Peninsula region. The wintering population of the continent expeditions is approximately 400 and they remain mostly near the stations, but in summer there is a great increase both in the population (which reaches over 3 000) and in the area affected by operations. These estimates do not include visits by tourists. Existing station facilities are being enlarged by six ATCPs (Australia, Chile, Federal Republic of Germany, France, Great Britain and New Zealand). Over the past two years, five countries have established new stations (Brazil, India, Japan, People's Republic of China and Uruguay), while Italy, Norway and Greenpeace International are planning to establish stations in Antarctica - the first two in new areas, the latter close to an existing station. Disturbance to the terrestrial environment is mostly confined to areas near stations on ice-free land and associated lakes systems, but diseases have been transmitted to seals and birds (Morgan and others, 1978).

The second motivation for studying the terrestrial protected sites stems from the paradox of the Antarctic Treaty alluded to by Brian Roberts (see above; his photograph has been looking over my shoulder for the past year). On the one hand, Contracting Parties may formulate measures to conserve natural and cultural resources prior to exploitation and, on the other, reserve for themselves the obligation of ensuring that they comply with Treaty provisions.

Protected terrestrial sites are established by ATCPs to protect selected ecosystems, species, habitats and historic monuments from interference. Boundaries and guidelines for behaviour within them are

formulated and agreed unanimously by ATCPs. The first regulations for establishing and maintaining protected sites in the Antarctic Treaty area were the Agreed Measures for the Conservation of Antarctic Fauna and Flora. They are now 21 years old and ATCPs have considerable experience in their application; several amendments and supplementary recommendations have been made to deal with 'imperfections'. Examination of the terrestrial protected site system is valuable from the viewpoint of assessing (a) the operational priorities of ATCPs, (b) the extent to which ATCPs have been able to strike a balance between operational requirements and adherence to measures formulated and unanimously agreed by Parties, and (c) whether protected sites created by international agreement are more secure than those established unilaterally. CCAMLR may make decisions in parallel with those of the Antarctic Treaty for establishing protected sites, but so far none have been declared. In reality, ATCPs account for the bulk of the membership to CCAMLR, which is linked to Antarctic Treaty principles. Thus there is another dimension to the consideration of the terrestrial protected site system - to ensure that its 'imperfections' are not transmitted to the regulation of protected sites established in the marine environment.

Finally, there has been little subsequent development of protected area designations and measures formulated by the Antarctic Treaty in the 1960s and 1970s. This is despite the system of cooperation established by the Treaty system which allows conservation needs to be anticipated (Bonner, 1984), and which is sufficiently flexible to accommodate many amendments (Orrego Vicuña, 1983). Over the past five years, there has been growing international interest in Antarctica, especially in setting aside large areas for nature conservation. The International Whaling Commission has designated a whale sanctuary (IUCN Bulletin, 1979) in that part of the Indian Ocean

which overlaps the area covered by CCAMLR; several nations around the Indian Ocean are investigating the possiblity of regional cooperation for the exploration, exploitation and environmental protection of the Ocean; some international conservation organisations have called for Antarctica to be declared an international park, and for Antarctica and the Southern Ocean to have World Heritage status. Regardless of existing and proposed protected site designations, the effectiveness of conservation measures is dependent on the degree of commitment to them shown by the many nations operating in the region. This points to the central role of Antarctic Treaty Parties in reviewing nature conservation measures and being aware of (a) advances in scientific knowledge, (b) disturbance to the Antarctic environment caused by increased numbers of stations and other activities, and (c) measures which have been successful outside the Treaty regions.

The opportunity for ATCPs to review nature conservation measures (including protection of sites) is always available at Consultative Meetings but does not appear to have been pursued effectively. However, the obligation to do so is heightened by the advances in such measures developed outside the Treaty area, and by the first detailed compilation of Antarctic conservation areas by SCAR (Bonner and Smith, 1985), which has drawn attention to imperfections.

CHAPTER 2

A summary is given of Antarctic nature conservation measures and the interest shown by various conservation bodies up to June 1961, when the Antarctic Treaty came into operation. The protected area system established on Treaty recommendations and related conventions are described, with special reference to the classification of terrestrial sites. The characteristics of existing protected areas are defined on the basis of an inventory of protected areas (Appendix 3).

2.1 Origins

Measures for the conservation of nature in some regions of Antarctica were in force nearly a century before the operation of the Antarctic Treaty but are poorly documented. It is important to take them into account as part of the background to nature conservation measures established under the Antarctic Treaty, as evidence of conservation methods which may have been tested in the region and of arrangements for the international coordination of nature conservation at the time the Antarctic Treaty was being negotiated. Legal controls for nature conservation in Antarctic regions before the Antarctic Treaty are summarised in Table 1. These can be divided into two periods: the sealing era from the late 1800s to the 1930s and the development of Antarctica after World War II.

2.1.1 Early Sealing Era

Early nature conservation measures were almost exclusively concerned with the sealing industry, which was a major incentive for the early exploration of Antarctica and the only economic activity in the region until the late 1800s. By this time indiscriminate killing had brought fur seals close to extinction and Elephant seal populations to a level which made the industry unenconomic. Without

TABLE 1. A summary of nature conservation legislation before the Antarctic Treaty.

1873 Sealing operations commenced at Macquarie Island under licence from the State Government of Tasmania. In 1919 sealing operations stopped by Government refusal to re-issue licences.

1878 British Seal Fisheries Protection Act established a 'closed season' for sealing in British-claimed territory. The Act was incorporated in the 1884 Fisheries Conservation Act.

1881 Falkland Islands Government Ordinance No.4 made regulations on the sealing industry in the Dependencies.

1891 Government of Tasmania regulations prohibited the killing of seals and penguins at Macquarie Island without permit.

1906 Falkland Islands Government Ordinance No.3 controlled whaling in territorial waters of the Dependencies.

1908 Falkland Islands and Dependencies Whale Fishery Ordinance. Set licencing fees for whaling operations, catch limits and areas of operation. Amended 1911, 1912, 1915, 1923, 1933 and 1934.

1909 Falkland Islands Government Ordinance No.7 gave protection to penguins.

1910 New Zealand Government declared Adams Island (Auckland Islands group) a nature reserve for the preservation of fauna and flora.

1912 Falkland Islands and Dependencies Seal Fishery (Consolidation) Ordinance established (in 1922) seal reserves on South Georgia.

1912 Falkland Islands and Dependencies Wild Animals and Birds (South Georgia) Ordinance. Protects wildlife listed in the Ordinance.

1913 Falkland Islands and Dependencies Wild Animals and Birds Protection Ordinance prevented disturbance to wildlife (excluding seals) except for scientific research or in emergency. Amended 1914, 1949 and 1935.

1921 Falkland Islands and Dependencies Seal Fishery Ordinance. Consolidated and amended previous laws relating to seal exploitation. Provided for a licence system for killing seals, and the appointment of seal fishery officers (inspectors). Volunteer Rocks, Elephant Jason, Bird, and Beaucheno Islands declared Seal Reserves.

1924 French Government Decrees regulated whaling and sealing in French Antarctic territory. Parts of Iles Kerguelen declared a Parc National for the protection of wildlife.

1926 Falkland Islands and Dependencies Ordinance No.6 established a Research and Development Fund to return revenues from whaling operations to research in connection with the whaling industry.

1928 Norwegian Provisional Order of Council prohibited the killing of Fur seals by Norwegian citizens. A Royal Decree of 1953 prohibited the killing of Fur and Elephant seals on Bouvetøya and Peter I øy.

1931 International Convention for the Regulation of Whaling signed by 26 nations - in force 1932.

1933 Government of Tasmania proclaimed Macquarie Island a sanctuary for wildlife under the 1918 Animals and Birds Protection Act.

1934 New Zealand Government declared the whole Auckland Islands group a nature reserve.

1937 International Agreement for the Regulation of Whaling - in force 1938.

1953 Law No. 13.908 passed by Argentina, prohibiting hunting of native animals in its Antarctic territory without a permit.

1955 Falklands Islands and Dependencies Wild Animals and Birds Protection Order provided protection for listed birds and mammals.

1956 Soviet Union declared the area round Haswell Island a protected site on 15 January, 10 days after 'Mirny' station (adjacent) was established.

1957 French Government suspended lobster fishing at Iles Saint Paul and Iles Amsterdam for a year to allow lobster populations to recover from over-exploitation.

Compiled from: Falklands Islands Gazzette, Extracts 1891-1955, Scott Polar Research Institute, pp.464, Holdgate and Roberts (1961), SCAR Bulletin (1961a), and Headland (in preparation).

exception protection measures for seals were unsuccessful: they lacked an adequate scientific basis, were virtually impossible to enforce, and were enacted 20 to 50 years after sealing operations had began on most islands - too late to compensate for pressures on seal populations. On Macquarie Island, penguins made good the shortfall in oil from Elephant seals, which had been near extermination (Cumpston, 1968). The licensing system implemented by the Tasmanian State Government in 1873 to regulate sealing operations at Macquarie Island (which commenced in 1810) appears to be the earliest piece of Antarctic nature conservation legislation. The first protected area in Antarctic regions was Adams Island (in the Auckland Islands group), which was declared a nature reserve in 1910 by the New Zealand Government.

A partial recovery of Elephant seal populations on some sub-Antarctic islands made possible a second epoch of sealing operations starting in the early 1900s and running longest at South Georgia (1909 to 1964) (Headland, 1984). Despite limited understanding of seal biology before World War II, the industry was better organised for managed exploitation; seal size, sex, and catch limits were set and inspectors were appointed to oversee operations. At South Georgia, a breeding population to support the industry was assured by the declaration in 1922 of seal reserves (Laws, 1953). By 1934 protected area status of one kind or another had been declared on Bouvetøya and Macquarie Islands, and parts of the Auckland Islands, South Georgia and Iles Kerguelen.

During the second epoch of sealing on South Georgia, the industry was operated by a whaling company (Compañia Argentina de Pesca) and sealing ended with the collapse of whaling. The number of seals that could be killed was seasonally adjusted depending on the size and composition of the Elephant seal stock in the four sealing divisions.

A sustainable yield of 6 000 seals was achieved (Headland, 1984).

2.1.2 After World War II

As a result of military, strategic and sovereign interests, the period after World War II saw a great expansion in the Antarctic operations of several nations and the start of operations for several others. It also resulted in a change in attitude to nature conservation in the Antarctic.

First, an important factor was the International Geophysical Year (IGY, 1957 to 1958), which established international scientific collaboration in the region and precipitated widespread and rapid expansion of human activity in the region. The IGY coordinating body, the Comité Special de l'Année Geophysique, recommended the creation of the non-governmental Special (later - 1962 - Scientific) Committee on Antarctic Research (SCAR) to 'coordinate, initiate, and promote scientific activity in the Antarctic, with a view to framing and reviewing programmes of scientific importance' (SCAR, 1972, 1981). SCAR first met in February 1958. An immediate concern was the 'protection of representative areas of natural environments' and assessment of the 'impact of man and introduced animals on the Antarctic environment' (SCAR Bulletin, 1959). A Permanent Working Group on Biology was established which immediately drew attention to 'careless aspects of modern operations at Antarctic scientific bases' and called on nations working there to take 'joint steps for the preservation of the Antarctic flora and fauna and its protection from needless persecution and destruction; and further, that the proper agency to co-ordinate such steps is the Special Committee on Antarctic Research' (SCAR Bulletin, 1960).

The objects of Antarctic nature conservation were first stated internationally at the Fourth Meeting of SCAR (1960), at which a report on the Conservation of Nature in Antarctica, prepared by the

Working Group on Biology, was provisionally accepted subject to approval by National Committees (SCAR Bulletin, 1961b). Among the 'General Principles' of nature conservation were:

- Antarctic fauna and flora are of outstanding scientific importance and scientific study requires them to be retained, as far as possible, in a natural state;
- species of Antarctic fauna have world-wide appeal and there is great scenic beauty which merits preservation as a world heritage;
- effective conservation measures require ecological studies of all forms of Antarctic life - all unnecessary pollution and contamination should be prohibited; and
- international cooperation is essential.

The recommendations given in the report formed the basis for the Agreed Measures for the Conservation of Antarctic Fauna and Flora which were formally adopted by Antarctic Treaty Consultative Parties in 1964.

Secondly, the scientific cooperation established by the IGY extended the range of organisations that could be actively involved in conservation of the region; this was a reveille for international conservation bodies and a time of changing intellectual attitude towards nature conservation, concern for individual species giving way to the importance of habitat preservation (Murphy, 1941, 1962, 1964; Evans, 1953).

International conservation organisations had not figured before the 1930s in Antarctic conservation measures. The International Committee for Bird Protection (later Council for Bird Preservation, ICBP), formed in 1922 was the first to express interest in Antarctic regions. In 1928 the ICBP recommended internationally coordinated action for the protection of migratory birds - a suggestion made originally in 1905 by the Royal Society for the Protection of Birds (Note 1). However, its programmes for migratory birds were centred in Europe despite an expressed interest in extending them to

Antarctica and other regions (Boardman, 1981).

In 1945 the United Nations Organisation (UN) was formed and, through its Educational, Scientific and Cultural Organisation (UNESCO), nurtured a growing interest in Antarctic nature conservation. In 1947, UNESCO's first Director General proposed the establishment of a UN conservation organisation to represent conservation interests on a global scale. Negotiations between UNESCO and the International Union for the Protection of Nature (IUPN), a Swiss branch of UNESCO led to the formation in 1949 of the International Union for the Conservation of Nature and Natural Resources (IUCN). In 1960, The XIIth International Conference of the ICBP (in collaboration with the IUCN) recommended that an International Antarctic Treaty should include provisions designed to maintain Antarctic fauna and flora, and urged 'the setting aside of adequate inviolate reserves for the preservation of this fauna and of its natural environment'.

To sum up, nature conservation measures in Antarctic regions pre-date the Antarctic Treaty by nearly a century. Early measures were closely related to sealing activities but, starting in 1910, several sub-Antarctic islands had been declared wildlife reserves. The first area to be designated for the protection of nature in the region subsequently covered by the Antarctic Treaty appears to be that round Haswell Island, which was so declared on 15 January 1956 - 10 days after the establishment of 'Mirny' Station. The island is located in territory claimed by Australia. Despite scientific investigations of Antarctic fauna and flora by several expeditions from the 1775 onwards, the introduction of legal controls beyond those relating to sealing (or whaling) was, at the very least, slow. The legislation was enacted for the protection of individual species; this pre-dated the ecological approach to conservation. In some cases, basic

conservation law even as late as the 1960s did not directly include plant life (Imshaug, 1972). Holdgate and Roberts (1961) concluded that it was international policy not to apply elaborate 'mainland' conservation legislation in a rigorous form to Antarctic territories. In practical terms this simplified legislation for the region seems reasonable fro the period before the IGY (i.e. up to 1958) when human population levels were low and expedition activities on a much smaller scale than present-day.

Treaty negotiations took place when international nature conservation organisations were poorly organised. Although they had undergone substantial changes following World War II, few could claim to have sufficient resources to be effective in the Antarctic; none had the support of the majority of nations involved in the Treaty negotiations. While there was international interest in establishing standard measures and reserved areas for the protection of nature in Antarctica, the advent of SCAR and its willingness to provide vital scientific advice to nations subscribing to an Antarctic Treaty gave little opportunity for outsiders to become involved.

2.2 Areas Protected under the Antarctic Treaty

Biologically, and in terms of nature conservation, it is convenient to regard the Antarctic and its wildlife as belonging to either the terrestrial or the marine environment. The terrestrial environment supports moss and lichen, and the simple biota of inland water bodies. Soils are mostly abiotic but there are soil fauna of invertebrates including worms and arthropods (Holdgate, 1977). In contrast, the marine environment is more complex and highly productive. While the diversity of marine mammals, fishes, crustaceans is restricted compared to lower latitudes, there is great species abundance (Knox, 1983). There is some overlap between environments as sea birds, Elephant and fur seals breed and moult on

the land.

Nature conservation measures, including those for protected areas, have been adopted as separate recommendations and conventions rather than as integral parts of the Antarctic Treaty, although 'the preservation and conservation of the living resources in Antarctica' is one of the principles and objectives of the Treaty (Article IX.f). However, Treaty recommendations and conventions are legally binding but not effective, nor do they provide explicit criteria or protection standards for ratifying legislation enacted by Contracting Parties. Technically, recommendations only apply to Consultative Parties, although acceding Parties have not objected to provisions relating to nature conservation. In order not to prejudice future considerations of mineral exploitation, there is no reference to 'non-living' resources, although their management is essential to habitat preservation and conservation.

2.2.1 Terrestrial Environment

The concept of protected areas in the terrestrial environment was established in the Agreed Measures for the Conservation of Antarctic Fauna and Flora (ATCM III-8) which apply to all land and ice-shelves south of 60° S latitude. The initiative for the Measures can be traced to SCAR (SCAR Bulletin, 1961a, 1961b; Carrick, 1960), although its provisions largely reflect those drafted and circulated at ATCM II by the UK delegation (Auburn, 1981). The Measures give the Treaty area the status of a 'Special Conservation Area' and were welcomed by conservation groups (Roberts, 1976). Laws (1972) points out that they were among the first internationally agreed systems for monitoring human impact on fauna.

Under the Measures, the killing, wounding, capturing or molesting of any native mammal (excluding whales) or bird is prohibited except by permit (Article VI). Disturbance (to the minimum extent necessary)

for the establishment, supply and operation of stations is permitted (Article VII), including the killing of seals for dog food, and the killing or disturbance of wildlife is allowed in emergency (Article V). State rights to the high seas are preserved; at the time the Measures were introduced, this recognised fishing and harvesting of marine fauna, although ATCM Rec III-1 recommended 'voluntary' regulations for 'pelagic' sealing or taking of fauna on the pack-ice in the Treaty area. All species of fur seal, and the Ross seal, are declared Specially Protected Species (Article VI), the importation of animals and plants is prohibited except by permit (Article VII) and there are quarantine restrictions on importation into the Treaty area to prevent the accidental introduction of parasites and diseases (Article IX).

During the life of the Measures, provision has been made for the establishment of Specially Protected Areas (SPAs) (Article VIII), Sites of Special Scientific Interest (SSSI) (ATCM VII-3) and Sites of Historic Interest (SHI)(ATCM VII-9). SHI are the most numerous protected site classification with 44 sites (Figure 2). In addition, Sites of Special Tourist Interest (ATCM VIII-9) and Marine Protected Sites (SCAR Bulletin, 1975) have been proposed. In this discussion, the emphasis is on SPAs and SSSI.

SPAs are intended to be 'areas of outstanding scientific interest' whose 'unique natural ecological system' is considered worthy of special protection. Their definition was subsequently (ATCM VII-2) refined to include:

- representative examples of the major Antarctic land and freshwater ecological systems;
- areas of unique complexes of species;
- areas which are the type locality or only known habitat of any plant or invertebrate species;

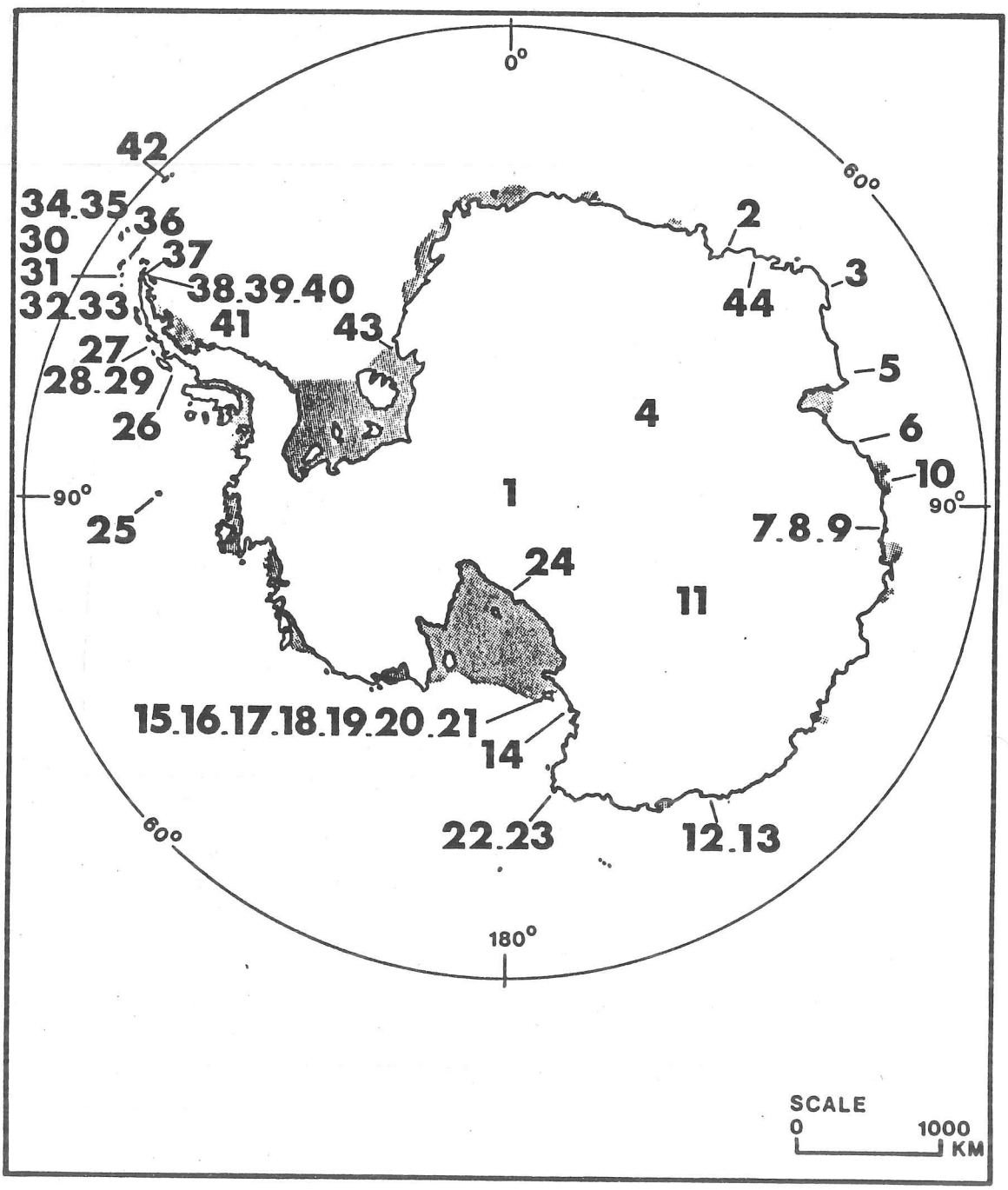

FIGURE 2. Locations of historic monuments under the Antarctic Treaty. Site descriptions are given in Appendix 1.

- areas which contain specially interesting breeding colonies of birds or mammals;
- areas which should be kept inviolate so that in the future they may be used for purposes of comparison with localities that have been disturbed by man.

Non-biological sites are therefore excluded. ATCM VII-2 also requires that the number of sites should be kept to the minimum required and for sites to be as small an area as possible to serve the purpose(s) for which they have been designated.

Access to SPAs is restricted to scientific investigators authorised by permit issued for 'compelling scientific purpose which can not be served elsewhere' and which in itself will not 'jeopardise the natural ecological system existing in that area'. The generally recognised interpretation of 'compelling scientific purpose' was given in the House of Lords by the Bishop of Norwich (Bush, 1982, p.198). The driving of vehicles in SPAs is forbidden.

SSSIs are intended to be areas 'of exceptional scientific interest' which 'require long-term protection from harmful interference'. The purpose of SSSI is to safeguard research opportunities and to prevent human interference to sites. SSSI are designated for a fixed period which may be extended following review by SCAR. A management plan is required which includes a description of the site, an outline of research and of restraints which may be needed. A permit for access is not mandatory as in the case of SPAs.

The sequence of events from the identification of sites worthy of special protection to their formal acceptance at ATCMs is not described in the Agreed Measures nor detailed in Treaty or SCAR documents; only the attributes of particular protected area classifications are given in Agreed Measures provisions. Two procedures for designating areas are possible.

First, in line with ATCM III-10 (SPAs) and ATCM VII-3 (SSSI),

SCAR is invited to make 'suggestions' to ATCMs for the designation of sites worthy of protection. In practical terms expedition personnel propose, to their national scientific committee of SCAR, sites of scientific and/or ecological importance. Submissions are reviewed by National committees; this often involves close liaison with organisations involved in Antarctic operations before the submissions are forwarded to SCAR through the Sub-Committee on Biology and Conservation. The Sub-Commitee's role here is that of a 'collecting house'. Finally, SCAR has responsibility for proposing to ATCMs areas for special protection. Because the SCAR Executive meetings are biennial and in alternate years to ATCMs, there is a minimum delay of two years before submissions to National Committees are formalised.

A second means of proposing sites for special protection is by Article XIV of the Agreed Measures, which allows amendments to the Annexes of the Measures by unanimous agreement of Consultative Parties through diplomatic channels.

The designation of protected sites has been spasmodic. Of the 19 SPAs which have been declared, 16 were designated in 1966, and 3 had their SPA status terminated in 1975. Of the 8 SSSI, 7 were designated in 1975.

2.2.2 Marine Environment

Marine wildlife is covered by the Convention for the Conservation of Seals (ATCM III-11) and the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR) which was signed in May 1980.

The Seals Convention applies to seals south of 60° S latitude; seals on land are not covered, although they are protected under the Agreed Measures. The Convention regulates the killing of seals to ensure the survival of seal species and that the marine ecosystem is not impaired. Ross, Southern Elephant and fur seals are protected, as

are Weddell seals up to one year old, or older during their breeding season; sealing zones and seasons for killing seals are defined. The Convention makes no provision for scientific research, although SCAR is 'invited' to assess relevant data and report to Contracting Parties (Article 5). It is forbidden to kill seals in three Seal Reserves which have a combined area of 190 000 km^2 (Figure 3).

CCAMLR applies to all living marine organisms, excluding whales south of an 'agreed' line which approximates the Antarctic Convergence (Figure 1). The Convention applies to waters adjacent to islands over which sovereignty is recognised by Contracting Parties. Its application to waters adjacent to land where sovereignty is contested (which includes Antarctica) has been resolved. 'Conservation' is defined as including rational use (Article II). Contracting Parties undertake to regulate fishing activities in a way which maintains the inter-relationships between members of the marine ecosystem - the so-called 'ecosystem approach'. Previous fishing agreements have usually considered species in isolation, ignoring the effects of harvesting on other species.

Administrative responsibility for CCAMLR rests with a Commission whose functions are defined in Article IX. On the advice of the Scientific Committee established under the Convention (Articles XIV and XV) the Commission has power to designate sanctuaries for the protection of marine life. At its Third Meeting (1984), the Commission closed to fishing the seas within 12 nautical miles of South Georgia because fish stocks had been depleted.

2.3 Characteristics of SPAs and SSSI

Existing protected sites are small in number and size. In April 1985 there were 14 SPAs (plus four proposed), and eight SSSI (14

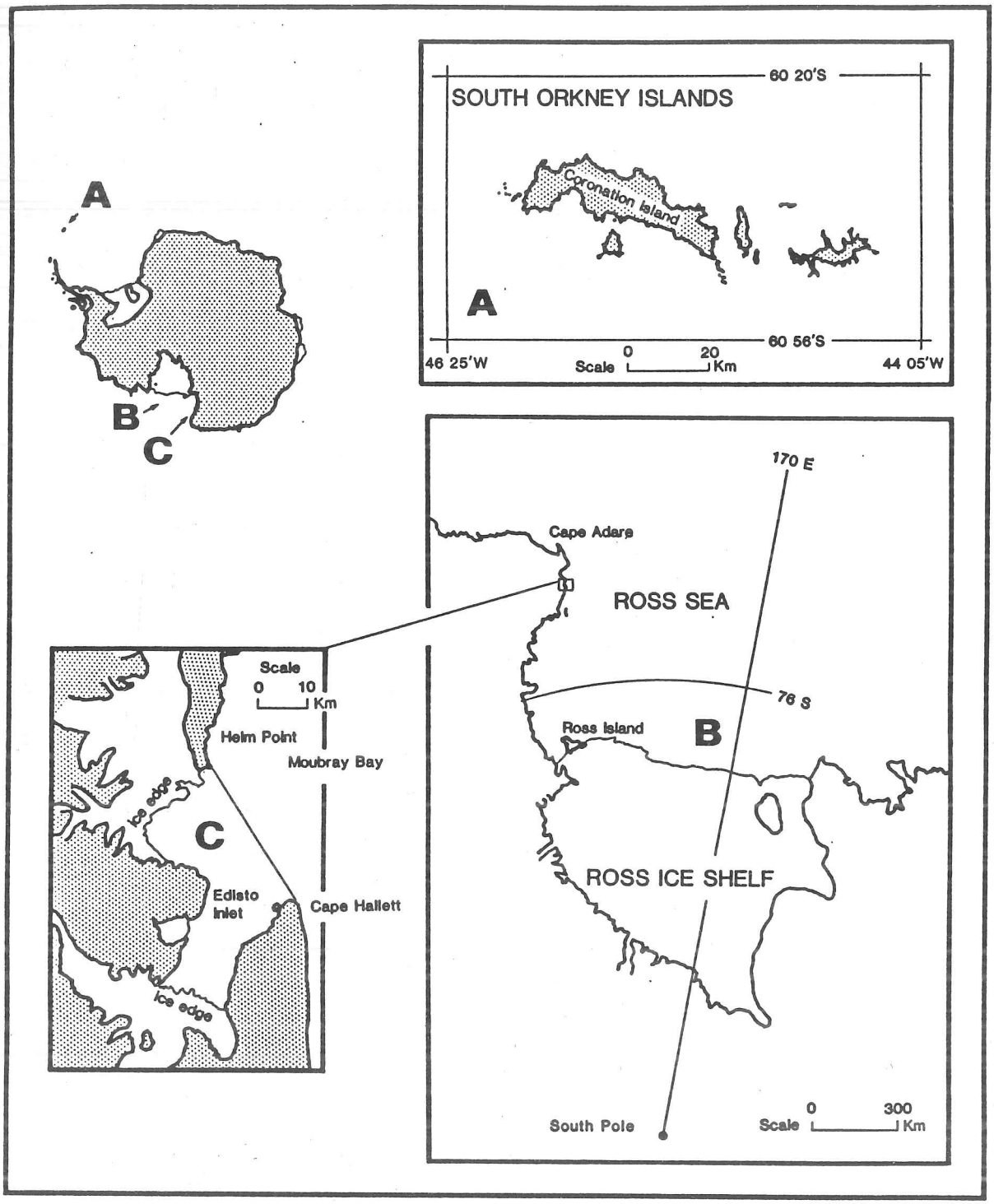

FIGURE 3. Locations of the three seal reserves established under the Convention for the Conservation of Antarctic Seals.

proposed including three marine SSSI). These are listed in Appendix 3, which also gives the date of designation or proposal, the reason for designation and the human activity associated with each site. Appendix 3 also gives the matrix cells for each site based on the matrices developed by SCAR (SCAR Bulletin, 1977) to classify terrestrial, freshwater and inshore marine ecosystems. The locations of SPAs and SSSI are given in Figures 4 and 5.

Of the 14 SPAs, nine are islands or island groups and two are peninsulas or islands. SPAs total 38.4 km^2 in area. Of the eight SSSI, one is an island and six are portions of islands; only two sites are on continental Antarctica. SSSI have a total area of 365.4 km^2. The combined area of SPAs and SSSI is less than one percent of the Antarctic continental area. The distribution patterns of SPAs and SSSI are similar; they are located close to permanently occupied stations; most sites are located within 10 km of stations.

The number of protected sites (including proposed Marine SSSI) in which terrestrial, marine and inland water ecosystems are represented is given below:

	Terrestrial ecosystem	Inland water ecosystems	Marine ecosystems
SPAs	13	4	4
SSSI	7	7	4

The set of three matrices developed by SCAR (to classify the range of ecosystems for terrestrial, inland waters and inshore marine environments) may also, by recording the frequency with which each matrix cell occurs, be used to assess the range and relative abundance of ecosystem types (Tables 2 and 3).

Terrestrial ecosystems with SPA status are entirely coastal sites below 100 m elevation above sea level. Bird breeding sites are best

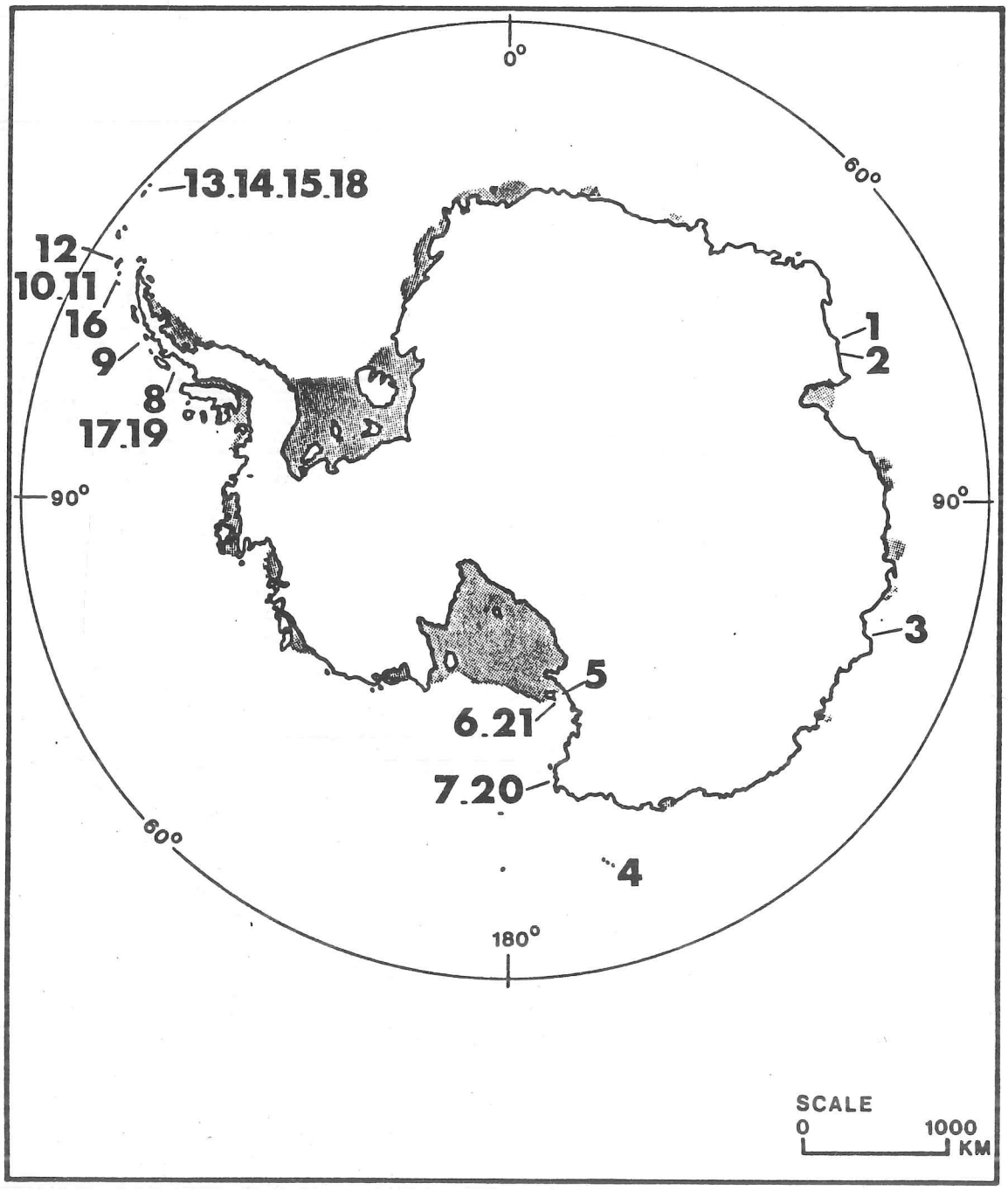

FIGURE 4. Locations of existing and proposed Specially Protected Areas established under the Agreed Measures for the Conservation of Antarctic Fauna and Flora. Site descriptions are given in Appendix 3.

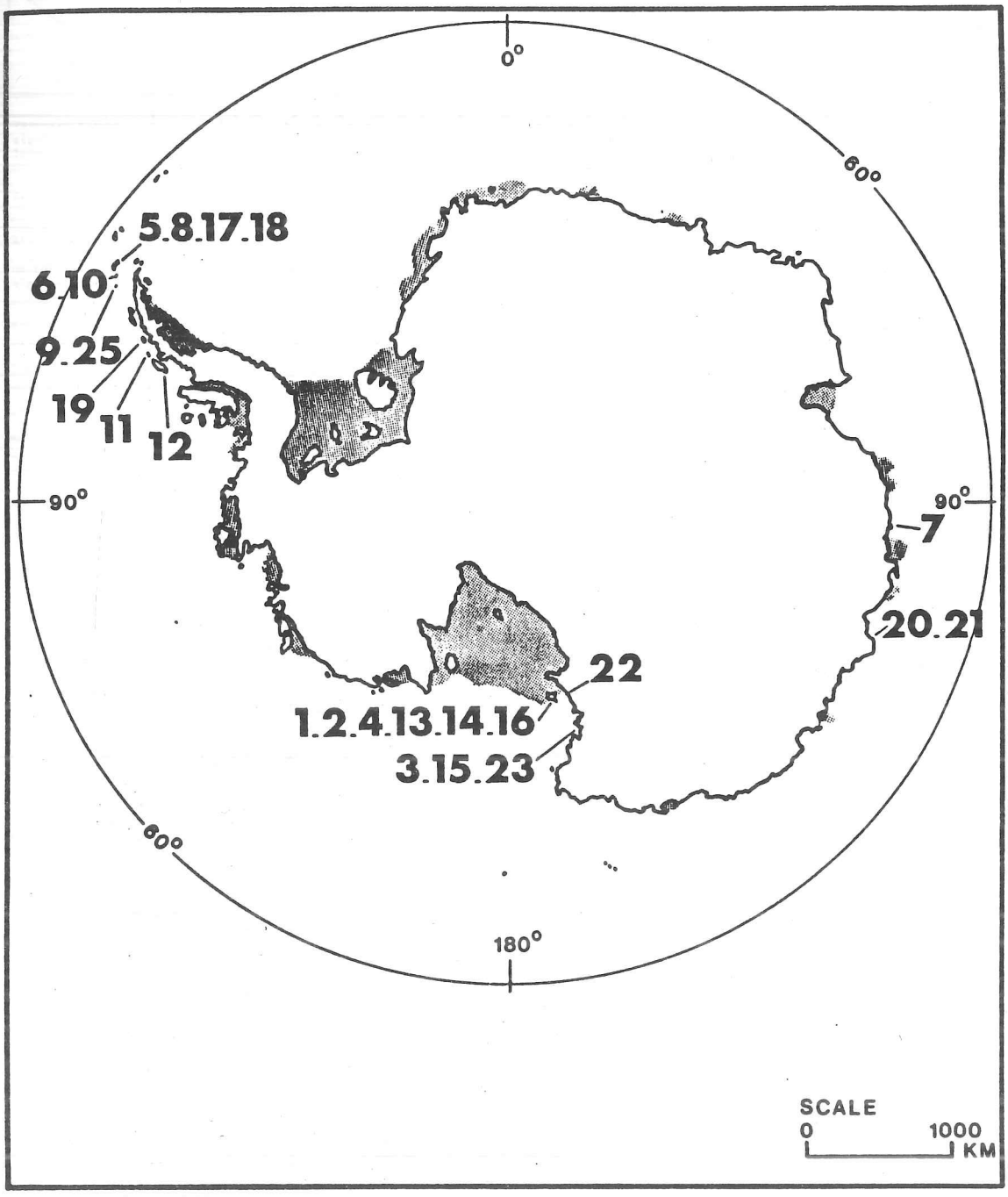

FIGURE 5. Locations of existing and proposed Sites of Special Scientific Interest established under the Agreed Measures for the Conservation of Antarctic Fauna and Flora. Site descriptions are given in Appendix 3.

TABLE 2. The range and relative abundance of ecosystems found in Specially Protected Areas.

TERRESTRIAL

	Environmental variables / Basic variables	Ice-free rocks and soils (including large snow beds										Permanent ice		
		Coastal				Inland (>10km from shore)								
		adjacent to sea and up to 10km from shore		above ice shelf		valley		mountain				ice cap/glacier coastal/and/or		
		<1000 m alt	>1000m alt	<1000 m alt	>1000 m alt	<1000 m alt	>1000 m alt	<1000 m alt	>1000 m alt			<1000 m alt	100 - 1000 m alt	>1000m alt
A	Vascular plants significant/ locally dominant	2	X	X	X	X	X	X	X			X	X	X
B	Bryophytes sig/dom	10	X		X		X		X			X	X	X
C	Lichens sig/dom	11										X	X	X
D	Macrothalloid algae sig/dom	7	X		X		X		X			X	X	X
E	Microbiota sig/dom	13										X	X	X
F	Snow algae sig/dom	3	X		X	X	X		X					
G	Sterile	-												
H	Marine faunal enrichment	14												
		1	2	. 3	4	. 5	6	. 7	8	.		9	10	. 11

INLAND WATER ECOSYSTEMS

		LAKES										STREAMS	
		Permanent						Ephemeral					
		Fresh S<3 g/l		Medium S=3-30 g/l		Hypersaline S>30 g/l		Ice dammed wholly (melt pools)	partly (rock walls)	Rock or moraine dammed sea influenced	no sea infl.	over ice	over rock
		a	b	a	b	a	b						
J	Sterile												
K	Heterotrophs only												
L	Primary Producers Phytoplankton sig/dom				1					1		1	1
M	Algal felt sig/dom				2								1
N	Bryophytes sig/dom												
P	Herbivores												
Q	Carnivores			1	1								
		1	. 2	. 3	. 4	. 5	. 6	. 7	. 8	. 9	. 10	. 11	. 12

MARINE ECOSYSTEM

			BENTHIC					LITTORAL			
		Pelagic neritic	Bathyal >500m	Shelf zone (c 500-200m) hard bottom	soft bottom	Sub-littoral (c 200-0m) hard bottom	soft bottom	Rock/ boulder	Pebble	Sand, mud and/ or shell	Ice
R	Permanent ice										
S	Seasonal ice					3	2	5	5	3	
T	Absence of ice										X
U	Fresh water influence	X	X	X	X	1	1	1	1	1	
V	Enclosed water mass		X	X	X						
W	Geothermal influence										
		1	. 2	. 3	. 4	. 5	. 6	. 7	. 8	. 9	. 10

TABLE 2. The range and relative abundance of ecosystems found in Specially Protected Areas.

TERRESTRIAL

Basic variables \ Environmental variables		Ice-free rocks and soils (including large snow beds										Permanent ice		
		Coastal				Inland (>10km from shore)								
		adjacent to sea and up to 10km from shore		above ice shelf		valley		mountain		ice cap/glacier coastal/and/or		
		<1000 m alt	>1000m alt	< 1000 m alt	>1000 m alt	<1000 m alt	>1000 m alt	<1000 m alt	>1000 m alt	<1000 m alt	100 - 1000 m alt	>1000m alt
A	Vascular plants significant/ locally dominant	2	X	X	X	X	X	X	X	X	X	X	X	X
B	Bryophytes sig/dom	10	X		X		X		X	X	X	X	X	X
C	Lichens sig/dom	11									X	X	X	X
D	Macrothalloid algae sig/dom	7	X		X		X		X	X	X	X	X	X
E	Microbiota sig/dom	13									X	X	X	X
F	Snow algae sig/dom	3	X		X	X	X		X					
G	Sterile	-												
H	Marine faunal enrichment	14												
		1	2	3	4	5	6	7	8	9	10	11		

INLAND WATER ECOSYSTEMS

		LAKES										STREAMS	
		Permanent						Ephemeral					
		Fresh S<3 g/l		Medium S=3-30 g/l		Hypersaline S>30 g/l		Ice dammed wholly (melt pools)	partly (rock walls)	Rock or moraine dammed sea influenced	no sea infl.	over ice	over rock
		a	b	a	b	a	b						
J	Sterile												
K	Heterotrophs only												
L	Primary Producers Phytoplankton sig/dom				1					1		1	1
M	Algal felt sig/dom				2								1
N	Bryophytes sig/dom												
P	Herbivores												
Q	Carnivores			1	1								
		1	2	3	4	5	6	7	8	9	10	11	12

MARINE ECOSYSTEM

			BENTHIC				LITTORAL			
		Pelagic neritic	Bathyal >500m	Shelf zone (c 500-200m) hard bottom	soft bottom	Sub-littoral (c 200-0m) hard bottom	soft bottom	Rock/ boulder	Pebble	Sand, mud and/ or shell	Ice
R	Permanent ice										
S	Seasonal ice					3	2	5	5	3	
T	Absence of ice										X
U	Fresh water influence	X	X	X	X	1	1	1	1	1	
V	Enclosed water mass		X	X	X						
W	Geothermal influence										
		1	2	3	4	5	6	7	8	9	10

TABLE 3. The range and relative abundance of ecosystems found in Sites of Special Scientific Interest (SSSI). Proposed marine SSSI are included.

TERRESTRIAL

	Environmental variables / Basic variables	Ice-free rocks and soils (including large snow beds								Permanent ice		
		Coastal				Inland (>10km from shore)						
		adjacent to sea and up to 10km from shore <1000 m alt	adjacent to sea and up to 10km from shore >1000m alt	above ice shelf < 1000 m alt	above ice shelf >1000 m alt	valley <1000 m alt	valley >1000 m alt	mountain <1000 m alt	mountain >1000 m alt	ice cap/glacier coastal/and/or <1000 m alt	ice cap/glacier coastal/and/or 100 - 1000 m alt	ice cap/glacier coastal/and/or >1000m alt
A	Vascular plants significant/ locally dominant	1										
B	Bryophytes sig/dom	4										
C	Lichens sig/dom	5										
D	Macrothalloid algae sig/dom	5										
E	Macrobiota algae sig/dom	5				1	1		1			
F	Snow algae sig/dom	3										
G	Sterile	-				1	1	1	1			
H	Marine faunal enrichment	14										
		1	2	3	4	5	6	7	8	9	10	11

INLAND WATER ECOSYSTEMS

		LAKES										STREAMS	
		Permanent						Ephemeral					
		Fresh S<3 g/l a	Fresh S<3 g/l b	Medium S=3-30 g/l a	Medium S=3-30 g/l b	Hypersaline S>30 g/l a	Hypersaline S>30 g/l b	Ice dammed wholly (melt pools)	Ice dammed partly (rock walls)	Rock or moraine dammed sea influenced	Rock or moraine dammed no sea infl.	over ice	over rock
J	Sterile												
K	Heterotrophs only			1	1								2
L	Primary producers Phytoplankton sig/dom	2	2	2	2								
M	Algal felt sig/dom	2	2	3	3								2
N	Bryophytes sig/dom												
P	Herbivores	1	1	1	1								
Q	Carnivores	1	1	1	1								
		1	2	3	4	5	6	7	8	9	10	11	12

MARINE ECOSYSTEM

			BENTHIC					LITTORAL			
		Pelagic neritic	Bathyal >500m	Shelf zone (c 500-200m) hard bottom	Shelf zone (c 500-200m) soft bottom	Sub-littoral (c 200-0m) hard bottom	Sub-littoral (c 200-0m) soft bottom	Rock/ boulder	Pebble	Sand, mud and/ or shell	Ice
R	Permanent ice										
S	Seasonal ice					3	4	4	4	4	
T	Absence of ice										
U	Fresh water influence					1	1	1	1	1	
V	Enclosed water mass					1	3				
W	Geothermal influence						1				
		1	2	3	4	5	6	7	8	9	10

represented, followed closely by microbiota, lichens and bryophyte plant communities. Few inland aquatic ecosystems are represented and their range is narrow; hypersaline lakes are not included. The range of inshore marine ecosystems is limited to sites influenced by seasonal ice and freshwater.

Ecosystems with SSSI status have much in common physiographically with SPAs. Terrestrial ecosystem sites have coastal locations and there is a relative abundance of bird and seal breeding areas. Inland water ecosystems are limited to fresh and medium-saline water bodies but the trophic levels for both ecosystem types are incompletely represented. The inshore marine ecosystems are predominantly littoral sites influenced by seasonal ice.

CHAPTER 3

The ability of the Antarctic Treaty terrestrial protected area system to achieve conservation objectives is examined. Analysis involves consideration of the completeness of Antarctic Treaty provisions, site planning, management procedures and conflicting land-uses attributable to the legal regime established by the Treaty. Analysis points to (a) manifestations of the Antarctic Treaty which may influence future conservation measures under the Convention for the Conservation of Antarctic Seals and the Convention for the Conservation of Antarctic Marine Living Resoures (CCAMLR), and (b) improvements to the system of terrestrial protected sites (Chapter 4).

3.1 Conservation Objectives and Protected Sites

Life-forms peculiar to Antarctica, climatic extremes and the political regime established by the Antarctic Treaty make the achievement of effective nature conservation measures difficult. Also, there are neither comparable mixes of ecosystems nor equivalent continental land masses regulated by international agreement that may be used to place Antarctic conservation measures in perspective. Perhaps the closest analogy is Svalbard: Norway has sovereignty over the archipelago and territorial seas under the 1920 Spitzbergen Treaty. Comparisons with land-use planning in the Arctic, although possible, are limited.

A protected sites system is one measure available for the conservation and preservation of the Antarctic marine and terrestrial environments (including their scientific attributes). Conservation objectives are not stated in the Antarctic Treaty or in Agreed Measures but are implied and summarised by Carrick (1964) and Holdgate (1970a): (a) protection of the scenic beauty and wildlife, (b) protection of undisturbed habitats and the stabilisation of habitats

which have been disturbed by man, and (c) wise management of the biological resources of the Southern Ocean. Thus, in the terrestrial environment, conservation is intended to minimise disturbance to habitats and ecosystems by man, whereas in the Seals Convention and CCAMLR, conservation is the wise management of living resources. The first two objects are relevant to the Agreed Measures, which cover terrestrial, freshwater and island habitat types.

Antarctic Treaty recommendations establish three principle protected area designations for the terrestrial environment for conservation purposes. First, Specially Protected Areas (SPAs) provide the highest level of protection. SPA status may be granted or revoked by unanimous agreement of ATCPs. Entry to SPAs is allowed only for compelling scientific studies which cannot be conducted elsewhere and which do not endanger the ecosystem under protection. Secondly, Sites of Special Scientific Interest (SSSI) are an important tool for nature conservation. Their primary object is to prevent human interference which may adversely affect research opportunities. Geological, biological and biologically inactive sites may be declared SSSIs, whereas SPA status is restricted to biological sites. While SSSI status is applied to sites for fixed periods, there is no requirement that research be undertaken within them, although research is conducted at most sites. Thirdly, Sites of Historic Interest (SHI) are intended to preserve the historic monuments and protect them from damage. There are (in 1985) 44 SHIs, including the wintering quarters of early expeditions, plaques, cairns, a disused over-snow vehicle and other monuments. Technically, a fourth protected site designation was created by ATCM XI-3, which gave the status of a tomb to the site of the 1979 aircraft disaster on Mt Erebus, Ross Island, which cost 257 lives.

Selection criteria and management requirements for each protected

site classification vary considerably (Chapter 2). ATCM VII-2 requires that the number and area of SPAs be kept to a minimum. Sites damaged by human interference may be declared SPAs. Management plans are required only for SSSI and, despite a recommendation by the Scientific Committee on Scientific Research (SCAR), management plans for SPAs have not been formally adopted. Managerial responsibility for protected sites lies with ATCPs, but there is considerable dependence on scientific advice from SCAR. In 1972 the SCAR Working Group on Biology established a Sub-Committee on Conservation charged with (a) protection of environments and biota by the designation of areas representative of undisturbed ecosystems, and (b) the formulation of management plans for these areas (Bonner and Smith, 1985).

There are few analyses of the protected area system for the Antarctic terrestrial environment which involve practical knowledge of the plight of protected sites. Those by Cameron and others (1977), and Parker and others (1978) are notable but now out-dated. Here, case studies of protected sites are included under headings corresponding to conservation objects: (a) ecosystem and landscape preservation, (b) land-use planning, and (c) implementation and operation. Political and operational factors which influence protected sites are also discussed.

3.2.1 Ecosystem and Landscape Preservation

The degree of protection afforded to ecosystems and landscapes is governed by (a) scientific knowledge of their distribution, extent, diversity and their conservation needs, and (b) the scope of the protected site classifications. Greater scientific understanding allows identification of sites worthy of special protection and the establishment of appropriate protected site classifications. This systematic approach to site protection has not been fully adopted in

Antarctica. While scientific surveys have covered most ice-free land areas and the diversity, distribution and relative abundance of ecosystems are generally known (Walton, 1984), there is no strategy to ensure that protected areas are classified into biogeographical provinces, or that for each province there are a number of protected ecosystem types for replication. Instead, existing protected areas are neither representative of Antarctic ecosystems generally nor evenly distributed biogeographically. There are also deficiencies caused by the limited scope of protected area classifications.

First, only partial protection is given to some ecosystems. Tables 2 and 3 illustrate the narrow range and relative abundance represented in SPAs and SSSI. Most protected ecosystems (bird and mammal breeding sites, and some coastal vegetation) depend on the marine environment for nutrients. However, the protection of marine sites has not been formally established by ATCMs - nor have marine sites for the protection of terrestrial ecosystems been proposed. In 1975 the SCAR Working Group on Biology invited proposals for 'Specially Protected Marine Areas' and 'Marine Sites of Special Scientific Interest' (MSSSI) (SCAR Bulletin, 1975). It subsequently supported proposals for MSSSI for the protection of benthic communities at Chile Bay, Greenwich Island and Port Foster, Deception Island (SCAR Bulletin, 1978; 1982), and South Bay, Doumer Island (SCAR Bulletin, 1983). Management plans for these have been informally adopted by ATCMs. There are no marine SPAs. SPAs cannot be declared for biologically inactive features such as geological outcrops, or continental and sea ice, which may have important local effects on some ecosystems. It is also important to restrict human activities on some parts of the ice cap to ensure the continued existence of uncontaminated sites for environmental monitoring (SCAR Bulletin, 1985).

Recognition of ice-free areas worthy of special protection is no guarantee that protected status will formally be extended to them. A well documented case of this is the Dry Valleys of Victoria Land. In 1968, the SCAR Working Group on Biology cited the Dry Valleys as deserving SPA status (Ugolini, 1970). Damage to the Valleys resulting from scientific studies was described by Benoit (1970) and the danger of contaminating biologically poor and sterile soils was noted by Holdgate (1970). Subsequent scientific investigations have caused carbon isotope contamination at various locations in the Dry Valleys (Parker, 1972). In 1969 and 1976 SCAR called for SPA proposals to be drafted for the Dry Valleys (SCAR Bulletin, 1969, 1977). The Dry Valley Drilling Programme, which commenced in the early 1970s, had a major environmental impact when drilling fluids leaked from drill casings; drilling fluids were pumped into a major lake (Parker and others, 1978). These incidents occurred despite rigorous environmental impact assessment in the early stages of programme planning. Lake Bonney remains the only major lake in the region not to have been contaminated to some degree by geological drilling. At ATCM VIII a site in the Barwick Valley (300 km^2) was declared a SSSI. In 1976, the SCAR Working Group on Biology recommended that Lake Bonney in the Dry Valleys be declared a SSSI, and that existing protected site boundaries be extended, particularly for inland and marine areas vulnerable to disturbance (SCAR Bulletin, 1977), but no action has yet been taken in relation to the region or to its coastline, where geological drilling is now underway (Antarctic, 1984b).

Secondly, scenic reserves cannot be established under existing protected site classifications. There are no guidelines for delimiting SHI, thus it is possible for SHI to include visual features but this opportunity has not been taken. Sites of Special Tourist

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Secondly, scenic reserves cannot be established under existing protected site classifications. There are no guidelines for delimiting SHI, thus it is possible for SHI to include visual features but this opportunity has not been taken. Sites of Special Tourist

Interest (SSTI), proposed at ATCM VIII-9, may list visual amenity selection criteria, but as yet no sites have been proposed or established.

3.2.2 Land-use Planning

While the Agreed Measures were innovative at the time of their introduction they have employed primitive land-use planning concepts and have not benefited from improved site planning methods used elsewhere. Inflexibility in site planning is partly the result of (a) the requirement for the number and size of SPAs to be kept to a minimum (ATCM VII-2), (b) the failure of ATCPs to formalise protected marine sites for the preservation of inshore marine areas on which land-breeding animals forage and which are a vital source of nutients for many plants, and (c) the small area of the ecosystems involved and their wide geographic separation. Two elements of land-use planning are used to direct discussion: (a) site planning needs and concepts, and (b) site management.

The small size of sites and the lack of 'buffer zones' makes them susceptible to interference by man. Apart from protected islands and some peninsulas, the sites are delimited by rectilinear boundaries, which often neglect local biological or topographical features important to the protection of the ecosystems in question. Unless suitably extensive, rectilinear boundaries seem inappropriate; the demand for land and ice-covered areas around most sites is not pressing and protected areas do not reflect the boundaries of territorial claims. The ecological integrity of protected areas would be safeguarded by selecting natural landforms as site boundaries. This is particularly so for freshwater lakes and streams, which are oligotrophic water bodies and therefore easily upset by contamination of their catchments (Heyward, 1977). For example, the watershed of Barwick Valley (including glacier catchments) would be a more useful

boundary for a site which is intended as a 'reference base' for comparative studies with other Dry Valleys. The now revoked SPA on Fildes Peninsula, which included a lake and its shore up to 100m above the water's edge, is another example of ineffective planning. The protected shoreline represented a fraction of the total area of the lake's drainage basin and, in effect, the area of shore protected varied according to lake level.

In 1968 the SCAR Working Group on Biology recognised the need to increase the areas of protected sites (Holdgate, 1970b) and in 1976 a recommendation along these lines was made to SCAR National Committees (SCAR Bulletin, 1977). Proposals for SSSI as buffer zones around SPAs have been made for Caughley Beach and Cape Royds, both on Ross Island (Bonner and Smith, 1985). This is a useful land-use planning technique within existing protected area classifications. However, because SSSI are intended to protect scientific opportunities and are designated for fixed periods, it cannot be regarded as an effective substitute for more appropriate land-use zoning.

Because ATCPs require that the number and size of SPAs should be kept to a minimum (ATCM VII-2), there is obvious need for frequent review and re-adjustment of site boundaries, and the temporal and spatial requirements of wildlife cannot be accommodated. The area needed to provide a refuge for wildlife for 10 years may differ from that needed for 50 years, over which the amplitude of environmental fluctuations can be expected to be greater. This deficiency is apparent at protected sites for seals and penguins, and for ice-free land and freshwater pools which are also in a positive state of colonisation (Bonner, 1984). In 1984 a draft proposal to establish Biosphere Reserves, typically much greater in area than existing protected sites, was raised at SCAR and is currently under review (SCAR Bulletin, 1985).

Management plans are required only for SSSI and these are inadequate in regulating access to, and behaviour in, sites. This is despite the fact that among scientific activities, geological and biological research are responsible for the greatest number of potentially serious impacts (Myers and others, 1980). Generally, plans list only permissible activities. There is no recognisable authority to manage each site, nor are there guidelines for the conduct of scientific activities (such as sampling locations, techniques and access points where appropriate), or for the scheduling of field sampling activities. The net effect of poor management is localised and potentially significant human interference with biology, resulting in diminished research opportunities. Depending on the sampling techniques of field parties, the removal of specimens reduces the richness of sites for future studies. Some scientific studies may prejudice others. The inadvertent importation of microbiota into the Dry Valleys by field parties has contaminated sterile soils and further limited the locations where they may be studied. Research activities need to be carefully planned to preserve the intrinsic value of the sites concerned and to optimise scientific output.

There is no systematic monitoring of the network of protected sites. The frequency of visits to SSSI depends on the associated scientific programme. Access to SPAs can be made only for compelling scientific reasons. Practical knowledge of specific sites is limited to the ATCPs involved in research activities there. Accordingly, management practice adopted for a protected site is formulated by one Treaty Party and occasionally jointly, as are decisions on what is an acceptable level of disturbance. This arrangement has had varying success, as environmental practices among ATCPs vary considerably. There has not been an inspection of conservation sites sponsored by SCAR or Treaty despite Article VII of the Antarctic Treaty, which

provides for this kind of control. The reports of inspections of stations have not included inspections of protected areas (Beck, personal communication).

Routine site monitoring would also identify basic shortcomings, bureaucratic or otherwise, of protected sites. For example, Cape Crozier was given SPA status at ATCM IV (1966) because of its 'rich bird and mammal fauna' and 'mixing of marine and terrestrial elements of outstanding scientific interest'. At ATCM VIII SPA status was revoked and SSSI designation extended only to part of the SPA site and an adjoining area, for long-term studies of population dynamics and social behaviour of penguins accessible from 'McMurdo' station (United States) and 'Scott' Base (New Zealand). Although the extent of the Cape Crozier Emperor penguin rookery was mapped in 1962 (Department of Lands and Survey, 1962) subsequent SPA or SSSI sites do not fully cover the rookery. The SSSI is described as being 40 km^2 in area (ATCM VIII-4) but this is an over-estimate. A small shelter and a helicopter landing pad are located in the revoked SPA.

Accurate large-scale maps of protected sites need to be produced for proposing and managing sites. Site maps which accompany Antarctic Treaty recommendations frequently omit natural features and constructions within or close by sites. Accurate site maps are scarce and mostly outdated. Site locations given by SCAR (Bonner and Smith, 1985) for the Fildes Peninsula SSSI and the Barwick Valley SSSI differ from ATCM VII-4 and from the United States Geological Survey (1978).

The existing monitoring of protected sites is, administratively, long-winded and incapable of matching the flow of relevant information or of reacting to expedition activities in Antarctica. Because SCAR and ATCMs are each held biennially and in alternate years, SSSI designations have been extended by ATCMs without having been formally reviewed by SCAR (see report of ATCM XII).

3.2.3 Implementation and Operation

The regulation of human activity in Antarctica is problematical for two reasons.

First, the Antarctic Treaty system is one based on voluntary self-restraint (Heap and Holdgate, in press). ATCPs have responsibility for implementing the Agreed Measures, the Seals Convention and CCAMLR in accordance with Treaty Article IX (f). All recommendations and conventions, although seemingly separate, are inter-linked by obligations established under Article IV of the Treaty, which protects the interests of Claimant and Non-Claimant Parties; it is aimed at achieving a status quo ante should the Treaty be terminated. In the case of CCAMLR, which may involve nations outside the Antarctic Treaty, Contracting Parties are bound to Article IV regardless of whether they are party to the Treaty. A practical result of this inter-linking of Treaty recommendations and conventions has been the expansion of the control of the Parties, both geographically and in terms of jurisdiction, over the living resources of the High Seas south of the Antarctic Convergence. It has also led to multiple systems of jurisdiction (Whyndam, 1973). Jurisdiction is based on:

- **Territory.** Claimant Parties assert rights in relation to access and regulation of living and mineral resources;
- **Citizenship.** All Parties, whether they are claimants or not, may exercise control over their citizens throughout the Treaty area. Observers and exchange scientists are subject only to the jurisdiction of the country of which they are citizens (Article VIII-1);
- **Origin of operations.** Article VII-5 requires Contracting Parties to circulate notice of activities in advance of expeditions proceeding from its territory to the Antarctic.

There are major ramifications in respect of nature conservation. For legal controls on nature conservation to be effective they must be capable of enforcement by a competent authority (Roberts, 1977). The

Antarctic Treaty makes no provision for a central authority to oversee the implementation of Treaty recommendations and related legislation. Instead, 'appropriate authority' is given to Contracting Parties. Enforcement is complicated because Parties enact legislation which is consistent with their juridical positions on sovereignty. It is not clear whether Parties are under an obligation to recognise each other's legislation (Auburn, 1982). In addition, Contracting Parties have drawn heavily on their domestic legislation and experience in setting wildlife protection standards and these vary in objectives and effectiveness. Depending on country of origin, environmental impact assessment may or may not be incorporated in planning Antarctic operations, and penalties for the same offence may differ - so may the definition of 'offence'.

Secondly, because no agency has been established by the Antarctic Treaty to monitor the performance of ATCPs in respect of nature conservation, it is virtually impossible for ATCPs to make an objective assessment of existing conservation measures or related recommendations by SCAR. There is also a need for the greater involvement of SCAR, but its capacity to meet added obligations is marginal. In 1985 SCAR's membership was 17 (plus various WMO and ICSU agencies), operating on a budget from ATCPs of $US 125 000. SCAR's vast responsibilities for nature conservation, devolved on it by ATCPs, or which it has initiated, are summarised in Table 4.

Although a non-governmental body, the overwhelming majority of SCAR's members are scientists from national Antarctic organisations. Many belong to a number of SCAR committees or Working Groups of scientific programmes which SCAR has fostered, are members of national delegations to Special, Consultative or Preparatory ATCMs, or are involved in the Scientific Committee established by CCAMLR. An Executive Secretary with secretarial support is SCAR's only permanent

TABLE 4. Antarctic Treaty Consultative Meeting (ATCM) nature conservation recommendations devolving on, or initiated by, the Scientific Committee on Antarctic Research (SCAR).

Agreed Measures for the Conservation of Antarctic Fauna and Flora	
ATCM III-10	Requests SCAR to prepare reports on wildlife conservation and annexes to the Agreed Measures (i.e. protected species, specially protected sites).
ATCM IV-19	Welcomes SCAR's decision to study the status of Antarctic animal species and preservation requirements.
ATCM VI-9	Calls on SCAR to arrange publication and exchange of information under ATCM IV-19.
ATCM VII-2	Invites SCAR to review areas designated as SPAs.
ATCM VII-3	Invites SCAR to review areas designated as SSSI.
ATCM VIII-3	Requests SCAR to propose SSSI
Convention for Conservation of Antarctic Seals	
ARTICLE 5	Recommends that SCAR receives, compiles and exchanges scientific information solicited by the Convention and reports on harmful effects of seal harvesting.
Convention for the Conservation of Antarctic Marine Living Resources	
ARTICLE XIII	Establishes working links with the Commission and Scientific Committee established by the Convention.
Other Recommendations	
ATCM V-3	Encourages SCAR to continue research on the Southern Ocean.
ATCM VI-4	Invites SCAR (a) to assess human interference in the Treaty area, (b) to propose measures to minimise harmful interference, and (c) to recommend scientific programmes on changes in the environment.
ATCM VI-5	Invites SCAR to consider principles for the controlled use of radio isotopes in the Treaty area.
ATCM VII-6	Invites SCAR to assess possible impact on the environment of the Antarctic Treaty area and dependent ecosystems of mineral exploration and exploitation.
ATCM VIII-11	Invites SCAR to take responsibility for the Antarctic component of the research programme organised by SCOPE*.
ATCM VIII-13	Invites ATCPs, in collaboration with SCAR, (a) to monitor changes in the environment, and (b) continue participation in relevant research programmes of UNEP**.
ATCM VIII-14	Coordinate national geoscientific research and assesses likely environmental impact of mineral exploration and exploitation.
ATCM X-4	Refers to SCAR the consideration of procedures for the collection of geological specimens.
ATCM X-7	Invites SCAR to review programmes for determination of baseline measurements of hydrocarbon development.
ATCM XII-3	Invites SCAR to advise on (a) activities which may be harmful to the environment, and (b) environmental assessment procedures.

* SCOPE - Scientific Committee on Problems of the Environment
** UNEP - United Nations Environment Programme

staff. Consequently, SCAR committees and Working Groups are pressed to perform tasks requiring the coordinated input of members experience lengthy delays. For example, in line with responsibilities listed in Table 4, one would have expected SCAR routinely to monitor sites it had recommended to ATCPs for SPA and SSSI status but, until recently, this has not been the case. In 1982, SCAR decided to compile a listing of conservation sites. It was published in March 1985, but a final version is not expected until 1987 (Bonner and Smith, 1985). Similar delays are experienced in other branches of SCAR. The SCAR Telecommunications Manual took four years to prepare, and nearly two years were needed for the report of the 1982 SCAR Symposium on Antarctic Logistics.

Without additional finance and full-time staff, the SCAR Working Group on Biology cannot expect to cope effectively with demands above current level. This is not an encouraging sign; SCAR responsibilities under the Seals Convention or CCAMLR have not been fully exercised and a regime for the exploitation of minerals in Antarctica, which may involve SCAR, is imminent.

3.2. Logistic Constraints

Only about one percent of the Antarctic is ice-free and accessible for the construction of stations, and associated facilities are extremely scarce. These locations are also vital habitats of plants, breeding birds and seals. The greatest concentration of stations and wildlife occurs in the Antarctic Peninsula region and islands of the maritime Antarctic. Protected sites are also concentrated in this region.

The land-use conflict between the claims of wildlife (and measures for its protection) and the necessity for operational stations is inevitable. Consultative status to the Antarctic Treaty requires the conduct of substantial scientific research in the region

'such as the establishment of a station' (Treaty Article IX), but the Treaty is not prescriptive on the siting of stations. Also, disturbance 'to the minimum extent necessary' for the establishment, supply and operation of stations is permitted under the Agreed Measures (Article VII). The establishment of a station as a basis for Consultative status was removed at the First Special ATCM (1977) but this has not deterred nations acceding to the Treaty from constructing them. Nations with Antarctic territorial claims might view restrictions on the siting of their stations as an erosion of sovereign rights.

The resilience of ecosystems in the face of interference from stations in close proximity is a major consideration in designating protected sites. Different approaches to site planning and management are required for each protected site, depending on the ecosystems involved, and on local factors such as terrain, station size, proximity, activities and anticipated growth. Nonetheless, competition between wildlife and man for land is real and disturbance is inevitable. SPAs and stations may be mutually exclusive.

At Cape Hallett, a small patch (1.2 km^2) of particularly rich and diverse vegetation which supports a variety of terrestrial fauna of outstanding scientific interest was declared a SPA in 1966. The SPA is part of the Willett Cove embayment, 300 m east of 'Hallett' station (United States and New Zealand) which operated continuously from 1956 to 1965, and closed in 1973. Before its designation, the SPA was subject to widespread disturbance for nearly a decade. Eklund (1964), Rudolph (1970) and Johnston (1971) describe disturbance to breeding birds caused by station construction and activities. Construction included site levelling and roadworks using caterpillar tractors. Two small huts were erected in the SPA (Department of Scientific and Industrial Research, 1963). Separate United States Navy and New

Zealand emergency food depots were located at its southern boundary. During the bird breeding season blasting was necessary to install radio antennae. In the station area snow drifts formed by constructions permanently cover land which used to be ice-free, fertile and colonised by breeding birds (Dater, 1965a; Pascoe, 1984). The ground covered by buildings and stores represents 20% of the total penguin breeding area at Cape Hallett (Keys, 1984). The winter antics of station personnel in the early 1960s included homemade fireworks consisting of hydrogen balloons carrying oil-soaked rags. Soil was imported to the station and plants were cultivated outside. In 1964, restrictions were placed on station personnel to limit interference to birdlife (Dater, 1965b, 1965b). There were regular helicopter and fixed-wing aircraft operations; sufficient sea ice cover on Willett Cove for small aircraft operations was a factor in favour of locating a station at Cape Hallett, and Edisto Inlet (a Seal Reserve in accordance with the 1972 Seals Convention) was used as an ice-runway until the early 1970s (Fredrickson, 1971). The roadworks which form the western boundary of the SPA provided access to the Edisto Bay landing strip. Aircraft passengers visiting 'Hallett' included pet dogs and cats. An estimated 55 000 gallons of fuel oil remain in ageing storage tanks and pose an ever-present threat to the local environment. Clean-up operations commenced in 1984/5; a small emergency and scientific base is to be re-established. Surplus fuel supplies are being removed (Antarctic, 1983, 1984a, 1984b). It is proposed to enlarge the Cape Hallett SPA (Bonner and Smith, 1985), but SPA status seems inappropriate. Human impact on the local environment at Cape Hallett was greater than at most Antarctic stations and its most important contribution may be as a SSSI for scientific studies of man's interaction with the polar environment.

PLATE 1. The Antarctic French station "Dumont d'Urville", Terre Adélie. The scarcity of accessible land for station constructions is illustrated by "Dumont d'Urville" (circa 1980), which is perched on Ile de Petrel, 2 km from the Antarctic mainland. The station was established after the French station 'Port Martin', 60 km east, was destroyed by fire in 1952. The coastline of French Antarctic Territory is mostly ice cliffs. Crevassing associated with outlet glaciers occurs several kilometres inland. Neighbouring islets are being quarried to construct a runway.

3.3 Political Constraints

Terrestrial protected sites were among the first boundaries created under the Antarctic Treaty; activities permitted within them have been agreed by all ATCPs. As the Treaty system is founded on a commitment to self-restraint by a range of nations of differing political bias and attitudes to resource exploitation (Heap and Holdgate, in press), the plight of protected sites provides a rare insight into the operational priorities of ATCPs and the workings of the Treaty.

On Fildes Peninsula, King George Island, there is a demonstrable gap between the theory and practice of the terrestrial protected area system. At ATCM IV (1966) Fildes Peninsula and the off-lying Ardley Island (30 km^2) were given SPA status because of their 'outstanding ecological interest'. SPA status was applied to Arley Island despite the fact that radio antennae and three buildings, including a helicopter and seaplane hangar, had been established there and used by the Argentine Navy sporadically since 1953 (United States Project Officer, 1961). During the 1967-8 austral summer the Soviet Union constructed 'Bellingshausen' station on the Peninsula, and Chile followed a year later by constructing 'Presidente Frei Montalva' station. This involved the erection on Ardley Island of radio antennae and a hut, which were removed in 1982/3 (Carajal, 1982a). At the Second SCAR Symposium on Antarctic Biology (1968) SCAR sought an adjustment to the Fildes Peninsula SPA boundary (excluding Ardley Island) to take account of disturbance to nature caused by station activities (SCAR Bulletin, 1969). At ATCM V (1968) SPA status was revoked, except for a small lake and surrounding shoreline within 100 m of the water's edge at the northeast corner of the Peninsula. Subsequently, the SCAR Working Group on Biology recommended that SPA status be terminated because the catchment of the protected lake was

likely to be contaminated by extensive areas of land cut by tracked vehicles (SCAR Bulletin, 1975). The lake now supplies fresh water to 'Artigus' station (Uruguay). SPA status was revoked at ATCM VIII (1975) and, at the same time, two other sites (1.8 km^2) on the Peninsula were designated as SSSI to preserve fossils and Tertiary strata. The northernmost SSSI included a bunkering depot and a road linking the fuel depot with 'Bellingshausen' station, which were constructed in 1972/3. Vehicular traffic, except in emergency, is prohibited in the management plan. In 1979/80, Chile prepared a 1 200 m landing strip across the Peninsula and opened 'Teniente Rodolf Marsh Martin' station, adjacent to it. This is about 1 km from 'Presidente Frei Montalva' and connected with it by road. Subsequently, the landing ground was improved for intercontinental aircraft; the main approach path for landing is over Ardley Island (Carajal, 1982b; Studd, 1983). The People's Republic of China has established the most recent station, 'The Great Wall of China'. It was erected in two weeks and involved over 500 expedition personnel. Construction necessitated the eviction of penguins from breeding sites, and collections of lichen from various parts of the Peninsula were made to provide a uniform albedo surface for meteorological sensors (private communication). Five major stations, an intercontinental air runway, and several huts on Fildes Peninsula, with two others on Ardley Island, now occupy the original Fildes Peninsula SPA (Headland and Keage, 1985). Since 1968 the numbers of breeding penguins on Ardley Island have declined from about 5 000 to 1 000 pairs (Ollig, personal communication). The SSSI on Fildes Peninsula, and those on Byers Peninsula, are the only sites protected for geological reasons. The SCAR Working Group on Geology recommended that geological features, outcrops or deposits not be declared

[Courtesy Mr Pat Cooper]

PLATE 2. 'Don't disturb the natural ecosystem by installations!' A sign erected in February 1985 by scientists working inland of the Chinese, Chilean and Soviet stations on King George Island. This is a 'common-sense' approach to protect an important study site in an area of high human activity. Regardless of the accessibility of sites, signposts are required at the boundaries of all protected areas. A useful signpost for Antarctic conditions is described in Parks (1984). The marker consists of a brightly-coloured hollow tube in which the site details and a visitor's log are housed. ATCM VI-14 recommends that site descriptions be in several languages.

protected sites in order not to attract undue attention to them (SCAR Bulletin, 1984).

Experience at Fildes Peninsula demonstrates that protected sites have little force in the face of logistic and political priorities. The development has been haphazard; there has been little consultation among the nations involved. While the Agreed Measures make special provision for the establishment of stations, the concentration and expansion of stations has caused severe and widespread disturbance. Under these pressures, SPAs have proved more of an inconvenience than a management tool for nature conservation. SSSI status would appear to have been applied as an expedient. The irony is that the unregulated establishment of 'research' stations has significantly impaired protected sites and the scientific attributes of Fildes Peninsula.

Political necessity appears to be responsible for the excessive duplication of station facilities among nations. SCAR's influence on events on Fildes Peninsula has been limited. SCAR's charter gives it the status of only an advisory body to ATCPs, who interpret and implement advice, an example being the recommendation by SCAR that the SPA boundary on Fildes Peninsula be redefined following the establishment of two stations there. This resulted in the termination of SPA status for Ardley Island and all of Fildes Peninsula except a small lake and its shoreline. Because there is no mechanism under the terms of the Antarctic Treaty for assessing competing demands for resources, problems on Fildes Peninsula are likely to be duplicated elsewhere.

3.4 Conclusions

The existing system of terrestrial protected sites has limited capability of meeting its objectives.

Selection criteria for SPAs and SHI are too narrow - the

requirement for the number and areas of SPAs to be kept to a minimum, and for the fixed-period designations for SSSI, imposes self-defeating restrictions on each category. SPAs should allow for marine and non-biological sites. Marine SSSI need to be formalised. Broadening of selection criteria would provide more effective ecosystem protection, including the use of natural features to delimit sites. There is no protected site classification to preserve landscape and visual catchments.

Existing sites are not fully representative of Antarctic ecosystems; a network of representative sites can only be formulated from an inventory of habitat and ecosystem types, which gives their relative abundance, distribution and geographical area. This would allow protected sites to be established on a biogeographic basis with redundancy in each biogeographic province. The inventory of ecosystem and habitat types would contribute to a conservation strategy for the Antarctic environment as a whole.

There is a demonstrable gap between the theory and practice of the terrestrial protected area system. Protected sites close to major stations, despite their status, are liable to disturbance. More potent site management plans need to be developed. The degree of protection afforded to protected sites must be consistent with actual and anticipated levels of human activity - activities could be permitted as a temporary, seasonal or permanent arrangement. The responses of ATCPs to recommendations by SCAR for the extension of protected status to particular sites has been varied - the wider interests of ATCPs have prevailed in some cases. It has been suggested that a contributory factor is the low priority given to Antarctic scientific activities by some national governments (Alburn, 1982), although increasing Antarctic operations with corresponding financial commitment, and the acceptance by ATCPs of interim measures

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for nature conservation may make this assertion difficult to support.

These conclusions suggest that some or many ATCPs need to show much greater commitment to obligations created by protected sites, and that the obligations must be enforcable. There is also a greater role for SCAR - particularly its Working Group on Biology. The Working Group advises ATCPs on conservation research and has the expertise to formulate a conservation strategy for the Antarctic continent, including the inspection of protected sites and nature conservation measures of ATCPs.

CHAPTER 4

As a result of the shortcomings of the terrestrial protected site system discussed in Chapter 3, and the developments in site planning and management outside the Antarctic, some possible amendments to terrestrial protected sites are proposed. These are: (1) to continue and develop present procedures and arrangements (the status quo), (2) to revise selectively Antarctic Treaty recommendations and conventions, (3) to declare Antarctica a World Park, and (4) to introduce a protected site classification, adapted from the UNESCO biosphere reserve concept.

4. Introduction

Principal responsibility for nature and landscape preservation south of 60° S lies with ATCPs; this responsibility is self-imposed (Antarctic Treaty Article IX) and acknowledged internationally by some agencies outside the Antarctic Treaty (e.g. IUCN, 1981). Ideally, revision of the terrestrial protected site measures should be considered as one component in a conservation strategy for the whole of Antarctica and its associated ecosystems. The strategy would take into account inter alia the sensitivity of the terrestrial environment to interference and, based on the likely extent and persistence of disturbance to the environment as a result of research and logistic and commercial activities, would establish guidelines for Antarctic operators. In fact, the Agreed Measures, the Convention for the Conservation of Antarctic Seals and CCAMLR have already established a 'decentralised and functionally oriented' management system for Antarctic marine and terrestrial resources (Scully, 1983). The biological interdependence of terrestrial environment on the marine environment, with the relatively autonomous regimes established by Treaty recommendations and related conventions, necessarily complicate

the revision of measures for protection of terrestrial sites. Each resource management regime has conflicting approaches to environmental management; the primary object of the Agreed Measures is to minimise disturbance by man, whereas the Seals Convention and CCAMLR allow for rational use of the environment. As a result, suggested revisions to the terrestrial protected site system may include restrictions which conflict with arrangements formulated under the Seals Convention and CCAMLR.

The approach adopted here is to identify improvements to the terrestrial protected site system which might respond to the inadequacies discussed in Chapter 3. Emphasis is given to practical improvements within the Antarctic Treaty which anticipate developments likely to affect the terrestrial environment, including any regime for the exploitation of minerals, and SCAR/IUCN collaboration. Generally, revisions to Treaty recommendations and practice are suggested without considering their political aspects. As each ATCP has enacted the Agreed Measures separately, the relevance of some suggested amendments will vary among Parties. In the absence of an Antarctic conservation strategy, the World Conservation Strategy (WCS; IUCN, 1980; IUCN Bulletin, 1980) and Arctic land-use planning and management practice are discussed as examples for improving the terrestrial protected site system. Improvements can be categorised as those which require selective adjustments of existing measures (option 2), and new measures and procedures (options 3 and 4).

4.1. Option I - Status Quo

The status quo option is to continue existing measures - key Antarctic Treaty directives are:

> Treaty Article IX (f), requiring Contracting Parties to take measures for the 'preservation and conservation of living resources in Antarctica';

ATCM IX-5, drawing attention of ATCPs to interference with the Antarctic environment caused by operations there; and

ATCM XII-3, drawing attention of ATCPs to the need for environmental impact assessment (EIA) of scientific and logistic activities.

A precautionary philosophy underlies these and other nature conservation measures; hitherto recommendations and agreements have been based on self-restraint. However, the gradual evolutionary approach to the resolution of Antarctic Treaty issues (Scully, 1983) is disadvantageous to protected sites subject to rapidly increasing disturbance. Owing to increasing human activities (including new research stations and extensions to existing facilities, increased scientific activity and possible future shore-based mineral or fisheries activities), practical - rather than precautionary - measures need to be implemented.

One test for the evolution of conservation measures is ATCM XII-3, which cites the importance of Environmental Impact Assessment (EIA) on existing and future scientific and logistic programmes. The recommendation, and the invited response of SCAR (Benninghoff and Bonner, 1985), contains issues which are contentious in the Treaty system, especially the proposal to circulate among ATCPs impact assessments and the need for self-imposed restrictions. EIAs will potentially involve assessing disturbance to the terrestrial and marine environments and direct ATCPs towards issues and decision-making central to an Antarctic conservation strategy. It is likely that discussion of ATCM XII-3 by the Treaty Parties will be protracted; there is the possiblity that operations and activities in Antarctica will continue to increase at a rate exceeding that which the Treaty system can effectively guide so that disturbance to the environment is minimised. This deficiency is recognised outside the Treaty; SCAR has proposed a review of terrestrial protected sites in

the event of mineral activity in Antarctica (SCAR, 1979). Also, Holdgate (1984) has stressed the importance of effective processes for environmental impact assessment, feeding into resource management systems, with monitoring to compare performance with prediction.

4.2. Option 2 - Revise Selectively Existing Measures

Antarctic Treaty recommendations are formulated and agreed by all ATCPs; they provide the basic framework for selective revision, taking advantage of the experiences of ATCPs and plans for continuing involvement in the region. This option presupposes the active and continuing review of nature conservation procedures on an increased scale. This would be initiated by ATCPs and conducted either (a) by establishing a permanent Working Group reporting to ATCMs, (b) by preparation of a conservation strategy which would incorporate monitoring and review procedures, (c) or on the basis of advice from SCAR, or (d) by a combination of the above.

For convenience, selective improvements are summarised under five headings but, in practice, each impinges on several Treaty recommendations and procedures.

4.2.1 Site Identification and Selection

Criteria for identification of Specially Protected Areas (SPAs; Agreed Measures Article VII; ATCM VII-2) and Sites of Special Scientific Interest (SSSI; ATCM VIII-3) are science-oriented; they need to be broadened in scope to include ecosystem concepts embodied in the WCS which have been adopted by CCAMLR. The Agreed Measures do not refer to ecosystems, nor to any ecological terms related to the ecosystem concept; ecosystem complexity and stability are not formally recognised criteria for site planning (Risebrough and others, 1972). Elements of ecosystem complexity include: species richness, connectance, interaction strength, and evenness. For ecosystem stability there are considerations of resilience, resistance, and

variability. Individual species abundance, species composition and trophic level abundance are additional variables (Pimm, 1984). The ecosystem approach indicates the need to give protection to marine elements affecting terrestrial protected sites, and to monitor changes at all sites (both man-induced or naturally occurring impacts). Current practice makes it difficult to foresee threats or to devise strategies to protect sites from the secondary effects of seemingly disparate activities. Criteria for SPAs should be expanded to include non-biological sites. Formal protection of rare geological outcrops, especially fossils, needs to be established; some rare fossil occurrences coincide with the location of major Antarctic stations and inter-continental runways, and visits to these areas are among the most frequent in Antarctica.

Ray and others (1984), and Ray (in press) outline different ways of identifying protected sites using the ecosystem approach. These include (a) identification based on lists of selected species, their diversity and probable threats to them, (b) classification of environments based on regional biotic and physical attributes, and (c) a habitat matrix approach based on biogeographical classifications. Theoretically, the pattern of protected sites to emerge from these selection processes, compared to existing procedures, would give a greater number of sites of larger area, encompass representative ecosystem and habitat types, and be more evenly distributed among biogeographical provinces. In addition, the regional signficance of wildlife would be emphasised. Landforms and areas of exceptional natural beauty would also be accorded regional importance.

Geographic area is an important element in site identification; the stability of a site is dependent on its size and the ability of management practice to react to any pressures placed on it. Principles for establishing protected site boundaries are discussed by

Zentilli (1977) and the (Canadian) Task Force on Northern Conservation (Department of Indian Affairs and Northern Development, 1984), and summarised below; boundaries should

- encompass the values or resources that justify establishment of the site;
- include natural features as boundaries;
- include buffer zones to preclude future use of sites which could pose a threat to a site's integrity;
- enclose sufficient area to facilitate infrastructure for administration, visitor use, protection, maintenance, and conservation, even though these areas may be devoid of interest from the viewpoint of conservation; and
- enclose the visual catchments, sea and landscapes.

Site identification criteria for historic sites given by ATCM I-9 are too general; sites which do not conform to 'traditional' concepts of Antarctic historical monuments have been so declared. These include a plaque from the Lions International Club (SHI No.35; see Appendix 1), statues (37, 40), a light-house (29), and a concrete monolith (32). To some extent, the pattern of SHIs (Figure 2) reflects the over-enthusiasm by some ATCPs to designate sites rather than a comprehensive coverage of important monuments. While monuments are protected, their surroundings are frequently not - often detracting from their visual quality and the archaeological significance of relics which may be scattered about the monument (Harrowfield, 1983). For example, historic monument status which has been given to a hut and a plaque at Cape Denison (SHI Nos. 12 and 13), associated with the 1911-14 Australasian Antarctic Expedition, should be terminated in favour of historic status being given to Boat Harbour and the whole station area as described by Ledingham (1979).

Improved site identification criteria are no guarantee that desirable sites will be protected; the logistic requirements of Antarctic operators and the termination, within short periods, of

protection status for some sites (e.g. Fildes Peninsula), the inappropriate designation of others (e.g. Cape Hallett), and the failure to afford protection to valuable sites (e.g. Dry Valleys) indicate weaknesses in site selection procedures.

First, more thorough investigation of proposals for protected sites is required among SCAR Working Groups in the early stages of site evaluation. Currently only the Working Group on Biology is involved in assessing the conservation value and management requirements of prospective sites independently of the planning and engineering proposals under consideration by the Working Group on Logistics. This gives rise to conflicting reports and confused guidance to ATCMs. An example is the 1978 SCAR General Assembly recommendation (adopted from the Biology Working Group) to establish two Marine SSSI in Chile Bay, Greenwich Island, for the protection of benthic communities (Bonner and Smith, 1985). These sites are 500 m and 800 m west of 'Capitán Arturo Prat' station (Chile). In 1982, the SCAR Working Group on Logistics reported on the proposed construction of a runway up to 1 430 m long extending into Chile Bay north of 'Capitán Arturo Prat'. Construction would involve site levelling by blasting 1 000 m^3 of rock, drainage to the sea of coastal lagoons, local quarrying of 100 000 m^3, and a breakwater along the coastline (Alarcon and others, 1982). The 1982 report makes no reference to the proposed marine SSSIs.

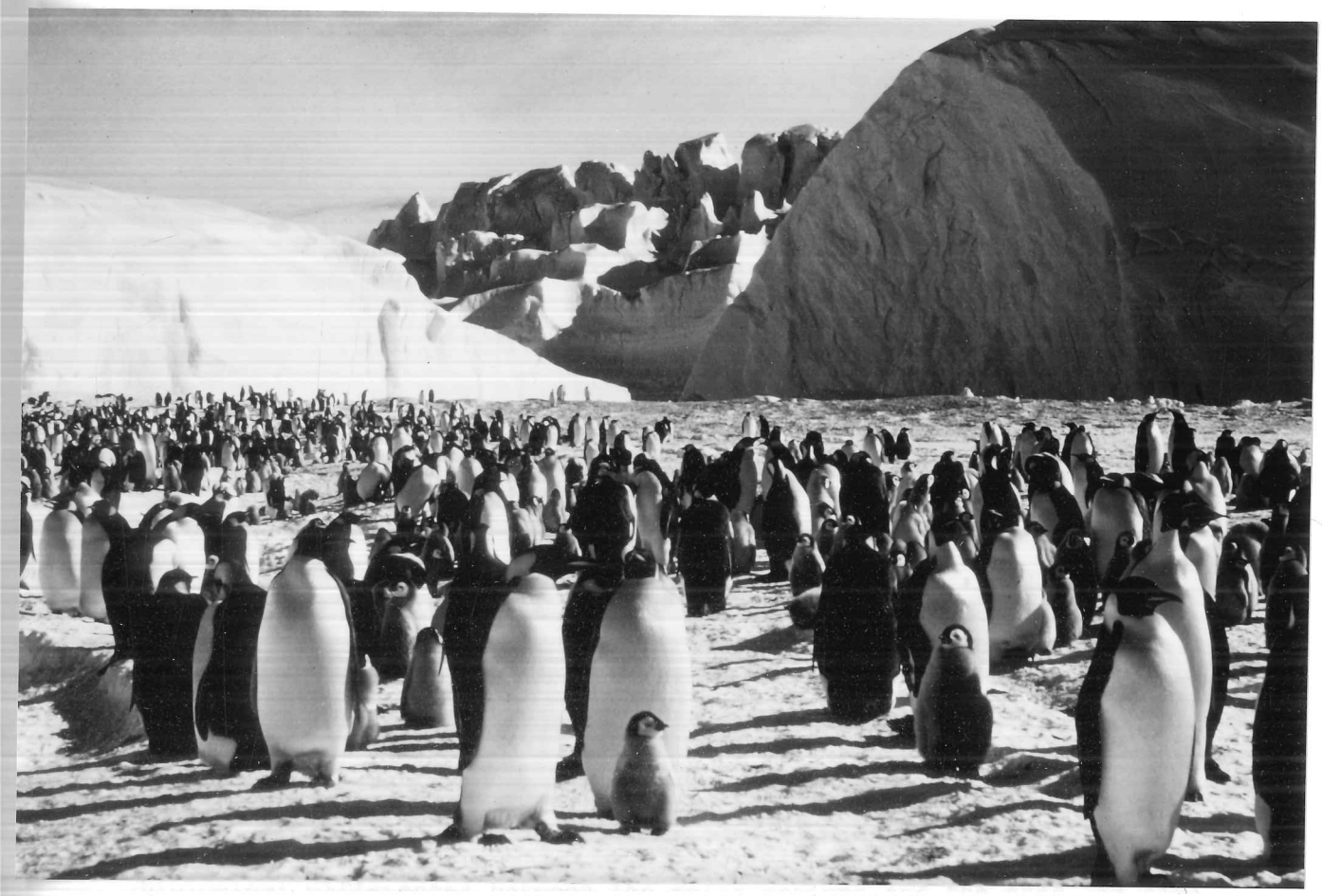
Secondly, the value and special needs of proposed and existing sites would be better conveyed to ATCPs by SCAR representation at ATCMs. There would be additional benefits to SCAR and ATCMs from this arrangement. For SCAR it would (a) streamline communication between the two, (b) serve to remind SCAR of its administrative responsibilities to ATCMs, and (c) aid the formulation of research proposals of relevance to ATCPs. The caveat for SCAR is that

involvement at ATCMs should not be prejudicial to its primary role of promoting collaborative scientific activities in Antarctica. The value for ATCMs would be (a) to have recourse to SCAR for reports and advice, and (b) to solicit SCAR advice on specified ATCM agenda items, especially in relation to SCAR recommendations for protected sites. It is desirable that SCAR should be involved in defining boundaries and management procedures for sites whose protected status is altered - it is inconsistent for ATCPs to require SCAR to recommend SPAs and SSSIs and yet, without consultation with SCAR, to revoke and re-establish SPA and SSSIs (Byers Peninsula and Fildes Peninsula). Experience has shown that this results in re-defined sites incapable of maintaining the biological assemblages for which they were designated.

4.2.2 Protection of Inshore Marine Areas

Designation of marine protected sites is complicated by the overlapping responsibilities of the Agreed Measures, the Seals Convention and CCAMLR - all avoid the question of exploiting non-living resources and exacerbate the problem of designating protected sea-floor areas.

Apart from seal reserves established by the Seals Convention (Figure 2), and the sea ice within SPAs (Cape Crozier, Taylor Rookery and the Dion Islands), special protection has not been afforded to inshore areas. Under CCAMLR Article IX marine sanctuaries can be established, but involvement of CCAMLR for establishing protected sites to complement terrestrial sites must be viewed as an expedient. It would (a) potentially involve organisations other than Antarctic Treaty Parties in decisions relating to the Antarctic terrestrial environment, (b) duplicate procedures for nominating and managing protected sites selected primarily to safeguard wildlife occurring on land, (c) place added pressures on SCAR to advise the



[Australian Antarctic Division]

PLATE 3. Emperor penguin rookery, Taylor Glacier, Mac.Robertson Land. The Agreed Measures for the Conservation of Antarctic Fauna and Flora have not been effectively applied to the in-shore marine environment although they specifically exclude whales and give special protection to seals. In-shore sea ice areas colonised by Emperor penguins are protected at Cape Crozier, Taylor Glacier and the Dion Islands but these designations make no reference to sea ice.

Scientific Committee established by CCAMLR (CCAMLR Article XV) to recommend conservation measures - the Scientific Commission is already dependent on scientific research organised under the aegis of SCAR.

Expanding the Agreed Measures beyond land and ice shelves to cover inshore marine sites does not entirely solve these problems, especially the one of jurisdiction over the sea bed.

There is no easy way to formalise procedures for marine protected sites. Because of its broad scientific scope and advisory role in the Agreed Measures, the Seals Convention and CCAMLR, it seems prudent that SCAR, rather than the CCAMLR Scientific Commission, should have responsibility for nominating and monitoring in-shore sites. Also, protection of the marine environment is a basic consideration in the imminent regime for the exploitation of Antarctic minerals (ATCM IX-1), and it is unlikely that the regime would avoid establishing a means of inter-linking the Agreed Measures, CCAMLR and the Seals Convention to ensure consistent nature conservation measures (including the designation of protected sites).

Salm and Clark (1982), and Ray (in press), discuss the identification and selection of marine protected areas on the basis of experience in the Arctic, but analyse highlight physiographic and biological differences between the polar regions and the need, in some instances, for independent approaches to the selection of marine protected sites.

Antarctic off-shore marine ecosystems are generally circumpolar in distribution, with few genetically distinct populations. Endemism is high for animals and plants south of the Antarctic Convergence and seals and birds show a high degree of longtitudinal migration within

the circumpolar belt (Laws, 1977). Identification of important marine areas is hampered because the biology of the Southern Ocean has been under-sampled (SCAR/SCOR, 1977). The extent and distribution of benthic communities are perhaps the easiest to define and protect because of their diversity and abundance (Dell, 1972; White, 1984).

The designation of protected inshore areas to safeguard foraging areas for land-breeding bird and seal populations (including Weddell seals, which breed on the near-shore sea ice) is complicated, but a practical way of minimising disturbance to land-breeding animals is to safeguard their foraging range from breeding sites. Seals and most birds are pelagic feeders; however, their feeding ecology and diet is poorly understood. Breeding locations, duration and estimates of average daily food intake for Elephant (55 kg), fur (62 kg), and Weddell (64 kg) seals, along with a description of food composition, are given by Laws (1984). The foraging range from breeding sites is highly variable within and among species. At South Georgia the feeding range of lactating fur seals extends for 300 km to just beyond the continental shelf, but precise information for fur seals at other locations and for other seal species is not available (McCann, personal communication). During the breeding season, Elephant seals are mostly shore-bound; this is followed by a brief time feeding at sea before the return to land to moult. Weddell seals are the most localised of all seal species and are thought to have a much more limited foraging range than other species. There is marked ecological separation in feeding behaviour: Elephant and Weddell seals feed on fish and squid at depths greater than 100 m, compared with fur seals, which feed mainly on krill and fish in water depths up to 80 m. Among seabirds there is considerable variation in feeding areas; penguins range from 30 to 500 km whereas petrels and albatrosses range from 300 to over 2 000 km (Croxall, 1984). Large feeding ranges and ecological

separation within and among species of avifauna and seals increase the number of feeding locations and reduce competition among them. This is vitally important where seal and bird breeding locations are in close proximity.

Factors which need to be considered when planning protected sites based on the foraging ranges of breeding birds and seals include (a) seasonal oceanographic conditions, (b) seasonal variations in food stocks, including 'up-current' activities (i.e. krill harvesting) which may influence food availability and foraging range, and (c) the land available for penguin and seal breeding sites, as populations limited by the availability of land for breeding would probably suffer greater disturbance from 'up-current' interference in food stocks. However, geographically defined marine protected sites cannot safeguard pelagic feeding birds and seals breeding on land from changes in water circulation, and 'up-current' fish and krill exploitation which may significantly deplete food stocks. Pelagic feeding animals are significantly affected by the movement of 'fronts' which separate three different water masses; the most significant is the Antarctic Convergence. Fronts have eddy diameters ranging from 80 to 500 km and durations from weeks to several months (Knox, 1983). Adverse seasonal or annual sea surface circulation combined with 'up-current' krill and fish exploitation may reduce significantly the breeding success of seals and birds in a region (Croxall, personal communication). Hence there is a strong case for designating geographically defined protected areas based on 'expected' foraging ranges in concert with the regulation of 'up-current' fish and krill exploitation. Also, protected sites based on foraging ranges from breeding sites are unlikely to safeguard non-breeding seal and bird populations away from breeding sites. For Elephant and Weddell seals this percentage is broadly similar (at least 20% of the total

population), but less for fur seals (McCann, personal communication). Figures for bird species are not available.

4.2.3 Site Management

Mandatory management plans for all protected site designations, site monitoring, and legal controls capable of enforcement are the three possible improvements described in Chapter 3.

Currently, management plans are required only for SSSI and, like the maps which accompany SSSI (and SPA) recommendations, have little substance. In accordance with the requirements listed in ATCM VIII-3, management plans generally consist of the following paragraphs: site description, reason for designation, outline of research, expiry date of designation, proposed points of access, proposed pedestrian and vehicular routes, scientific activities and guidelines for sampling, and other restraints. Despite the poor quality of management plans (not one lists management objectives) most have operated for several years and have had their terms extended twice; management plans for SSSI are in need of major revision and are thus inadequate models for other protected site classifications.

Management plans are to ensure the optimum use of a site without deleterious effects on the special features which render it worthy of protection. Their objectives and scope vary depending on the special needs of protected sites, land-use pressures, and the institutional organisation for site management. Poor scientific understanding, unpredictable land-use pressures (especially those from stations) and vague institutional responsibilities for enforcement, militate against attaining management goals for protected sites in Antarctica. Similar problems are experienced in land-use planning in the Arctic, which has biological and landform similarities to Antarctica and where administrative responsibility for environmentally sensitive areas is decentralised, even within one nation. Recent land-use planning

studies in Arctic Canada (notably the (Canadian) Task Force on Northern Conservation (Department of Indian Affairs and Northern Development, 1984) and Nelson and Jensen (1984) reach conclusions pertinent to site management planning in Antarctica.

First, the scarcity and widely dispersed nature of scientific information on remote areas increases the need for experienced scientists to formulate management plans and to submit evaluations before plans are formalised. Although similar procedures exist for Antarctic protected sites, the evaluation of management plans for SSSI has not been rigorously pursued. The quality of management plans would be enhanced if they were formulated and evaluated by SCAR on the lines recommended by Nelson and Jensen. The collaboration of SCAR with the IUCN would complement management planning for Antarctic protected sites.

Secondly, management plans have an important contribution to make in influencing the attitude and performance of participating institutions. In Antarctica, protected site boundaries and the activities permitted within them are agreed by all ATCPs, but there is a demonstrable gap, in some instances, between theory and practice. Management plans have a dual role of reminding ATCPs of their obligations in respect of wildlife and landform preservation, and of prescribing specific behaviour standards for specific sites. As Antarctic protected sites are small in area and their biological inhabitants are vulnerable, management plans must eradicate the impression that areas outside protected sites are less likely to be affected by behaviour standards. Regulations governing permanent and moveable cultural and historic monuments on Svalbard, as described by Reymert (1979), could serve as a model for similar management methods in Antarctica.

Greater awareness can also be achieved by designating

administrative authority over protected sites and by establishing a site monitoring system. For practical reasons, 'guardian' responsibility for protected sites (in Antarctica) should be vested in the nearest major Antarctic station or in the station sponsoring major research effort on the particular site. Guardian responsibility would extend (a) to ensuring proposed activities comply with Agreed Measures, SSSI or SHI provisions, (b) to providing intending visitors with accurate information on sites, (c) to overseeing visitors and field activities, (d) to recording visits and studies undertaken within sites, and (e) to reporting this information regularly to a protected area monitoring centre (discussed below). In accordance with the Agreed Measures, a person who oversees visitor and field activities should be designated an Inspector and be competent in the field activities proposed.

The lack of a well-defined reporting and monitoring procedure for protected sites is disadvantageous to ATCPs and the protected sites; basic information about conservation planning and related activities is not available, nor can operational procedures and performance for protected sites be assessed properly. The monitoring system would provide a long-term record of the status of particular sites and their contribution to the network as a whole. The SCAR listing of Antarctic Conservation areas (Bonner and Smith, 1985) is the first substantial compilation of information on protected sites and it would be wasteful for the listing not to be developed as a regional data base for Antarctica. Given its limited financial and Secretariat resources, SCAR (as the agency responsible for monitoring Antarctic protected sites) should investigate collaboration with the IUCN Protected Area Data Unit (PADU) for the design and operation of a data base. The PADU was established in 1981 by the Commission for National Parks and Protected Areas (CNNPA), and in 1983 became part of the IUCN's

Conservation Monitoring Centre (CMC) based in Cambridge (conveniently placed for access to the SCAR Secretrariat). The work of the PADU is described by Harrison (1984a, 1984b, 1984c); it encompasses IUCN, UNESCO and UNEP projects and keeps protected sites lists produced for various international conventions. Because SPAs and SSSI have been designed with scientific monitoring in mind and are pre-adapted for contributing to monitoring programmes, ATCPs should consider them as important contributions to continuing international environmental monitoring programmes. The PADU, through the CMC, is the data respository for the Global Environmental Monitoring Systems (GEMS) project started by SCAR's sister ICSU committe, the Scientific Committee on Problems of the Environment (SCOPE). GEMS is now managed by the UNEP. In 1977 Rudolph and Benninghoff (1977) proposed the creation of an Antarctic biological monitoring system to collaborate with GEMS, whose objects are to 'provide the information necessary to ensure the present and future protection of human health and safety and the wise management of the environment' (Munn, 1973). The World Meteorological Organisation, governmental and non-governmental agencies contribute to GEMS monitoring studies on human health, transport of airborne pollutants, climate, ocean dynamics and pollution, and renewable resources (Croze, 1984). Against a background of closer working relations between SCAR and the IUCN, SCAR collaboration with the PADU promises the most immediate and rewarding area of cooperation.

Despite the enthusiasm shown by nations operating in Antartica, when the Agreed Measures were introduced, for the concept of harmonised legislation and standing instructions to expeditions (Carrick, 1964; Roberts, 1966, 1977, 1978), the lack of legal controls capable of enforcement is a continuing obstacle to safeguarding protected sites. History has shown that it is highly unlikely that

ATCM would sanction a revision of Treaty Article IV (which preserves the judicial and territorial claims of ATCPs), or Articles IV, VIII(1) and VII (1)(b) (which grant quasi-diplomatic status to observers and exchange scientists and their staff). These conditions prescribe new strategies for monitoring protected sites. Site management plans could incorporate conservation standards, policing and penalty clauses, and a reporting procedure for offences. Penalties for offences should not necessarily be monetary. Instead, a report of offences might be submitted to the ATCP authority sponsoring the offenders, the obligation resting with the authority to demonstrate that action had been taken to correct mis-doing.

Regular inspections of protected sites should be made, in accordance with the inspection provisions of the Antarctic Treaty (Article VII (I)-(4)). The origins and scope of the provisions are given by Hanevold (1971). Their primary purpose is to ensure the use of Antarctica for peaceful purposes, including prohibitions on nuclear weapons and the disposal of nuclear wastes. Their importance for monitoring nature conservation practices has not been fully realised despite the preamble to the Agreed Measures which states that it shall not 'restrict the implementation of the provisions of the Antarctic Treaty with respect to inspection'. The inspection provisions are broad; all the stations and activities of the Treaty Parties may be inspected, inspections of ships and aircraft are permitted at points of disembarkation and embarkation of cargo or personnel, and inspections can be conducted uni- or multilaterally. Unilateral inspections have prevailed, mainly because of logistics, and associated costs. However, it is unlikely that national inspection teams in their present form would feel competent or sufficiently informed to be able to assess the relative merits of conservation measures, including protected site management. An opportunity for

this is available through the participation in inspections of SCAR, acting as a consultant to the sponsoring nation(s). Also, ATCPs might independently invite and sponsor SCAR to review, in confidence, their activities along the lines of the inspection, reporting and award system (European Diploma) established by the Council of Europe (1973). Either way, the participation of SCAR in protected site inspections is vital as a means of ensuring informed scientific assessment and response, and facilitating regular and systematic inspections of sites.

4.2.4 Environmental Impact Assessment (EIA)

EIA is a 'procedure designed to identifiy and predict the impact of a human action on the biogeographical and geophysical environment and on Man's health and well being, and to interpret and communicate information about the impact' (Munn, 1979). ATCM XII-3 recommends that ATCPs 'scrutinize ... research and logistic activities, in accordance with procedures they have developed or may develop' and, depending on the 'seriousness' of impacts, 'elaborate feasible research and logistic alternatives'. In addition, SCAR provided advice about categories of activities which might be expected to have a significant impact on the environment. Key elements found in some national EIA procedures are listed in the report of ATCM XII, presumably to stimulate consideration of EIA procedures in Antarctica, as their use and methodology is still poorly developed in most countries (Holt and Talbot, 1978; Bradbury and others, 1984).

ATCM XII-3 does not make EIA obligatory and the wording is vague - impact assessment can be defined within procedures already 'developed' by ATCPs - and while a suggested EIA format has been proposed by SCAR (Benninghoff and Bonner, 1985), the recommendation makes no suggestion of an independent review of completed EIAs. To adopt a pessimistic view, there are parallels between the intentions

expressed in ATCM XII-3 and those of the Agreed Measures, which call for disturbance associated with the establishment and operation of stations to be kept to a minimum; the inviolability of protected sites is not assured. Alternatively, for an evolving and progressive international agreement, which is how the Antarctic Treaty is portrayed by the Contracting Parties, ATCM XII-3 has subtle but significant differences from earlier nature conservation recommendations, particularly in respect of protected sites.

The EIA procedure will use ecological assessments as a basis for binary technical decisions on habitats and species threatened by a particular development - decisions which are potentially more difficult to make in Antarctica because scientific understanding is limited, particularly for the marine environment. As far as protected sites are concerned, EIA can be regarded as:

(a) an important tool for identifying little-known, unspoilt environments and fragile ecosystems;

(b) providing 'baseline' assessments of existing and proposed SPAs and SSSI as a means of determining their status and for future monitoring; and,

(c) where scientific and logistic activities have a significant impact
- recognising the special needs of existing and proposed protected sites;
- predicting impact of proposed activities, including second order and cumulative effects;
- formulating measures to minimise impact and maintain environmental and other qualities of protected sites.

However, by creating an obligation (however vague) to impose EIA procedures on scientific and logistic support activities, the greatest potential contribution is improved land-use planning. Broadly speaking, land in Antarctica can be classified into three zones: Antarctica has the status of (a) a 'Special Conservation Area' (Agreed Measures) within which there are (b) terrestrial protected sites (SPAs, SSSI, and SHI), and (c) station areas. Geographical boundaries for all but the station areas are obvious; the Antarctic Treaty makes

no provision for the delimitation of station areas, or for consultation among ATCPs about their siting. This is despite the fact that stations are a major source of local pollution and, in certain cases, their uncontrolled development has proved deleterious to protected sites (Headland and Keage, 1985). The failure of the Antarctic Treaty system to identify the need for EIA may account for nations not readily extending domestic EIA procedures to their Antarctic programmes. The redevelopment of Australia's three stations on the Antarctic continent and the initial construction for a runway at "Dumont d'Urville" (France) did not involve EIA. EIA must include the definition of boundaries, ecological and geographical - interactions which may well ignore preconceived frontiers (Holdgate, 1983). Thus, without a direct recommendation to that effect, EIA will necessitate delimiting station areas as a basis for environmental planning.

EIA is used in formulating planning and design parameters for remote settlements in the Canadian Arctic; examples, which might prove useful for Antarctic station planning and development, are discussed by Gerein (1980). The first attempt to delimit a station area was in 1965, when New Zealand in collaboration with the US Navy and the (US) National Science Foundation formulated an area development plan for Hut Point Peninsula, McMurdo Sound. Station boundaries and historical and scientific sites were incorporated and regulations were prepared for each (Cameron, 1972). In 1967 the McMurdo Land Management and Conservation Board was established. The passing of the 1969 National Environment Policy Act compelled the US Antarctic Program to prepare an EIA for its station and field activities; these were the first EIAs to be undertaken in Antarctica and involved regular reviews of the Hut Point development plan. The 1975 review resulted in broadening the Conservation Board's responsibilities to include (a) the protection

and preservation of monuments and buildings, and scientific benchmarks, (b) ensuring that logistic activities do not interfere with scientific studies, and (c) the protection and preservation of fauna and flora (Auburn, 1982). Although EIA procedures post-date land-planning for Hut Point, EIA has required consultation between nations to ensure that different land-use plans do not conflict and that protected sites are safeguarded. Such an approach is overdue on King George Island and sections of the Antarctic Peninsula, where several national stations are in close proximity.

4.3. Option 3 - A 'World Park'

The 'Special Conservation Area' status applied to the Antarctic Treaty area in the Agreed Measures may have encouraged the view that National Park or equivalent status existed there. The first call for an Antarctic World Park (AWP) was made in 1972 at the Second World Conference on National Parks. This and later calls for an AWP which have been conveyed to ATCPs are summarised below:

1972 Second World Conference on National Parks recommended that ATCPs 'negotiate to establish the Antarctic continent and its surrounding seas as the first World Park, under the auspices of the United Nations (UN)'.

1975 The South Pacific Conference on National Parks and Reserves sponsored by New Zealand, the IUCN and the South Pacific Commission proposed to the United Nations Law of the Sea Convention that Antarctica and its surrounding seas be established as a World Park.

1975 At ATCM VIII New Zealand proposed, unsuccessfully, that Antarctica be given World Park status.

1981 The General Assembly of the IUCN called on ATCPs to 'ascribe to the Antarctic environment as a whole, a designation which connotes worldwide its unique character and values, and the special measures accorded to its planning, management and conservation'.

1982 The World National Parks Congress, recommended to the IUCN that 'the concept of a world park and other appropriate designations [in relation to Antarctica] be developed more urgently'.

In addition, discussion of Antarctica by the UN General Assembly

in 1984 involved submissions from non-government organisations (NGOs) calling for 'full protection for Antarctica and its related ecosystems' as a World Park (Greenpeace, 1984).

A World Park has yet to be established; it is not a coherent and generally recognised concept which can readily be applied to the Antarctic. The Antarctic World Park concept has not been firmly stated and there is uncertainty about its basic elements (Horsler, 1984). These include whether (a) the Park is synonymous with wilderness, (b) a minerals regime and a Park are mutually exclusive, and (c) ATCPs' rights would be preserved in establishing Park regulations. The salient features of AWP proposals made by several authors are summarised below.

The AWP concept pre-dates the 1978 IUCN Report on Categories, Objectives and Criteria for Protected Areas and the World Conservation Strategy (WCS; IUCN, 1980), but current thinking on the World Park draws on both. It implies acceptance of the concept of 'global commons' as defined by the WCS. According to Mosley (1984a), the northern geographic limit of the Park would be the Antarctic Convergence; it would encompass the entire Antarctic terrestrial and marine environment. Ship and station based research would continue. Commercial fishing would be prohibited and maritime sanctuaries established which exclude fisheries research. Mineral exploitation would be prohibited (Mosley, 1983), or a moratorium on mining imposed until appropriate research could ensure the protection of the Antarctic environment. An 'international authority' with administrative responsibility for Antarctic activities and environmental management is envisaged (ASOC, 1984; Barnes, 1984; Greenpeace, 1984; Mosley, 1984b). Ultimately, Antarctica would have World Heritage status under the 1972 UNESCO Convention for the Protection of the World's Cultural and National Heritage (Suter, 1980;

Mosley, 1984a).

While it is difficult to define the AWP concept, it is also uncertain whether it incorporates 'res communis', to which the common heritage of mankind principle is likened. Res communis (a) is incompatible with sovereign or "owners'" rights to territory, (b) safeguards common territory for future use, (c) aims to conserve resources, and (d) intends to distribute equitably among developing states benefits from resource exploitation. Neither the global commons nor the res communis concept is compatible with the Antarctic Treaty. Treaty Article IV preserves the rights of Parties with territorial claims, while Article XIII enables UN members, or nations invited by ATCPs, to accede to the Treaty, which aims to 'further the purposes and principles embodied in the Charter of the United Nations'. Thus ATCPs would argue that the Treaty satisfies items (b), (c), and potentially (d).

There are procedural problems in extending the Convention for the Protection of the World Cultural and National Heritage to Antarctica. Not all ATCPs are State Parties to the 1972 UNESCO Convention, and while it has been suggested that an Antarctic Claimant might take the initiative of nominating territory for World Heritage status (Mosley, 1983), this appears inconsistent with Treaty Article X, which prohibits ATCPs from activities contrary to the principles or purposes of the Treaty. Moreover, as a consequence of Treaty Article IV which expands the control of ATCPs - both geographically and in terms of jurisdiction - UNESCO's World Heritage Committee cannot confer protected area status because the activities and legal protection for a site cannot be guaranteed - even by an Antarctic Claimant over its own territory.

The 1972 call for the UN to take some responsibility for an Antarctic World Park was attenuated partly by developments within the

Antarctic Treaty, such as the Seals Convention, and partly because of the UN's inexperience in Antarctic affairs. The 1981 IUCN pledge of making available to ATCPs expertise to ensure that activities carried on in Antarctica have minimum effects on the ecosystem, signals a change in strategy to improving nature conservation controls wholly within the Antarctic Treaty framework. The delay in adopting this later strategy probably reflects poor working knowledge of the Antarctic Treaty. In particular, Article III-(2) encourages ATCPs to establish co-operative working relations with specialised agencies of the UN and other organisations with an interest in Antarctica.

There are currently no World Parks and, although 13 years old, the AWP idea has advanced little beyond conception. Mosley (1984a) points out that delays are symptomatic of resource exploitation regimes established by the Antarctic Treaty, which are characterised by long gestation periods. An AWP is the aim of the Antarctic and Southern Ocean Coalition (ASOC) and Greenpeace International but is not IUCN policy, although widely debated within it (Mosley, 1984b; Ray and others, 1984). There is no organisation equivalent to the 'international authority' which has been proposed to manage Antarctic activities within an AWP, although there are parallels with the Antarctic Treaty and the Commission established under CCAMLR. IUCN has observer status on the Commission established by CCAMLR, and NGOs belong to some national delegations to ATCMs. Hence the Treaty system is the obvious one within which conservation controls may be developed further.

4.4. Option 4 - Antarctic (Biosphere) Reserves

In addition to improvements to existing protected sites, ATCPs need to develop more elaborate site classifications to complement and enhance the existing areas. A new protected site designation should aim to

- give to areas degrees of protection which respond to a range of land-use pressures including tourism, with educational programmes on an international scale;

- make provision for formulating management programmes for compatible development which would increase protection of important sites and guide development in others;

- provide for protection of terrestrial and coastal environments, single and mutliple land-use. This will involve the application of land zoning techniques.

These thoughts have their origins in the 1968 SCAR Symposium on Antarctic Biology at which Sladen and Holdgate raised the possibility of bigger protected sites incorporating high habitat diversity (Sladen, 1970). Little progress has been made towards a new terrestrial protected site classification. Special Sites of Tourist Interest were proposed (ATCM VII-9), but none have been established, and selection criteria are not definite. Marine protected sites have been recommended but have not been formalised.

In 1984, operating independently but along similar lines, the IUCN (Mosley, 1984b) and SCAR (SCAR Bulletin, 1985) raised the possibility of applying to the Antarctic the 'Biosphere Reserve' concept developed by UNESCO's Man and the Biosphere Programme (MAB). Discussion within the IUCN centred on using the Biosphere Reserves concept as a means of extending World Heritage Status to Antarctica under the World Heritage Convention. Obstacles to achieving this objective have been outlined in the previous Section. SCAR is evaluating the application of the Biosphere Reserve concept to Antarctica without MAB involvement; the Working Group on Biology is preparing examples of 'Antarctic (Biosphere) Reserves' for the Antarctic Peninsula and Ross Sea regions.

Biosphere Reserves are one of ten internationally recognised protected site classifications promoted by the IUCN's Committee on National Parks and Protected Areas (CNPPA). They are conceived as 'protected areas of land and coastal environment (conservation units)

which constitute a global network, representative of the major biomes' (IUCN, 1984). They include unspoilt ecosystems and the restoration of extensively modified ones to natural conditions so that they will be suitable as sites for ecological research, education, training, and environmental monitoring. The area of individual reserves is intended to bear a direct relationship to the number of species found there, although there is considerable variation within any ecosystem type and the number of species represented. The preferred boundaries are natural features and the mean size of reserves (excluding Greenland) is 5 100 km^2. Ideally, reserves will have a 'core area' devoted to preservation of natural or near-natural ecosystems, surrounded by a 'buffer zone' which should consist of ecosystems ranging from natural to heavily modified. The various types of modified sites should generally be included in the the 'buffer zone' (di Castri and Loope, 1977).

The IUCN (1984) details the attributes and management objectives for each of the CNPPA reserve classifications, which are listed below:

I	- Scientific Reserve	VI	- Resource Reserve
II	- National Park	VII	- Natural Biotic Reserve
III	- National Monument	VIII	- Multiple Use Management Area
IV	- Managed Nature Reserve	IX	- Biosphere Reserve
V	- Protected Landscape	X	- World Heritage Site

SPAs and SSSIs established by the Antarctic Treaty have similarities to the Scientific Reserve classification, and SHIs can be likened to the National Monument classification. Attributes which set Biosphere Reserves apart from other protected area categories and which are appropriate for Antarctica include:

- the ability to accommodate special combinations of land-uses which cannot be duplicated by any other reserve category;
- emphasis on the use of natural areas for research, and the encouragement of educational and training activities - long-term scientific investigations may assist site management;

- emphasis on selection of representative samples of major ecosystems rather than those which are exceptional, and on conservation of ecosystems rather than upon individual species;
- potential contribution to an international network of reserves for global monitoring studies.

In 1983, 226 Biosphere Reserves totalling 1 154 828 km^2 had been established in 62 countries (UNESCO, 1983). Arctic and sub-Arctic Biosphere Reserves account for 76.5% (879 793 km^2) of the total area designated under the biosphere classification. These figures do not include the proposal to establish Ellesmere Island (196 000 km^2) as a Biosphere Reserve (England, 1983), four reserves planned in the Soviet Union (Pryde, 1984), or the protected area network (ECE) established in Nordic countries, which is likened to the Biosphere Reserve concept (Pahlsson, 1983). Of the 32 Parties to the Antarctic Treaty, all but South Africa have National Committees under UNESCO's MAB programme (UNESCO, 1983), and 18 have established Biosphere Reserves in their respective countries. However, the concept has been applied to Antarctic regions only in a limited way; sub-Antarctic Macquarie Island (12 785 km^2) which is outside the Antarctic Treaty area, was given Biosphere Reserve status in 1977. Arctic and sub-Arctic Biosphere Reserves are listed in Table 5.

Arctic Biosphere Reserves cover the terrestrial (including ice sheets and shelves) and marine environments. Reserve status has been given to bird sanctuaries, migratory routes for wildlife, tourist areas, scientific research and archeological sites, sites of educational and cultural interest, and scenic reserves. Several reserves include remote settlements with some economic dependence on the reserves.

The Biosphere Reserve classification complements Antarctic Treaty protected site designations and, regardless of collaboration with the MAB programme, ATCPs must view the concept as a much-needed land-use

TABLE 5. Arctic Biosphere Reserves.

Country and date of designation	Area (km2)	Site descriptions
United States of America (Alaska)		
Noatak Biosphere Reserve (1976)	30 352	
Aleutian Islands Biosphere Reserve (1976)	11 009	
Denali Biosphere Reserve (1976)	7 820	
Glacier National Park (1976)	4 102	
Greenland		
North and northeast Greenland (1977)	700 000	(de Bonneud, 1976)
Norway		
Northeast Svalbard Nature Reserve (1976)	15 550	(Norwegian Ministry of the Environment, 1981)
Soviet Union		
Kronotsky zapovednik (1985)	10 990	(Sokolov, 1981)
Pechero-Ilychsky zapovednik (1985)	72 130	(Sokolov and Chernov, 1983)
Laplandsky zapovednik (1985)	27 840	(Pryde, 1984)

Compiled from: UNESCO (1983) and references cited.

planning and management tool. 'Antarctic (Biosphere) Reserves' could be defined within the Antarctic Treaty as 'internationally agreed protected areas managed to demonstrate conservation values'. This definition would be compatible with the judicial preconditions imposed by Treaty Article IV. Antarctic Reserves would be 'internationally agreed' by ATCPs in keeping with Treaty principles and procedures; 'protected areas' requiring special measures to preserve ecosystems and land features; 'managed to demonstrate conservation values', involving an obligation to management objectives for specific land-uses and agreed conservation values, and of regular review of site management. 'Antarctic Reserves' can potentially offer a means of

- alleviating specific inadequacies caused by limitations of existing protected site classifications. For example, provision of 'buffer zones' and protection of coastal environments; and
- allowing additional single and multi-purpose sites to be designated. This could involve the designation of inviolate areas, scenic reserves, and station sites.

Some Antarctic operators are moving (consciously or otherwise) towards the Biosphere Reserve concept in land-use planning. New Zealand and the United States are developing for the whole of Ross Island, a management plan which includes one established and one proposed SPA, 3 established and 4 proposed SSSIs, and 7 SHIs (Thomson, personal communication).

Biosphere Reserves, as large areas within which multi-purpose activities may take place, will pose new challenges to Antarctic land-use planning. As discussed earlier, the boundaries of any protected site should depend on the purpose for which the site is established. There is also a need to protect the marine elements of terrestrial sites and to establish 'buffer zones' around sites. Scientific studies will provide vital information on the location and status of terrestrial fauna and flora, and information for determining seal and bird foraging patterns from breeding sites on land, which form the

biogeographical provinces for terrestrial ecosystems. For site protection measures, however, translation into land-use plans is complicated by Antarctica's physiography; it is almost entirely covered by a deforming ice sheet (13.5×10^6 km^2) and surrounded in winter by a skirt of sea ice which undergoes a large annual variation ranging from 2.5×10^6 to 20×10^6 km^2 (Allison, 1983). Sea ice and icebergs are important habitats for birds, seals, and ice-associated flora.

4.4.1. Ice Catchments and Selected Ice Flowlines

An untried land planning concept with potential for polar protected sites is the use of ice catchments and selected ice flowlines, in combination with the adjoining pack ice zone, to delimit conservation units. The biologically inactive Antarctic ice sheet is not covered by Antarctic Treaty protected site classifications, despite the fact that the ice sheet (a) constitutes almost the entire surface area of the Antarctic continent, (b) includes landform features peculiar to Antarctica, often on a scale which makes them unique, (c) has a controlling influence on the continental surface wind circulation and sea ice movements near-shore, (d) is the focus for substantial continuing glaciological and atmospheric research which may be jeopardised by the cumulative increase in pollutants in Antarctica, and (e) is claimed as sovereign territory by several nations. The compaction of successive layers of snowfall deposited over many thousands of years makes the ice sheet an important store of paleoclimatic and environmental information. Allison (1983) summarises scientific investigations which have been conducted on the ice sheet. Those which require uncontaminated sampling locations include isotopic analysis of snow and ice, measurement of the quantity and composition of gas entrapped in ice, and the concentration and composition of deposited solid particles.

The Antarctic ice sheet may be divided into 13 catchments (Figure 6); seven have convergent ice flow terminating in ice shelves and outlet glaciers, the remaining catchments have diverging or parallel ice flow which can be sub-divided into regions. The entire national programmes of several ATCPs lie within particular ice catchments or selected ice streams, thus providing a basis for sub-division and regional land-use planning. There are also whole catchments and major ice streams unihabited by man which include large areas of ice-free land, diverse habitats and wildlife, and historic monuments. The Rennick catchment (113 840 km^2) in Northern Victoria Land is a useful example. The catchment area includes a high proportion of ice-free land which has considerable geological interest (Stump and others, 1983), historic monuments at Cape Adare (SHI No.s 22 and 23), one established and one proposed SPA at Cape Hallett (SPA No.s 7 and 20), extensive Adélie penguin rookeries, and Adélie and Emperor penguin rookeries at Cape Hallett and Coulman Island; the Adélie penguin rookery at Coulman Island is the largest known (Wilson, 1983, 1984). Similar mixes of landforms, biology, and historical features occur in several other ice streams not permanently occupied by man. These areas have considerable potential as undisturbed baseline sites for comparison with other areas. The use of ice streams or catchments to delimit sites will utilise natural boundaries and reduce the likelihood of cumulative wind-borne pollution in 'baseline' sites.

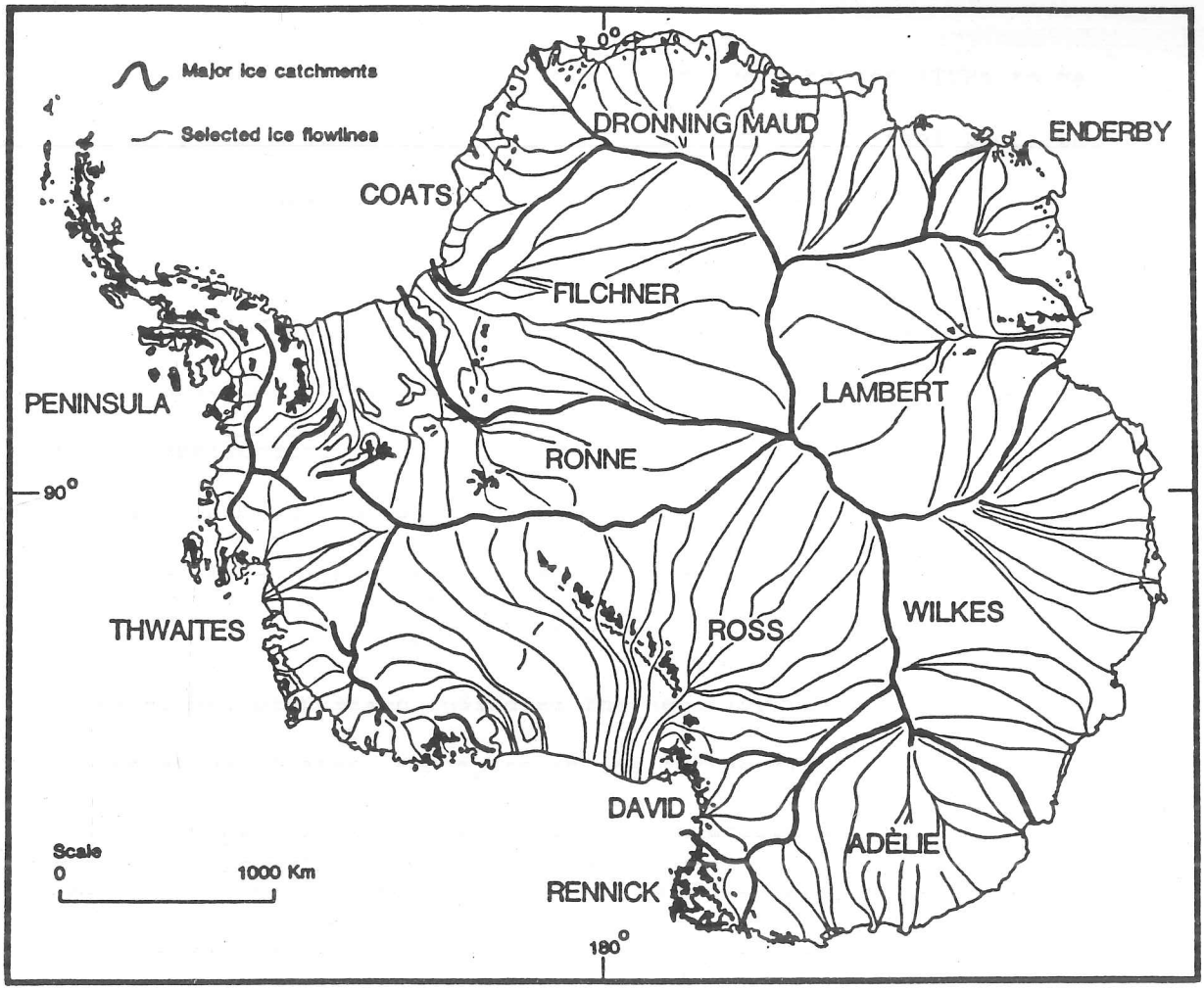


FIGURE 6. Major ice catchments and selected flowlines for the Antarctic ice sheet. Estimated catchment areas are listed.

Estimated areas (km^2)

Ross	2 600 300	Ronne	1 408 820
Filchner	1 728 320	Coats	1 191 360
Dronning Maud Land	1 243 980	Enderby land	353 440
Lambert	1 293 700	Wilkes Land	1 781 940
Adélie Land	942 900	Rennick	113 840
David	256 370	Thwaites	712 400
Antarctic Peninsula	290 540		

The total continental area of Antarctic is 13 918 070 km^2.

*

The names and catchment boundaries have no official status.

Adapted from: DREWRY, D. J. (ed). 1983. Antarctica: Glaciological and Geophysical Folio, Scott Polar Research Institute, University of Cambridge.

CHAPTER 5

5. Conclusions

The preceding discussion illustrates the need for ATCPs to be more responsive in establishing and operating terrestrial protected sites, commensurate with Antarctic Treaty obligations. ATCPs also need to ensure that the inadequacies of the terrestrial protected site system, including inadvertent or deliberate disregard of measures, are not transmitted to future conservation measures for the Antarctic marine environment.

The four options which have been suggested for the improvement of the terrestrial protected site system are not exclusive; parts of options may be combined. Regardless of the preferred option or combination, discussion indicates the need for (a) an Antarctic conservation strategy encompassing the terrestrial and marine environments, (b) the establishment of an active Antarctic Treaty Secretariat, and (c) expansion of the SCAR Secretariat and greater collaboration with the IUCN. These proposals need to be implemented in parallel. Together they would improve consultation between SCAR and ATCPs, and SCAR and IUCN, in the design and monitoring of protected sites, as well as ensuring that nature conservation measures were capable of being enforced.

5.1 Antarctic Conservation Strategy

If the ultimate objective of the Antarctic Treaty as an environmental mechanism is the harmonisation of utilitarian, conservation and aesthetic values (Heap and Holdgate, in press), it is difficult to see how this can be achieved without a conservation strategy to integrate Treaty recommendations on nature conservation and historic sites, the Convention for the Conservation of Antarctic Seals, and CCAMLR.

Because of the considerable overlap and ecosystem interdependence between the terrestrial and marine environments, consistent conservation standards and practice are required. The strategy proposed would have three central elements so far as the protected sites are concerned. These are (a) the preparation of ecosystem and habitat inventories for both environments as a basis for establishing a representative terrestrial protected site system, (b) formalised site selection and land-use planning criteria for a range of habitat, ecosystem and landscape types, and (c) systematic surveillance and monitoring of protected sites, perhaps by way of a 'guardian' arrangement for each site. Implicit in the expansion of the scope of site selection and land-use planning criteria is the addition to existing site designations of at least one new protected site category of much greater area, which would include multiple land-use.

5.2 Antarctic Treaty Secretariat

While the Antarctic Treaty system has a demonstrated capacity to evolve institutions and techniques in response to new developments (Scully, 1983), it has not found it necessary to establish a Secretariat to oversee the implementation of recommendations and conventions.

Between 1961 and 1985, Antarctic Treaty Contracting Parties have increased in number from 12 to 32 (Headland, 1985); ten have acceded in the last four years, suggesting that participation will continue to increase. Harmonisation of conservation and other values has become disproportionately more difficult with the accession of each new Contracting Party. While ATCPs might argue that the increasing number of Contracting Parties and the complexity of the Treaty system are not sufficient reasons to warrant the establishment of a Secretariat, there seems little option if Treaty nations wish, collectively, to consult and co-operate more actively with other international

organisations, particularly those with which the Treaty system has been coy. An active Secretariat would provide the Treaty Parties with a means of introspection; it might advise ATCMs in the same way SCAR provides scientific advice. Advice should include rules for behaviour in protected sites, and collaboration with SCAR on the preparation of site management plans, together with environmental impact assessment.

5.3 Expanded SCAR Secretariat

While SCAR has been responsive to requests made to it, or which have devolved on it, by the Antarctic Treaty, this study shows the need for SCAR to be more active in the selection, design and monitoring of the system of protected sites, and in environmental impact assessment. However, with the current level of financial support available, additional demands would prejudice SCAR's primary role of initiating, promoting and coordinating scientific activity.

Expansion of the SCAR Secretariat seems warranted for two reasons.

First, with the three-fold increase in the number of countries active in the Antarctic an even greater increase in scientific productivity has occurred. At the same time, requests for scientific advice have been directed to SCAR by Antarctic Treaty recommendations and conventions. Secondly, commensurate with Treaty recommendations and against a background of increasing Antarctic operations, SCAR needs to take a more active role in preparing management plans for protected sites, in the inspection of sites and in environmental impact assessment. There is also a need for improved communications among SCAR Working Groups in assessing proposals for protected sites, and for site monitoring (in collaboration with the IUCN's Protected Area Data Unit) in the form of a regional data base on Antarctic protected sites. SCAR should initiate and take the central role in preparing an Antarctic conservation strategy.

5.4 Concluding Remarks

Currently, low levels of human activity in Antarctica, and the advent of the Antarctic Treaty, may encourage the view that conservation measures can be implemented more effectively in the Treaty area than elsewhere, but this does not appear to be the case. Yaffee, in a study on the implementation of the United States 1973 Endangered Species Act (1982), describes obstacles which led to several revisions of early drafts, and three amendments to the Act. He concludes that 'prohibitive policy' - where government authorities and individuals do not have legal choices about their behaviour - is the most difficult to enforce, even within one country. Perhaps the greatest challenge to the Antarctic Treaty is to impose restrictions capable of enforcement. Protected sites in the Treaty area, as indeed National Parks and protected areas outside it, are not entirely safeguarded.

The activities of nations involved in Antarctica are internationally highly visible, particularly regarding nature conservation. ATCPs need to adopt more elaborate concepts and management for protected sites if they are to be regarded as responsible trustees acting on behalf of a much wider group of nations and community.

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APPENDIX 1.

1. Dates and Places of Antarctic Treaty Consultative Meetings.

Antarctic Treaty signed 1 December, 1959 - in force 23 June 1961.

I - 10 to 24 July, 1961, Canberra.
II - 18 to 28 July, 1962, Buenos Aires.
III - 2 to 13 June, 1964, Brussels.
IV - 13 to 18 November, 1966, Santiago.
V - 18 to 29 November, 1968, Paris.
VI - 19 to 31 October, 1970, Tokyo.
VII - 30 October to 10 November, 1972, Wellington.
VIII - 9 to 20 June, 1975, Oslo.
IX - 19 September to 7 October, 1977, London.
X - 17 September to 5 October, 1979, Washington.
XI - 23 June to 7 July, 1981, Buenos Aires.
XII - 13 to 27 September, 1983, Canberra.

2. Dates and Places of General Assemblies of the Scientific Committee on Antarctic Research.

I [inaugural] - 3 to 5 February, 1958, The Hague.
II - 4 to 11 August, 1958, Moscow.
III - 2 to 6 March, 1959, Canberra.
IV - 29 August to 2 September, 1960, Cambridge.
V - 9 to 14 October, 1961, Wellington.
VI - 20 to 24 August, 1962, Boulder.
VII - 23 to 27 September, 1963, Cape Town.
VIII - 24 to 29 August, 1964, Paris.
IX - 20 to 24 September, 1966, Santiago.
X - 10 to 15 June, 1968, Tokyo.
XI - 17 to 22 August, 1970, Oslo.
XII - 14 to 19 August, 1972, Canberra.
XIII - 3 to 7 September, 1974, Jackson Hole.
XIV - 18 to 23 October, 1976, Mendoza.
XV - 16 to 26 May, 1978, Chamonix.
XVI - 14 to 24 October, 1980, Queenstown.
XVII - 5 to 9 July, 1982, Leningrad.
XVIII- 1 to 5 October, 1984, Bremerhaven.

APPENDIX 2.

Monuments identified by the Antarctic Treaty as Sites of Historic Interest.

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1. Flag mast erected in December 1965 at the South Geographical Pole by the First Argentine Overland Polar Expedition.

2. Rock cairn and plaques at 'Syowa' Station in memory of Shin Fukushima, a member of the 4th Japanese Antarctic Research Expedition, who died in October 1960 while performing his duties.

3. Rock cairn and plaque on Proclaimation Island, Enderby Land, erected in January 1930 by Sir Douglas Mawson. The cairn and plaque commemorate the landing on the Island of Sir Douglas Mawson with a party of men from the British, Australian and New Zealand Research Expedition of 1929-31.

4. Station building to which the bust of V. I. Lenin is fixed, together with a plaque in memory of the conquest of the Pole of Inaccessibility by Soviet Antarctic explorers in 1958.

5. Rock cairn and plaque at Cape Bruce, Mac.Robertson Land, erected in February 1931 by Sir Douglas Mawson. The cairn and plaque commemorate the landing on the Cape of Sir Douglas Mawson with a party of men from the British, Australian and New Zealand Research Expedition of 1929-31.

6. Rock cairn at Walkabout Rocks, Vestfold Hills, Princess Elizabeth Land, erected in 1939 by Sir Hubert Wilkins. The cairn contains a canister containing a record of his visit.

7. Stone with inscribed plaque, erected at Mirny Observatory, Mabus Point, in memory of driver-mechanic Ivan Khmara who perished on fast ice in 1954.

8. Metal monument-sledge at Mirny Observatory, Mabus Point, with plaque in memory of driver-mechanic Anatoly Shcheglov who perished in the performance of official duties.

9. Cemetery on Buromskiy Island, near Mirny Observatory, in which are buried Soviet, Czechoslovakian and GDR citizens, members of the Soviet Antarctic Expedition, who perished in 1960.

10. Building (magnetic observatory) at 'Dobrowolsky' Station, Bunger Hills, with plaque in memory of the opening of 'Oasis' Station in 1956.

11. Heavy tractor at 'Vostok' Station with plaque in memory of the opening of the Station in 1957.

12. Cross and plaque at Cape Denison, George V Land, erected in 1913 by Sir Douglas Mawson on a hill situated 300 metres west by south from the main hut of the Australasian Antarctic Expedition of 1911-14. The cross and plaque commemorate Lieutenant B. E. S. Ninnis and Dr. X. Mertz, members of the expedition, who died in 1913.

13. Hut at Cape Denison, George V Land, built in January 1912 by Sir Douglas Mawson for the Australasian Antarctic Expedition of 1911-14.

14. Remains of a rock shelter at Inexpressible Island, Terra Nova Bay, constructed in March 1912 by Victor Cambell's Northern Party, British Antarctic Expedition, 1910-13.

15. Hut at Cape Royds, Ross Island, built in February 1908 by Ernest Shackelton.

16. Hut at Cape Evans, Ross Island, built in January 1911 by Captain Robert Falcon Scott.

17. Cross on Wind Vane Hill, Cape Evans, Ross Island, erected by the Ross Sea Party of Ernest Shackelton's Trans-Antarctic Expedition, 1914-16, in memory of three members of the Party who died in the vicinity in 1916.

18. Hut at Hut Point, Ross Island, built in February 1902 by Captain Robert Falcon Scott.

19. Cross at Hut Point, Ross Island, erected in February 1904 by the British Antarctic Expedition, 1901-04, in memory of T. Vince, a member of the expedition who died in the vicinity.

20. Cross at Observation Hill, Ross Island, erected in January 1913 by the British Antarctic Expedition, 1910-13, in memory of Captain Robert Falcon Scott's party which perished on the return journey from the South Pole, March 1912.

21. Stone Hut at Cape Crozier, Ross Island, constructed in July 1911 by Edward Wilson's party (British Antarctic Expedition, 1910-13) during the winter journey to collect Emperor penguin eggs.

22. Hut at Cape Adare built in February 1899 during the 'Southern Cross' Expedition led by C. E. Borchgrevink. There are three huts at Cape Adare: two date from Borchgrevink's expedition, and one from Scott's Northern Party, 1910-11.

23. Grave at Cape Adare of Norwegian biologist, Nicolai Hanson, a member of C. E. Borchgrevink's 'Southern Cross' Expedition, 1899-1900. This is the first known grave in Antarctica.

24. Rock cairn known as "Amundsen's Cairn", on Mount Betty, Queen Maud Range erected by Roald Amundsen on 6 January, 1912, on his way back to 'Framheim' from the South Pole.

25. Hut and plaque on Peter I Øy, built by the Norwegian Captain Nils Larsen in February 1929 at 'Framnaesodden'.

26. Abandoned installation of Argentine Station 'General San Martin' on Barry Island, Debenham Islands, Marguerite Bay, with cross, flag mast and monolith built in 1951.

27. Cairn with plaque on Megalestris Hill, Petermann Island, erected in 1909 by the second French expedition led by J. -B. Charcot.

28. Rock cairn at Port Charcot, Booth Island, with wooden pillar and plaque inscribed with the names of the first French expedition led by J. -B. Charcot which wintered there in 1904 aboard 'Le Français'.

29. Light-house named 'Primero de Mayo' erected on Lambda Island, Melchoir Islands, by Argentina in 1942.

30. Shelter at Paradise Habour erected in 1950 near the Chilean Base 'Gabriel Gonzales Videla' to honour Gabriel Gonzales Videla, [said by Chile to be] the first Head of State to visit the Antarctic.

31. Memorial plaque marking the position of a cemetry on Deception Island where some 40 Norwegian whalers were buried in the first half of the twentieth century, The cemetry was swept away by a volcanic ereption in February 1969.

32. Concrete monolith erected in 1947, near 'Capitán Arturo Prat' Base on Greenwich Island. Point of reference for Chilean Antarctic hydrographic work.

33. Shelter and cross with plaque near 'Arturo Prat' Base on Greenwich Island. Named in memory of Lieutenant-Commander Gonzalez Pacheco, who died in 1960.

34. Bust of Chilean naval hero Arturo Prat erected in 1947 at the Base of the same name on Greenwich Island.

35. Wooden cross and statue of the Virgin of Carmen erected in 1947 near 'Capitán Arturo Prat' Base on Greenwich Island. There is also nearby a metal plaque of the Lions International Club.

36. Metal plaque at Potter Cove, King George Island, erected by Edward Dallmann to commemorate the visit of the German expedition of 1 March, 1874.

37. Statue of Bernardo O'Higgins, erected in 1948 in front of the Station of the same name.

38. Hut on Snow Hill Island built in January 1903 by a party of the Swedish South Polar Expedition, led by Otto Nordenskjold.

39. Stone Hut at Hope Bay built in January 1903 by a party of the Swedish South Polar Expedition, led by Otto Nordenskjold.

40. Bust of General San Martin, grotto with a statue of the Virgin Lujan, and a flag mast at Base 'Esperanza', Hope Bay, erected by Argentina in 1955; together with a graveyard with stele in memory of members of Argentine expeditions who have died in the area.

41. Stone Hut on Paulet Island built in February 1903 by C. A. Larsen, Norwegian captain of the wrecked vessel 'Antarctic' of the Swedish South Polar Expedition, led by Otto Nordenskjold, together with a grave of a member of that expedition.

42. Area at Scotia Bay, Laurie Island, South Orkney Islands, in which are found: stone hut built in 1903 by the Scottish Expedition led by W. S. Bruce: the Argentine Meteorological and Magnetic Observatory, built in 1905; and a graveyard with seven tombs (dating from 1903).

43. Cross erected in 1955, at a distance of 1 300 metres north-east of the Argentine base 'General Belgrano' at Piedrabuena Bay, Filchner Ice Shelf.

44. Plaque erected at the temporary Indian Station 'Dakshin Gangotri', Princess (sic) Astrid Kyst, Dronning Maud Land, listing the names of the members of the First Indian Antarctic expedition which landed nearby on 9 January, 1982.

SOURCE: Annex to Antarctic Treaty Recommendation VII-9, and the Report of the XIIth Antarctic Treaty Consultative Meeting.

APPENDIX 3. Antarctic Specially Protected Areas (SPAs) and Sites of Special Scientific Interest (SSSI). Site locations are given in Figures 4 and 5 respectively.

SPAs	APPROXIMATE AREA (sq.km)	DATE DESIGNATED OR PROPOSED	REASON FOR DESIGNATION SCAR MATRIX CODE	ASSOCIATED HUMAN ACTIVITY (supplementary to Bonner and Smith, 1985)
1. Taylor Rookery, Mac.Robertson Land	0.2	ATCM IV November 1966	Emperor penguin colony. One of the few colonies located wholly on land. Terrestrial - C1, E1, H1.	Field hut inside SPA manned continuously from 1967 to 1959. Regular winter and summer visits to hut made from 'Mawson' (established 1954)(Dubrovin and Petrov, 1971). Killing of penguins by escaped dogs has been recorded but without long-term damage to penguin populations. 'Mawson' station 140 km east.
2. Rookery Islands, Holme Bay	0.9	1966	Breeding site for six bird species. Two (Giant petrel and Cape petrel) occur nowhere else in the region. Terrestrial - E1, H1.	Mawson 30 km south-west.
3. Ardery Island and Odbert Island, Budd Coast	2.4	1966	Breeding site for several bird species. Terrestrial - B1, C1, D1, E1, H1.	Field hut 2 km east. 'Casey' station (Australia), established 1970, is 14 km north. It replaced 'Wilkes' station, established by the United States in 1957, closed 1969, at which time it was operated by Australia. Sporadic scientific visits.
4. Sabrina Islet, Balleny Islands	0.7	1966	Island supports representative fauna and flora which have a high latitude distribution. Terrestrial - C1, D1, E1, H1.	Occasional visits by ship and helicopter parties.
5. Beaufort Island, Ross Sea	18.6	1966	Important breeding location for several bird species in the region. Island is a valuable reference area for research. Terrestrial - E1, H1.	Occasional landings by helicopter from passing ships and associated scientific activities.
6. Cape Crozier, Ross Island (see SSSI No.4)	(18.0)	1966	Original designation - protect rich bird and mammal fauna and adjoining terrestrial elements, which are of outstanding scientific value. SPA status terminated 1975.	

7.	Cape Hallett, Victoria Land	0.1	1966	Rich and diverse vegetation supporting a variety of terrestrial fauna and an important bird breeding site. Terrestrial - B1, C1, D1, H1.	A joint New Zealand and United States station operated continuously from 1957 to 1965 and then for summers only. A road borders the SPA. Establishment of station displaced about 8 000 Adèlie penguins from a colony adajacent to the SPA. A significant reduction in the breeding success of Skuas also recorded. In the Cape Hallett area, recovery of Adèlie penguins or Skuas has not been secured despite 10 years without station occupancy (Pascoe, 1984). Removal of station constructions commenced in 1984 (Bonner and Smith, 1985). Occasional visits have included helicopter landings by scientific parties from the F.R. Germany, New Zealand and United States, and tourist ships.
8.	Dion Islands, Marguerite Bay	0.2	1966	Islands support the only breeding Emperor penguins on the west side of the Antarctic Peninsula. Terrestrial - B1, C1, D1, E1, H1.	Refuge hut on island. Island group occupied over winter in 1980 by a French private expedition aboard Damien II.
9.	Green Island, Berthelot Islands	2.2	1966	Exceptional vegetative cover supporting a diverse Antarctic ecosystem. Terrestrial - B1, C1, E1, H1.	Island is 6 km south-west of British and Argentine summer stations on the Argentine Islands. No major constructions.
10.	Byers Peninsula, Livingston Island, South Shetland Islands (see SSSI No.6)		1966	Original designation - Protection of a large variety of fauna and flora in a small area which is of scientific interest.	
11.	Cape Shirreff, Livingston Island	2.6	1966	Diversity of plant and animal life, including Elephant seals, which are of research interest. Terrestrial - B1, C1, E1, H1. Inland waters - M12, Q3-4. Marine - S7, S8, S9.	From 1819 to 1825 site of intensive sealing. No major constructions.
12.	Fildes Peninsula, King George Island, South Shetland Islands (see SSSI No.5)	(27.0)	1966	Original designation - protection of a biologically diverse region of outstanding ecological interest.	Prior to SPA status, hangar and summer base constructions on Ardley Island. 'Bellingshausen' station (USSR) constructed in SPA in 1967, followed by 'Presidente Eduardo Frei' (Chile), established in 1968. Several field huts and refuges established on the Peninsula and off-lying islands (Headland and Keage, 1985). Considerable disturbance to wildlife around stations and nearby penguin rookeries (Lipps, 1978).
		(0.1)	ATCM V 1968	Redesignation - protection of one of several small lakes which, being ice-free in summer, are of ecological interest.	

13. Moe Island, South Orkney Islands	1.2	1966	A representative sample of the marine Antarctic ecosystem. An important reference site for comparative biological studies. Terrestrial - B1, C1, E1, H1.	No major constructions. Nearest station is 'Signy Island' (British), 3.6 km north-east. Surrounding sea is a Seal Reserve under the Convention for the Conservation of Antarctic Seals.
14. Lynch Island, South Orkney Islands	0.9	1966	The most extensive coverage of Hair grass known in the Antarctic Treaty area. Terrestrial - A1, B1, C1, E1, H1. Maritime - S5-8.	No major constructions. Nearest station is 'Signy Island' (British), 4.6 km south. Surrounding sea is a Seal Reserve under the Convention for the Conservation of Antarctic Seals.
15. Southern Powell Island group, South Orkney Islands	6.2	1966	Substantial fauna and flora communities. Site includes a growing Fur seal population. Terrestrial - B1, C1, D1, E1, F1, H1. Inland waters-L4, L11, L12, M4, P4, Q4. Marine - S5-9, U5-9.	No major constructions. Nearest station is 'Orcadas' (Argentina) 10 km east. Surrounding sea is a Seal Reserve under the Convention for the Conservation of Antarctic Seals.
16. Coppermine Peninsula, Robert Island, South Shetland Islands	0.7	ATCM VI 1970	Substantial fauna and flora communities of scientific interest. Terrestrial - B1, C1, D1, E1, F1, H1. Inland waters - M4, M12. Marine - S7, S8, S94.	Chilean refuge hut on the isthmus but no other constructions. Nearest station is 'Arturo Prat' (Chile), 14 km south.
17. Litchfield Island, Arthur Habour, Southern Anvers Island	1.5	ATCM VIII 1975	Unusually rich terrestrial and marine life. Breeding location for six bird species. Terrestrial - A1, B1, C1, D1, E1, F1, H1. Marine - S5, S7, S8.	Island is adjacent to three stations: 400 m south of 'Base N' (British) occupied from 1954 to 1958, and destroyed by fire in 1971 (Lipps, 1978); 'Old Palmer' station, occupied from 1964 to 1968; and 1 km west of (new) 'Palmer' station (United States). Debris surrounding all stations is being removed (Bonner and Smith, 1985).

TOTAL AREA 38.4 km^2

PROPOSED SPAs WITHIN THE ANTARCTIC TREATY AREA

18. North Coronation Island, South Orkney Islands	SCAR XVIII 1984	Rarely visited coastline. Site includes continental ice, ice-free land and inshore area.	
19. Lagotellerie Island, Marguerite Bay	1984	Remote plant community 90 km from the limit of their southern distribution.	

20. Extension to Cape Hallett, SPA No.7	1984	Near double the area of the existing site to cover more vegetated ground.
21. Caughley Beach, Ross Island	1984	Proposal to set aside a core area within a proposed SPA to protect moss stands from interference by visitors and research activities.

SSSI	APPROXIMATE AREA (sq.km)	DATE DESIGNATED OR PROPOSED	REASON FOR DESIGNATION SCAR MATRIX CODE	ASSOCIATED HUMAN ACTIVITY (supplementary to Bonner and Smith, 1985)
1. Cape Royds, Ross Island	0.3	ATCM VIII 1975	Southernmost Adèlie penguin colony. Monitoring of penguin populations is of considerable scientifc value. Terrestrial - E1, H1.	Penguins harvested by various expeditions in the early 1900s. Between 1955 and 1961, penguin populations nearly halved to 1 100 pairs. Reduction attributed to disturbance from 'McMurdo Sound' (United States) and 'Scott Base' (New Zealand), which are 36 km distant, and from frequent visits by tourist vessels. Decline halted in 1963 by adoption of regulations agreed between United States and New Zealand, which limit visits to the site and overflying of aircraft (Thomson, 1977). Adèlie penguin population now recovered its pre-1955 level.
2. Arrival Heights, Ross Island	0.7	1975	'Radio-quite' zone for instrumentation concerned with atmospheric research.	Various radio antennae, observatory buildings and road works.
3. Barwick Valley, Victoria Land	300	1975	Among the least disturbed and contaminated in the Dry Valleys of Victoria Land. Valuable reference site for comparative biological studies. Terrestrial - E5, E6, E8, G5-8. Inland waters - K3-4, K12, M3-4.	Camps and depots established over the years have been mainly cleared. Vashka Lake level monitored since 1971/2 season. 'Vanda' station (New Zealand) 15 km south. Station is serviced by helicopter.
4. Cape Crozier, Ross Island	19.3	1975	Redisignation - important site for monitoring Adèlie penguin populations. Terrestrial - B1, C1, D1, E1, H1.	Helicopter landing area and a small hut adjacent to site. Site includes the location of the message post left on the 1901-4 Discovery Expedition for the Morning. Adjacent is Wilson's stone igloo (Historic Monument No.21). 'McMurdo' (United States) and 'Scott' (New Zealand) stations are 70 km south-west.
5. Fildes Penninsula, King George Island, South Shetland Islands	1.8	1975	Protection of fossils and Tertiary rock strata. Terrestrial - B1, C1, D1, H1. Inland waters - L1, P1, Q1. Marine - S5-9.	See Chapter 3, and Headland and Keage (1985).

6.	Byers Peninsula, Livingston Island, South Shetland Islands	28.9	1975	Protection of fossils. Terrestrial - A1, B1, C1, D1, E1, H1. Inland waters - K12, L1-4, M1-4, M12, N1-2, P1-2. Marine - S7, S8, S9.	Important sealing ground 1820-1825. No major constructions.
7.	Haswell Island, Queen Mary Land	0.8	1975	Opportunities for research on several bird species. Terrestrial - C1, D1, E1, H1.	'Mirny' station (Soviet Union) is 3 km south. Neighbouring Buromskiy Island, 600 m south, is a graveyard for the members of the Soviet expedition who perished in a fire at 'Mirny' in 1960. Buromskiy Island is an Historic Monument (Site No.9).
8.	Admiralty Bay, King George Island, South Shetland Islands	13.6	ATCM X	Protection of bird and mammal populations which are being studied. Terrestrial - A1, B1, C1, D1, E1, H1. Inland waters - L1-4, M1-4, M12, P1-4, Q1-4. Marine - S5-9, U5-9.	'Arctowski' station is 200m from the northern site boundary. The site of the Italian station 'Cincha Italia' (1976-7) is 400 m west of 'Arctowski'. Regular visits to site by tourist cruise ships (Headland and Keage, 1985).

TOTAL AREA 365.4 km^2.

PROPOSED SSSI WITHIN THE ANTARCTIC TREATY AREA

9.	Port Foster, Deception Island, South Shetland Islands			Preservation of two areas for scientific studies of the benthic in the caldera of Deception Island. Marine - S6, V6, W6.	
10.	Chile Bay, Greenwich Island, South Shetland Islands			Preservation of two 'baseline' sites for comparative benthic research in the Antarctic. Marine - S8-9, V6.	Sites are 2 to 3 km off-shore 'Capitán Arturo Prat station (Chile) established in 1947. A 1 430 m landing strip for inter-continental aircraft on the shore of Greenwich Bay (600 m north of station) is proposed. Site development includes drainage of lagoons, site levelling using local aggregate and modification of the shoreline by the construction of a breakwater (Alarcon and others, 1982). See Chapter 4.

11. South Bay, Dommer Island, Palmer Archipelago	Recommended SCAR XVII 1978	Preservation of sub-tidal and benthic habitats to a depth of of 45 m for comparative studies. Marine - S5-7, V5-6.	
12. Rothera Point, Adelaide Island	Recommended SCAR XVIII 1984	Preservation of a botantical research site from nearby station activities.	Nearby 'Rothera' station (British) established in 1976. Station has a snow runway facility.
13. Caughley Beach, Ross Island (Refer SPA No.21)	1984	Establish a 'buffer' zone to a proposed SPA, which is the focus of continuing terrestrial biological studies.	Mainly United States and New Zealand scientific activity with emphasis on biology and geology. 'Cape Bird' (summer) station is within 500 m and serviced by helicopter. Tourist cruise ships have visited under supervision. In 1979, oiled penguins observed at Cape Bird rookery (Wilson, 1979).
14. Tramway Ridge, Ross Island	1984	Preservation of one of the few locations in Antarctica of fumarolic vegetation associated with local volcanism.	Increased scientific activity in the site since 1971/2 by New Zealand, United States and Japanese scientists.
15. Canada Glacier, Victoria Land	1984	An important site for continuing biological and limnological studies.	Increasing scientific activity over the past decade. Hut established at Lake Fryxell (near the site) in 1978/9. Impacts around Lake Fryxell have included minor earthworks, erection and destruction by high winds of a glass-house, trampling of vegetation. The impact on the SPA is not known.
16. Extension to Cape Royds, Ross Island (SSSI No.1)	1984	To extend SSSI site No.1 500 m seaward.	
17. Maxwell Bay, King George Island, South Shetland Islands	1984	Preservation of the south-east coast of Maxwell Bay from interference to mammal and seabird breeding areas.	
18. Harmony Cove, Nelson Island, South Shetland Islands	1984	Preservation of representative fauna and flora for research studies.	
19. Cape Primavera, Danco Coast	1984	Preservation of seabird breeding sites and tidal pools for continuing research.	

20. Bailey Peninsula, Budd Coast	1984	Preservation of moss and lichen stands for comparative studies, including those on the impact of station activities on vegetation.	Site adjoins the site of the rebuilt 'Casey' station. The south and east boundary is a melt lake used to supply the station with water. A road forms the west and north boundary of of the site.
21. Clark Peninsula, Budd Coast	1984	As above.	
22. White Island, McMurdo Sound	1984	Preservation of a population of Weddell seals on the north and west coasts which feed under the Ross Ice Shelf.	
23. Linnaeus Terrace, Victoria Land	1984	Preservation of fragile rock formation and associated biota for continuing research.	
24. Biscoe Point, Anvers Island	1984	Preservation of large stands of two Antarctic flowering plants.	
25. Deception Island, South Shetland Islands	1984	Covers five areas on the inner coast of Port Foster which are are being recolonised by plants following volcanic alteration to the landscape.	The inner coast of Port Foster includes the sites of the Norwegian 'Hekto Whaling Company' factory (1912-1931), 'Base B' (British) 1943-1968, 'Presidente Pedro Aguirre Corda' (Chile) 1954-1968, 'Decepcion' station (Argentina) 1947-1968. Extensive volcanic activity took place 1967-1971.