The Antarctic Treaty

Measures adopted at
the Thirty-first Consultative Meeting
held at Kyiv 2 June - 13 June 2008

Presented to Parliament
by the Secretary of State for Foreign and Commonwealth Affairs
by Command of Her Majesty
March 2009

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The Measures[1] adopted at the Thirty-first Antarctic Treaty Consultative Meeting are reproduced below from the Final Report of the Meeting.

In accordance with Article IX, paragraph 4, of the Antarctic Treaty, the Measures adopted at Consultative Meetings become effective upon approval by all Contracting Parties whose representatives were entitled to participate in the meeting at which they were adopted (i.e. all the Consultative Parties). The full text of the Final Report of the Meeting, including the Decisions and Resolutions adopted at that Meeting, is available on the website of the Antarctic Treaty Secretariat at www.ats.aq.

The approval procedures set out in Article 6 (1) of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty[2] apply to Measures 1 to 14 (2008).

[1] As defined in Decision 1 (1995), published in Miscellaneous No. 28 (1996) Cm 3483

[2] Treaty Series No. 15 (2006) Cm 6855

The texts of the Antarctic Treaty together with the texts of the Recommendations of the first three Consultative Meetings (Canberra 1961, Buenos Aires 1962 and Brussels 1964) have been published in Treaty Series No. 97 (1961) Cmnd. 1535 and Miscellaneous No. 23 (1965) Cmnd. 2822. The text of the Environmental Protocol to the Antarctic Treaty has been published in Treaty Series No. 6 (1999) Cm 4256. The text of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty has been published in Treaty Series No. 15 (2006) Cm 6855.

The Recommendations of the Fourth to Eighteenth Consultative Meetings, the Reports of the First to Sixth Special Consultative Meetings and the Measures adopted at the Nineteenth and the Measures adopted at the Twenty-sixth, Twenty-seventh, Twenty-eighth, Twenty-ninth and Thirtieth Consultative Meetings were also published as Command Papers. No Command Papers were published for the Twentieth to Twenty-fifth Consultative Meetings.

MEASURES ADOPTED AT THE XXXI[st] Consultative Meeting held at Kyiv 2 June - 13 June 2008

Note: The above page numbers have been reproduced from the original Final Report of the meeting

Measure 1 (2008)

Antarctic Specially Managed Area No 7: South-west Anvers Island and Palmer Basin

The Representatives,

Recalling Articles 4, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty, providing for the designation of Antarctic Specially Managed Areas ("ASMA") and the approval of Management Plans for those Areas;

Recalling the agreement of ATCM XVI (1991) that Parties should require, voluntarily, that their national programme operators and, to the maximum extent possible, persons subject to their jurisdiction comply with the provisions of the proposed Multiple-Use Planning Area at South-west Anvers Island and vicinity;

Recalling

- Recommendation VIII-1 (1975), which designated Litchfield Island as Specially Protected Area (SPA) No 17,

- Decision 1 (2002), which renamed and renumbered SPA 17 as Antarctic Specially Protected Area ("ASPA") No 113, and

- Measure 2 (2004), which annexed a Management Plan for ASPA 113;

Recalling

- Recommendation XIV-5 (1987), which designated South Bay, Doumer Island, Palmer Archipelago as Site of Special Scientific Interest ("SSSI") No 28 and annexed a Management Plan for SSSI 28,

- Resolution 3 (1996), which extended the expiry date of SSSI 28 from 31 December 1997 to 31 December 2000,

- Measure 2 (2000), which extended the expiry date of SSSI 28 from 31 December 2000 to 31 December 2005,

- Decision 1 (2002), which renamed and renumbered SSSI 28 as Antarctic Specially Protected Area No 146;

Noting that the Committee for Environmental Protection has advised that South-west Anvers Island and Palmer Basin be designated as an Antarctic Specially Managed Area and has endorsed the Management Plan annexed to this Measure;

Recognising that South-west Anvers Island and Palmer Basin is an area where activities are being conducted, in which it is desirable to plan and co-ordinate activities, avoid possible conflicts, improve cooperation between Parties and avoid possible environmental impacts;

Desiring to designate Anvers Island and Palmer Basin as an Antarctic Specially Managed Area, within which ASPA 113 and ASPA 146 are located, and to approve a Management Plan for the Area, without any modification to the Management Plan for ASPA 113 which is annexed to Measure 2 (2004) or to the Management Plan for ASPA 146 which is annexed to Recommendation XIV-5 (1987);

Noting that South-west Anvers Island and Palmer Basin contains marine areas and that the Commission on the Conservation of Antarctic Marine Living Resources approved its designation as an Antarctic Specially Managed Area at its 26th meeting;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) South-west Anvers Island and Palmer Basin be designated as Antarctic Specially Managed Area No 7; and

2) the Management Plan which is annexed to this Measure be approved.

Management Plan for Antarctic Specially Managed Area No 7

SOUTH-WEST ANVERS ISLAND AND PALMER BASIN

Introduction

The region that includes south-west Anvers Island and the Palmer Basin and its fringing island groups has a wide range of important natural, scientific and educational values and is an area of considerable and increasing scientific, tourist and logistic activities. The importance of these values and the need to provide an effective means to manage the range of activities was recognised with adoption of the area as a Multiple-Use Planning Area for voluntary observance at the XVIth Antarctic Treaty Consultative Meeting (1991). With the acquisition of new data and information and changes to logistics and the pressures arising from human activities in the region, the original plan has been comprehensively revised and updated to meet current needs as an Antarctic Specially Managed Area (ASMA).

In particular, scientific research being undertaken within the Area is important for considering ecosystem interactions and long-term environmental changes in the region, and how these relate to Antarctica and the global environment more generally. This research is important to the work of the Committee for Environmental Protection, the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and the Antarctic Treaty System as a whole. There is a risk that these globally important research programs and long-term datasets could be compromised if activities were to occur in the marine area that were not appropriately managed to avoid potential conflicts and possible interference. While marine harvesting activities are not currently being conducted within the Area, and the marine component of the Area represents only 0.5% of CCAMLR Subarea 48.1, it is important that should harvesting be undertaken within the Area then it should be carried out in such a way that it would not impact on the important scientific and other values present within the Area.

Important values present in the proposed ASMA in the vicinity of Palmer Station and key activities to be managed are summarised as follows:

1. Values to be protected and activities to be managed

1(i) Scientific values

The diverse and easily accessible assemblages of marine and terrestrial flora and fauna in the south-west Anvers Island and Palmer Basin area are particularly valuable for science, with some datasets spanning the past 100 years and intensive scientific interest beginning in the 1950s. Studies have been carried out on a wide variety of topics, including long-term monitoring of seal and bird populations, surveys of plants and animals in both the terrestrial and sub-tidal environments, investigations of the physiology and biochemistry of birds, seals, terrestrial invertebrates and zooplankton, the behaviour and ecology of planktonic marine species, physical oceanography, and marine sedimentology and geomophology. While the United States (US) maintains the only permanent research station within the Area, research in these fields has been undertaken by scientists from a broad range of Antarctic Treaty Parties, often as collaborative projects with US scientists. Some important recent examples from the Palmer Long Term Ecological Research (LTER) program are described below.

The south-west Anvers Island and Palmer Basin area has exceptional importance for long-term studies of the natural variability in Antarctic ecosystems, the impact of world-wide human activities on Antarctica and on the physiology, populations and behaviour of its plants and animals. Research in this region is essential for understanding the linkages among avifauna, krill dynamics and the changing marine habitat.

In particular, the United States Antarctic Program (USAP) has a major and ongoing commitment to ecosystem research in the Antarctic Peninsula region, which was formalized through the designation in 1990 of the area around Palmer Station (US) as a Long Term Ecological Research (LTER) site. The Palmer LTER (PAL-LTER) site is part of a wider network of LTER sites, and one of only two in the Antarctic, designed specifically to address important research questions related to environmental change over a sustained period spanning more than several decades. Since 1991, the PAL-LTER program has included spatial sampling during annual and seasonal cruises within a large-scale (200,000km^2) regional grid along the west coast of the Antarctic Peninsula, as well as temporal sampling from October to March in the local area adjacent to Palmer Station. The Palmer LTER and the British Antarctic Survey are collaborating on research comparing the marine ecosystem in the Palmer Basin region with that in Marguerite Bay approximately 400km further to the south. In the Palmer region, the ecosystem is changing in response to the rapid regional warming first documented by BAS scientists. In addition, recent collaboration has been established as part of the International Polar Year with scientists from France and Australia using metagenomic tools to understand microbial community adaptations to the polar winter.

A major theme in the PAL-LTER is the study of sea-ice dynamics and related impacts on all aspects of the ecosystem (Smith *et al*. 1995). The annual advance and retreat of sea-ice is a major physical determinant of spatial and temporal changes in the structure and function of the Antarctic marine ecosystem, from total and annual primary production to breeding success in seabirds. The Western Antarctic Peninsula (WAP) is a premier example of a region experiencing major changes in species abundance, range and distribution, in response to regional climate change. This change is manifested primarily as a southern migration of regional climate characteristics (Smith *et al*. 1999, 2001). Paleoecological records on sea-ice, diatom stratigraphy and penguin colonization have also placed the current LTER data into a longer-term context (Smith *et al*. 1999, 2001). In particular, the Palmer Basin has been the site of extensive paleoecological and climate change studies. The Palmer Basin also exhibits a variety of geomorphological features of value.

Extensive seabird research has focused on the ecology of Adélie penguins and their avian predators and scavengers within the inshore 50km^2 PAL-LTER grid close to Palmer Station. Colonies on 18 islands in this area are visited every 2-7 days in the summer season, and three more distant control sites within the ASMA are also visited infrequently to assess the extent of possible disturbance from activities around Palmer Station. Sea ice forms a critical winter habitat for Adélie penguins, and interdisciplinary research has focused on the impacts of changes in the frequency, timing and duration of sea-ice on the life histories of this and other bird species, as well as on prey populations.

Torgersen Island is the site of a study on the impacts of tourism, and has been divided into two areas, one open to visitors and the other closed as a site for scientific reference. This site together with other nearby islands not visited by tourists provide a unique experimental setting to examine the relative effects of natural versus human-induced variability on Adélie penguin populations. The long-term data sets obtained from this site are of particular value in understanding the impacts of tourism on birds.

The south-west Anvers Island and Palmer Basin region also hold particular scientific interest in terms of newly-exposed terrestrial areas that have been subject to vegetation colonization after glacial retreat. With continuing trends of glacial retreat, these areas are likely to be of increasing scientific value.

Seismic monitoring at Palmer Station contributes to a global seismic monitoring network, and the remote location of the station also makes it a valuable site for long-term monitoring of global levels of radionuclides.

It is important that the region is carefully managed so that these scientific values can be maintained and the results of the long-term research programs are not compromised.

1(ii) Flora and fauna values

The south-west Anvers Island and Palmer Basin region is one of the most biologically diverse in Antarctica, with numerous species of bryophytes, lichens, birds, marine mammals and invertebrates (Appendix C). These organisms are dependent on both the marine and terrestrial ecosystems for food and habitat requirements, with the Palmer Basin exerting a substantial influence on regional ecological processes.

Breeding colonies of birds and seals are present on ice-free areas along the coast of Anvers Island, as well as on many of the offshore islands within the region. Eleven species of birds breed in the Area, with Adélie penguins (*Pygoscelis adeliae*) the most abundant, and several other species are frequent non-breeding visitors. Five species of seals are commonly found in the Area, but are not known to breed there. Palmer Basin is an important foraging area for birds, seals and cetaceans.

The two native Antarctic vascular plants, *Deschampsia antarctica* and *Colobanthus quitensis*, are commonly found on surfaces with fine soil in the area around Arthur Harbor, although they are relatively rare along the Antarctic Peninsula (Komárková *et al.* 1985). The vascular plant communities found at Biscoe Point (ASPA No 139) and on the Stepping Stones are some of the largest and most extensive in the Anvers Island region, and are particularly abundant for such a southerly location. Dense communities of mosses and lichens are also found on Litchfield Island (ASPA No 113) – a site specially protected for exceptional vegetation values – and at several other locations around Arthur Harbor.

The soils and plant communities provide an important habitat for invertebrates, and the ice-free islands and promontories close to Palmer Station are particularly valuable for their abundant populations of the endemic wingless midge *Belgica antarctica*, the southernmost, free-living true insect. This is also of significant value for scientific studies, since this species has not been found to the same extent close to other research stations on the Antarctic Peninsula.

1(iii) Educational and visitor values

The south-west Anvers Island area holds a special attraction to tourists because of its biological diversity, accessibility and the presence of Palmer Station. These features offer tourists the opportunity to observe wildlife, and gain an appreciation of Antarctic environments and scientific operations. Outreach to tourists via local tours and shipboard lectures given by scientists is a valuable educational tool, and information is also made available to high school students in the US by initiatives through the LTER program.

2. Aims and objectives

The aim of this Management Plan is to conserve and protect the unique and outstanding environment of the south-west Anvers Island and Palmer Basin region by managing the variety of activities and interests in the Area. The Area requires special management to ensure that these important values are protected and sustained in the long-term, especially the extensive scientific data sets collected

over the last 100 years. Increasing human activity and potentially conflicting interests have made it necessary to manage and coordinate activities more effectively within the Area.

The specific objectives of management in the Palmer Basin region are to:

- Facilitate scientific research while maintaining stewardship of the environment;
- Assist with the planning and coordination of human activities in the region, managing potential or actual conflicts of interest among different values, activities and operators, including between different areas of scientific research;
- Ensure that any marine harvesting activities are coordinated with scientific research and other activities taking place within the Area. This coordination could include the development of a plan for harvesting within the Area in advance of any such activities taking place.
- Ensure the long-term protection of scientific, ecological, and other values of the Area through the minimization of disturbance to or degradation of these values, including disturbance to fauna and flora, and to minimize the cumulative environmental impacts of human activities;
- Minimize the footprint of all facilities and scientific experiments established in the Area, including the proliferation of field camps and boat landing sites;
- Promote the use of energy systems and modes of transport that have the least environmental impact, and minimize the use of fossil fuels for the conduct of activities in the Area;
- Encourage communication and cooperation between users of the Area, in particular through dissemination of information on the Area and the provisions that apply.

3. Management activities

To achieve the aims and objectives of this Management Plan, the following management activities are to be undertaken:

- National Programs operating within the Area should establish a South-west Anvers Island and Palmer Basin Management Group to oversee coordination of activities in the ASMA. The Management Group is established to:
    - facilitate and ensure effective communication among those working in or visiting the Area;
    - provide a forum to resolve any potential conflicts in uses;
    - maintain a record of activities and, where practical, impacts in the Area;
    - develop strategies to detect and address cumulative impacts;
    - evaluate the effectiveness of management activities; and
    - disseminate information on the values and objectives of the ASMA to those working in or visiting the Area.

The Management Group should convene on an annual basis to review past, existing, and future activities and to make recommendations on the implementation of this Management Plan, including its revision when necessary.

- To guide activities in the Area, a general Code of Conduct for activities is included in this Management Plan (see Section 7) and further Guidelines relating to specific activities and zones are included in the Appendices.
- National Programs operating within the Area and tour operators visiting should ensure that their personnel (including staff, crew, visiting scientists and passengers) are briefed on, and are aware of, the requirements of this Management Plan;

- The USAP determines annually the number of tourist vessel visits to Palmer Station (approximately 12 per season) through a pre-season scheduling and approval process;
- Signs and markers shall be erected where necessary and appropriate to show the boundaries of Antarctic Specially Protected Areas (ASPAs) and other zones within the Area. Signs shall be secured and maintained in good condition, and removed when no longer necessary;
- Copies of this Management Plan and supporting documentation will be made available at Palmer Station (US). In addition, the Management Group shall make this information freely available in electronic form to enable visitors to consult plan requirements in advance and to enable them to carry a copy when visiting;
- Visits should be made to the Area as necessary (no less than once every 5 years) to evaluate the effectiveness of the Management Plan, and to ensure that management and maintenance measures are adequate. The Management Plan, Code of Conduct and Guidelines will be revised and updated as necessary.

Note: any activity planned inside an ASPA within the Area requires a permit and must refer to the appropriate management plan for guidance.

4. Period of designation

Designated for an indefinite period.

5. Maps

- Map 1. Regional map and ASMA boundary.
- Map 2. SW Anvers Island Restricted Zones: Rosenthal, Joubin and Dream islands.
- Map 3. Arthur Harbor & Palmer Station access.
- Map 4. Palmer Station Operations Zone.
- Map 5. Torgersen Island Zones.
- Map 6. Dream Island Restricted Zone.
- Map 7. Litchfield Island, ASPA No 113.
- Map 8. Biscoe Point, ASPA No 139.

6. Description of the Area

6(i) Geographical co-ordinates, boundary markers and natural features

General description

Anvers Island is the largest and most southerly island in the Palmer Archipelago, located approximately 25km west of the Antarctic Peninsula. It is bounded by Neumayer Channel and Gerlache Strait in the south-east and Bismarck Strait to the south (Map 1). Anvers Island is heavily glaciated, the south-western half being dominated by the Marr Ice Piedmont, a broad expanse of permanent ice rising gently from the coast to around 1000m elevation. The southern and western coastlines of Anvers Island within the Area comprise mainly ice cliffs on the edge of the Marr Ice Piedmont, punctuated by small rocky outcrops, ice-free promontories and numerous small near-shore islands. Other prominent land features within the Area include ice-free Cape Monaco at the

south-western extremity of Anvers Island, and Cape Lancaster in the south-east. These ice-free areas form important sites for animal and plant colonisation.

Six main island groups exist within the Area: in the north are the Rosenthal Islands (~22km NW of Palmer Station). Fringing the Palmer Basin are the Joubin Islands, the Arthur Harbor island group (location of Palmer Station), the Wauwermans Islands, the Dannebrog Islands and the Vedel Islands. These island groups are of low relief, generally of less than 100m in elevation, although local topography can be rocky and rugged together with small relict ice-caps.

Palmer Station (US) (64°46'27"S, 64°03'15"W) is located within Arthur Harbor on Gamage Point, an ice-free promontory on the south-western coast of Anvers Island at the edge of the Marr Ice Piedmont (Maps 3 & 4). Immediately to the south of the station are Hero Inlet and Bonaparte Point. Norsel Point lies 2.7km from Palmer Station at the NW extremity of the largest island in Arthur Harbor, which until recently was joined to Anvers Island by an ice-bridge. Other islands within a few km west of the station include Torgersen (Map 5), Humble, Breaker and Litchfield (Map 7) islands, the latter designated as ASPA No 113. Those nearby to the south-east include Shortcut, Christine, Hermit, Limitrophe, Laggard and Cormorant islands (Map 3). More distant, Biscoe Point, ASPA No 136, lies on a small island ~14km to the south-east that was until recently also joined by an ice-bridge to Anvers Island (Map 8). To the west, Fraser, Halfway (Map 2) and Dream (Map 6) islands lie 5.9, 6.4 and 9.4km respectively NW of Palmer Station in Wylie Bay.

There are three dominant marine features in the Palmer Basin region:

Shallow shelves: extend from Anvers Island and the adjacent island groups to depths of 90-140m.

Bismarck Strait: located south of Palmer Station and north of the Wauwermans Islands on an east–west axis, with depths generally between 360 to 600 m, connecting the southern entrances to Gerlache Strait and Neumayer Channel to Palmer Basin.

Palmer Basin: the only deep basin in the area, located 22km south-west of Palmer Station and with a maximum depth of ~1400m. It is bordered by the Joubin Islands to the north, the Wauwermans Islands to the east, and the Dannebrog and Vedel island groups in the south-east, and is surrounded by shelves shallower than 165m. A channel of ~460m depth connects Palmer Basin to the continental shelf edge west of the Area.

Boundaries of the Area

The South-west Anvers Island and Palmer Basin ASMA encompasses an area of approximately 3275km^2, including both terrestrial and marine components. For ease of navigation, the boundaries of the Area follow geographic features where practical and latitude/longitude lines in open ocean areas remote from prominent land features. The north-eastern boundary of the Area is defined as a line extending parallel to and approximately one kilometer inland from the south-west Anvers Island coastline. This terrestrial boundary extends from a northerly location at 64°33'S, 64°06'03"W, ~3.1km north of Gerlache Island, to 64°51'21"S, 63°42'36"W at Cape Lancaster in the south. From Cape Lancaster, the eastern boundary is defined as the 63°42'36"W line of longitude extending 7.9km across Bismarck Strait to 64°55'36"S on Wednesday Island, the most easterly of the Wauwermans Islands. The boundary then follows a general south-westerly direction to 65°08'33"S, 64°14'22"W at the southern extremity of the Vedel Islands, following the eastern coastlines of the Wauwermans, Dannebrog and Vedel island groups. The southern boundary of the area is defined as the 65°08'33"S line of latitude extending due west from 64°14'22"W in the Vedel Islands to 65°00'W.

The northern boundary is defined as the line of latitude extending from 64°33'S, 64°06'03"W to the coast (~3.1km north of Gerlache Island) and thence due west to the 65°00'W line of longitude.

The western boundary of the Area is defined as the 65°00'W line of longitude, extending between 64°33'S in the north and 65°08'33"S in the south.

The boundaries of the Area have been designed to include areas of high ecological value while also maintaining a practical configuration for ease of use and navigation. The original Multiple-use Planning Area boundary has been extended northwards to include the Rosenthal Islands, which contain several large colonies of chinstrap and gentoo penguins that may function as source populations for other colonies in the south-west Anvers Island region (W. Fraser *pers. comm.* 2006). The original boundary has also been extended westwards and southwards to include the full extent of the Palmer Basin, because of the biological, palaeoecological and oceanographic importance of this feature.

The extent of the terrestrial component has been revised from the original Multiple-use Planning Area boundary to exclude extensive ice fields on the Marr Ice Piedmont, which do not possess values related to the core objectives of the management plan. The boundary encompasses all ice-free coastal areas, the Palmer Basin which plays a key role in regional ecosystem processes, and the nearby associated island groups, which are biologically important and also the focus of most human activity in the region.

Climate

The western Antarctic Peninsula is experiencing the most rapid warming of any marine ecosystem on the planet (Ducklow *et al.* 2007). The mean annual temperature at Palmer Station between 1974-96 was –2.29° C, with an average minimum monthly air temperature over this period of –7.76° C in August, and a maximum of 2.51° C in January (Baker 1996). Data from Faraday / Vernadsky Station 53km to the south demonstrate a statistically significant trend of annual average temperature rise, from –4.4º in 1951 to –2.0º in 2001, an average rate of 0.057º C per annum (Smith *et al.* 2003). The minimum recorded temperature at Palmer Station as of 2006 is –31° C, and the maximum is 9° C. Storms and precipitation are frequent, with approximately 35-50 cm water equivalent of precipitation received annually in the form of snow and rain (Smith *et al.* 1996). Winds are persistent but generally light to moderate in strength, prevailing from the north-east.

Glaciology, geology and geomorphology

The dominant glacial feature within the Area is the Marr Ice Piedmont. Smaller glaciers and ice-caps are found on many of the islands and promontories, the largest of which is located on Gerlache Island in the Rosenthal Islands (Map 2). Recent observations show the local glaciers to be retreating by approximately 10m annually, with a number of ice-bridges between the Marr Ice Piedmont and offshore islands having collapsed.

Anvers Island and the numerous small islands and rocky peninsulas along its south-western coast are composed of late-Cretaceous to early-Tertiary age granitic and volcanic rocks belonging to the Andean Intrusive Suite. These rocks dominate the Anvers Island area (Hooper 1962) and similar rock types extend into the island groups further south.

The main marine geomorphological feature within the Area is Palmer Basin, an erosional, inner-shelf trough located at the convergence of former ice-flows that once drained across the continental shelf from three distinct accumulation centers on the Antarctic Peninsula and Anvers Island (Domack *et al.* 2006). Seafloor features include relict terraces, sub-glacial lake deltas, channels, debris slopes and morainal banks. These remain as evidence of the development of a sub-glacial lake within the Palmer Basin during, or prior, to the last glacial maximum, its subsequent drainage, and the recession of the Palmer Basin ice stream system (Domack *et al*. 2006).

Freshwater habitat

Throughout the Area there are no significant lakes or streams, although there are numerous small ponds and temporary summer melt streams (Lewis Smith 1996). These are mainly on Norsel Point and some of the offshore islands in Arthur Harbor: notably on Humble Island, and also found on Breaker, Shortcut, Laggard, Litchfield and Hermit islands, and at Biscoe Point (W. Fraser, *pers. comm.* 2006), although many are heavily contaminated by neighboring penguin colonies and groups of non-breeding skuas. The streams possess few biota other than marginal mosses (e.g. *Brachythecium austrosalebrosum*, *Sanionia uncinata*), which are a favored habitat for the larvae of the Antarctic wingless midge, *Belgica antarctica*. However, the ponds support a diverse micro-algal and cyanobacterial flora, with over 100 taxa being recorded, although numbers vary considerably between ponds (Parker 1972, Parker & Samsel 1972). Of the freshwater fauna there are numerous species of protozoans, tardigrades, rotifers, and nematodes, and a few free-swimming crustaceans of which the anostracan *Branchinecta gaini* (Antarctic fairy shrimp) and copepods *Parabroteus sarsi* and *Pseudoboeckella poppii* are the largest and most conspicuous (Heywood 1984).

Flora

The Area lies within the cold maritime Antarctic environment of the western Antarctic Peninsula, where conditions of temperature and moisture availability are suitable to support a high diversity of plant species, including the two native flowering plants Antarctic hairgrass (*Deschampsia antarctica*) and Antarctic pearlwort (*Colobanthus quitensis*) (Longton 1967; Lewis Smith 1996, 2003). In Antarctica these flowering plants occur only in the western Peninsula region, South Shetland and South Orkney Islands, occurring most frequently on sheltered, north-facing slopes, especially in gullies and on ledges near sea level. In a few favourable sites the grass has developed locally extensive closed swards (Lewis Smith 1996), notably at Biscoe Point (ASPA No 139), where closed swards cover up to 6500 m^2. Throughout the maritime Antarctic, and especially in the Arthur Harbor area, the warming trend since the early 1980s has resulted in populations of both species rapidly increasing in number and extent, and numerous new colonies becoming established (Fowbert & Lewis Smith 1994; Day *et al*. 1999).

Vegetation within the Area is otherwise almost entirely cryptogamic (Lewis Smith 1979), with bryophytes dominating moist to wet habitats and lichens and some cushion-forming mosses occupying the drier soils, gravels and rock surfaces (Komárková *et al.* 1985). Dense communities of mosses and lichens are found at several locations around Arthur Harbor, including Norsel Point, Bonaparte Point and Litchfield Island, as well as some of the outer islands and Cape Monaco. In particular, sheltered north-facing slopes support locally extensive communities of the moss turf sub-formations up to 30 cm in depth, with stands of the *Polytrichum strictum–Chorisodontium aciphyllum* association predominating (Lewis Smith 1982). In Arthur Harbor large banks of these mosses can be found overlying an accumulation of peat exceeding a meter in depth and radio-carbon dated at almost 1000 years old. These are particularly apparent on Litchfield Island (ASPA No 113), which is protected principally because of its outstanding vegetation values. Smaller examples are found on Laggard Island, Hermit Island and on Norsel Point, with small banks occurring on coastal promontories and islands throughout the Area. The largest of the Joubin Islands has a peat bank composed solely of *Chorisodontium* (Fenton & Lewis Smith 1982). From the late 1970s relictual patches of centuries-old peat formed by these mosses became exposed below the receding ice cliffs of Marr Ice Piedmont, notably on Bonaparte Point (Lewis Smith 1982). Wet level areas and seepage slopes usually support communities of the moss carpet and mat sub-formation in which *Sanionia uncinata, Brachythecium austrosalebrosum* and *Warnstorfia* spp. are usually dominant. One exceptionally extensive stand on Litchfield Island was destroyed by the increasing summer influx of fur seals during the 1980s.

Lichen-dominated (e.g. species of *Usnea*, *Pseudephebe*, *Umbilicaria* and many crustose forms) communities of the fruticose and foliose lichen sub-formation (often referred to as fellfield) are widespread on most stable, dry stony ground and exposed rock surfaces, often with associated cushion-forming mosses (e.g. species of *Andreaea*, *Hymenoloma*, *Orthogrimmia* and *Schistidium*) (Lewis Smith & Corner 1973). Rocks and boulders close to the shore, especially where influenced by nutrient (nitrogen) input from nearby penguin and petrel colonies, usually support various communities of the crustose and foliose lichen sub-formation. Many of the species (e.g. *Acarospora*, *Amandinea*, *Buellia*, *Caloplaca*, *Haematomma*, *Lecanora*, *Lecidea*, *Xanthoria*) are brightly coloured (orange, yellow, gray-green, brown, white).

The green foliose alga *Prasiola crispa* develops a conspicuous zone on the highly nutrient enriched soil and gravel around penguin colonies. In late summer melting ice fields and permanent snow patches develop a reddish hue as huge aggregations of unicellular snow algae accumulate in the melting firn. Elsewhere, green snow algae give the surface a distinctive coloration.

A checklist of flora observed in the Area is included in Appendix C.

Invertebrates

The vegetation communities found within the Area serve as important habitat for invertebrate fauna. As is common elsewhere on the Antarctic Peninsula, springtails and mites are especially prominent. Colonies of the mite *Alaskozetes antarcticus* are frequently observed on the sides of dry rocks, while other species are associated with mosses, fruticose lichens and Antarctic hairgrass. The most common springtail, *Cryptopygus antarcticus*, is found in moss beds and under rocks. Springtails and mites are also found in other habitats, including bird nests and limpet accumulations (Lewis Smith 1966).

The islands near Palmer Station are notable for their abundant populations of the wingless midge *Belgica antarctica*, a feature not found to the same extent close to other research stations on the Antarctic Peninsula. This endemic species is significant because it is the southernmost, free-living true insect. It inhabits a wide range of habitats including moss, the terrestrial alga *Prasiola crispa* and nutrient-enriched microhabitats adjacent to elephant seal wallows and penguin colonies. Larvae are exceptionally tolerant of freezing, anoxia, osmotic stress and desiccation.

Colonies of the seabird tick *Ixodes uriae* are frequently found beneath well-drained rocks adjacent to seabird nests and especially Adélie penguin colonies. This tick has a circumpolar distribution in both hemispheres and exhibits the greatest range of thermal tolerance (-30 to 40°C) of any Antarctic terrestrial arthropod. The abundance of this tick has decreased during the past three decades concomitantly with observed decreases in Adélie penguin populations (R. Lee *pers. comm.* 2007).

Birds

Three species of penguins, Adélie (*Pygoscelis adeliae*), chinstrap (*P. antarctica*) and gentoo (*P. papua*), breed in the south-west Anvers Island area (Parmelee & Parmelee 1987, Poncet & Poncet 1987, Woehler 1993). The most abundant species is the Adélie penguin, which breeds on Biscoe Point, Christine, Cormorant, Dream, Humble, Litchfield and Torgersen islands, as well as the Joubin and Rosenthal islands (Maps 2-8). Numbers of Adélie penguins have declined significantly over the last 30 years, thought to be linked to the effects of the changing climate on sea-ice conditions, snow accumulation and prey availability (Fraser & Trivelpiece 1996, Fraser & Hofmann 2003, Fraser & Patterson 1997, Trivelpiece & Fraser 1996). Numbers of Adélie penguins breeding on Litchfield Island declined from 884 pairs to 143 pairs between 1974/75 and 2002/03, with no pairs breeding in 2006/07 (W. Fraser *pers. comm.* 2007). Chinstrap penguins are present on Dream Island, on small islands near Gerlache Island, and on the Joubin Islands. The Rosenthal Islands contain

source populations of chinstrap and gentoo penguins that are likely to be closely linked to other colonies in the south-west Anvers Island region. Gentoo penguins are thought to be increasing in the region in response to the regional warming, and may be colonising new sites in recently deglaciated areas or sites vacated by Adélie penguins. In particular, small glaciers on the Wauwermans Islands are retreating and may provide important habitat for new gentoo colonies (W. Fraser *pers. comm.* 2006).

Southern giant petrels (*Macronectes giganteus*) breed at numerous locations within the Area. Blue-eyed shags (*Phalacrocorax* [atriceps] *bransfieldensis*) breed on Cormorant Island, Elephant Rocks and in the Joubin Islands. Other breeding bird species occurring in the Area include kelp gulls (*Larus dominicanus*), Wilson's storm petrels (*Oceanites oceanicus*), sheathbills (*Chionis alba*), south polar skuas (*Catharacta maccormicki*), brown skuas (*C. loennbergi*) and Antarctic terns (*Sterna vittata*). Common non-breeding visitors include southern fulmars (*Fulmarus glacialoides*), Antarctic petrels (*Thalassoica antarctica*), cape petrels (*Daption capense*) and snow petrels (*Pagadroma nivea*). A full list of breeding, frequent and less common or transient visitors recorded in the Area is provided in Appendix C.

Marine mammals

There are few published data on the marine mammals within the area. Cruises conducted in Gerlache Strait have observed fin (*Balaenoptera physalus*), humpback (*Megaptera novaeangliae*) and southern bottlenose (*Hyperoodon planifrons*) whales (Thiele 2004). Anecdotal observations by Palmer Station personnel and visitors have noted fin, humpback, sei (*Balaenoptera borealis*), southern right (*Eubalaena australis*), minke (*Balaenoptera bonaerensis*) and killer (*Orcinus orca*) whales within the Area, as well as hourglass dolphins (*Lagenorhynchus cruciger*) (W. Fraser *pers. comm.* 2007). Non-breeding Weddell (*Leptonychotes weddellii*) and southern elephant seals (*Mirounga leonina*) haul out on accessible beaches, and crabeater (*Lobodon carcinophagus*) and leopard seals (*Leptonyx hydrurga*) are also commonly seen at sea and on ice floes within the Area. Numbers of non-breeding Antarctic fur seals (*Arctocephalus gazella*), mainly juvenile males, have increased in recent years, and depending on the time of year hundreds to thousands of individuals may be found on local beaches throughout the Area. Their increasing abundance is damaging vegetation at lower elevations (Lewis Smith 1996, Harris 2001). Despite the lack of published data concerning marine mammals within the Area, their presence is likely to be related to foraging for Antarctic krill, which forms an important component in their diets (Ducklow *et al.* 2007). A list of marine mammals observed within the Area is provided in Appendix C.

Oceanography

The Western Antarctic Peninsula is unique as the only region where the Antarctic Circumpolar Current (ACC) is adjacent to the continental shelf. The ACC flows in a north-easterly direction off the shelf, and there is also some southward flow on the inner part of the shelf (Smith *et al*. 1995). Circumpolar Deep Water (CDW) transports macronutrients and warmer, more saline water onto the shelf, which has significant implications for heat and salt budgets in the south-west Anvers Island and Palmer Basin region. Circulation patterns and the presence of the CDW water mass may also affect the timing and extent of sea ice (Smith *et al*. 1995). The extent of sea ice cover and the timing of the appearance of the marginal ice zone (MIZ) in relation to specific geographic areas have high interannual variability (Smith *et al*. 1995), although Smith and Stammerjohn (2001) have shown a statistically significant reduction in overall sea-ice extent in the Western Antarctic Peninsula region over the period for which satellite observations are available. The ice edge and the MIZ form major ecological boundaries, and are of particular interest in the region because of their interaction with many aspects of the marine ecosystem, including phytoplankton blooms and seabird habitat. Within the Area, the Palmer Basin is a focal point of biological and biogeochemical activity and an important area of upwelling.

Marine ecology

The marine ecosystem west of the Antarctic Peninsula is highly productive, with dynamics that are strongly coupled to the seasonal and interannual variations in sea ice. The rapid climate changes occurring on the western Antarctic Peninsula, with resultant changes in sea ice, is affecting all levels of the food web (Ducklow *et al.* 2007). Marine flora and fauna within the Area are strongly influenced by factors including low temperatures, a short growing season, high winds influencing the depth of the mixed layer, proximity to land with the potential for input of micronutrients, and the varying sea-ice coverage. It is a high-nutrient, low-biomass environment.

High levels of primary production are observed within the region, maintained by topography-induced upwellings and stratification by fresh water input from glaciers (Prézelin *et al.* 2000, 2004; Dierssen *et al.* 2002). In terms of biomass, the phytoplankton communities are dominated by diatoms and cryptomonads (Moline & Prezelin 1996). Species distribution and composition varies with water masses, fronts and the changing position of the ice edge.

Salps and Antarctic krill (*Euphausia* sp.) often dominate the total zooplankton biomass (Moline & Prezelin 1996). Dominant organisms in the neritic province on the shelf south-west of Anvers Island are *E. superba, E. crystallorophias,* and fish larvae (Ross *et al.* 1996). The distribution and abundance of zooplankton is variable over time, and Spiridonov (1995) found krill in the Palmer Archipelago to exhibit a highly variable life cycle as compared with other areas of the western Antarctic Peninsula.

There is a high level of endemism among fish species sampled on the Antarctic continental shelf as compared with other isolated marine communities, with new species still being regularly discovered (Eastman 2005). Examples of fish collected within the Area are six species of Nototheniidae (*Notothenia coriiceps neglecta, N. gibberifrons, N. nudifrons, Trematomus bernachii, T. hansoni* and *T. newnesi*), one of Bathydraconidae (*Parachaenichthys charcoti*) and one of Channichthydae (*Chaenocephalus aceratus*) (De Witt & Hureau 1979, Detrich 1987, McDonald *et al.* 1992).

The soft-bottomed macrobenthic community of Arthur Harbor is characterised by high species diversity and abundance, being dominated by polychaetes, peracarid crustaceans and molluscs (Lowry 1975, Richardson & Hedgpeth 1977, Hyland *et al.* 1994). Samples collected during a study of UV effects on marine organisms carried out close to Palmer Station during the austral spring (Karentz *et al.* 1991) yielded 57 species (1 fish, 48 invertebrates, and 8 algae). Sampling was from a combination of rocky intertidal areas (yielding 72% of organisms), subtidal and planktonic habitats. Of the marine invertebrates collected, the greatest number of species was found in the phylum Arthropoda (12 species). The Antarctic limpet (*Nacella concinna*) is common in Arthur Harbor (Kennicutt *et al*. 1992b).

Human activities and impact

'Base N' (UK) was built on Norsel Point (Map 3) in 1955 and operated continuously until 1958. The United States established 'Old Palmer' Station nearby on Norsel Point in 1965, although in 1968 transferred the main US operations to the present site of Palmer Station on Gamage Point. 'Base N' was used as a biological laboratory by US scientists from 1965-71, although this burnt to the ground in 1971. 'Old Palmer' station was removed by the US in 1991, and all that remains of both 'Old Palmer' and 'Base N' are the original concrete footings.

On 28 January 1989, the Argentine vessel *Bahia Paraiso* ran aground 750m south of Litchfield Island, releasing more than 600,000 liters (150,000 gallons) of petroleum into the surrounding environment (Kennicutt 1990, Penhale *et al.* 1997). Contamination was lethal to some of the local biota including krill, intertidal invertebrates and seabirds, particularly Adélie penguins and blue-eyed shags (Hyland *et al.* 1994, Kennicutt *et al.* 1992a&b, Kennicutt & Sweet 1992). A summary of the spill, research on the environmental impact, and the joint 1992/1993 clean-up by Argentina – and The Netherlands can be found in Penhale *et al.* (1997).

All fin-fishing is currently prohibited in the western Antarctic Peninsula region (CCAMLR Statistical Subarea 48.1) under CCAMLR Conservation Measure 32-02 (1998) (CCAMLR 2006a). Krill fishing occurs in the offshore region to the north-west of the Palmer Archipelago, and is currently concentrated mainly around the South Shetland Islands further to the north. The total krill catch for Subarea 48.1 was reported at 7095 tonnes in the 2004/05 season (CCAMLR 2006b), and there has been some limited historical activity in the vicinity of the ASMA. However, fine-scale data show krill catches in the south-west Anvers Island region during only one 3-month period between 2000 and 2005, with a total catch of less than 4 tonnes (Q2, 2002/03)(CCAMLR 2006b: 187). CCAMLR-related activities are therefore occurring within or close to the Area, but are currently minimal.

Current human activities in the Area are mainly related to science and associated logistic activities, and tourism. Palmer Station (US) serves as the base for scientific research and associated logistic operations conducted in the western Antarctic Peninsula and Palmer Archipelago by the United States Antarctic Program (USAP) and collaborators from a number of other Antarctic Treaty Parties. Scientific and logistic support is received from ships operated or chartered by the USAP, which visit the station approximately 15 times per year. Aircraft are not operated routinely from Palmer Station, although helicopters may visit occasionally in summer. Local scientific transport and support is provided using small inflatable boats, which are operated throughout the 3-mile (~5km) 'safe boating limit' area during the summer season (Map 3). Frequent visits are made to islands within the safe boating limit for scientific research, and also for recreation by base personnel.

Published information on the impacts of science (for example from sampling, disturbance or installations) within the Area is limited. However, numerous welding rods inserted into soil to mark vegetation study sites (Komárková 1983) were abandoned at Biscoe Point (ASPA No 139) and Litchfield Island (ASPA No 113) in 1982. Where these remained, surrounding vegetation had been killed as an apparent result of highly localised contamination by chemicals from the rods (Harris 2001).

Between 1984/85 and 1990/91, the number of tour ship visits each season at Palmer Station increased from 4 visits (340 visitors) to 12 (1300 visitors). Since 1991 the number of tour ship visits to Palmer Station has been maintained at approximately 12 vessels annually, with visits arranged prior to the start of the season. Tourists typically land at the station itself for a tour of the facilities, visit the Visitor Zone on Torgersen Island (Map 5), and make short cruises around the nearshore islands using inflatable boats. Yachts also visit Palmer Station and the surrounding area, with 17 vessels visiting during the 2007/08 season. Studies of changes in penguin populations on Torgersen Island and nearby islands suggest that the impacts of visits by tourists, base personnel, and scientists on breeding performance have been small compared to longer-term climate-related forcing factors (Fraser & Patterson 1997, Emslie *et al.* 1998, Patterson 2001).

6(ii) Structures within the Area

Modern Palmer Station (Map 4) consists of two main buildings, a laboratory facility and several ancillary structures including an aquarium, small boathouse, workshops, storage and communications facilities. The station is powered by one diesel-electric generator, the fuel for which is stored in two double-walled tanks. A pier has been constructed adjacent to the station at the entrance to Hero Inlet, which may accommodate medium-sized scientific and logistic support ships. The station is operated year-round and can accommodate approximately 44 people, with a summer occupancy of at least 40, and a winter complement of around 10.

6(iii) Restricted and managed zones within the Area

Three types of management zones (Restricted, Visitor and Operations) are designated within the Area. Two ASPAs are also located within the Area.

(a) Restricted Zones

Sixteen sites of special ecological and scientific value are designated as Restricted Zones (Maps 2-6). These sites are particularly sensitive to disturbance during the summer months, and are listed as follows:

Table 1: Restricted Zones within the South-west Anvers Island and Palmer Basin ASMA

Bonaparte Point (incl. 'Diana's Island' and 'Kristie Cove')	Laggard Island
Christine Island	Limitrophe Island
Cormorant Island	Norsel Point
Dream Island	Rosenthal Islands
Elephant Rocks	Shortcut Island
Hermit Island	Shortcut Point
Humble Island	Stepping Stones
Joubin Islands	Torgersen Island (SW half of island)

The Restricted Zones include a buffer extending 50m from the shore into any adjacent marine area (Map 2). A 50m Restricted Zone buffer also extends around Litchfield Island (ASPA No 113). In order to protect sensitive bird colonies throughout the breeding season to the maximum extent possible, and also plant communities, access to Restricted Zones between 1 October to 15 April inclusive is restricted to those conducting essential scientific research, monitoring or maintenance. All non-essential small boat traffic should avoid transit of or cruising within the 50m marine buffers of Restricted Zones.

Specific guidelines for scientific research activities within Restricted Zones are included in the Scientific Guidelines for the ASMA (Appendix A).

(b) Visitor Zone

The north-eastern half of Torgersen Island is designated as a Visitor Zone (Map 5). Visitors are currently directed to this part of the island, while access to the Restricted Zone in the south-west part of the island, which is set aside as a scientific reference area, is restricted to those conducting essential scientific research, monitoring or maintenance. Specific guidelines for activities within the Visitor Zone are included in the Visitor Guidelines for the ASMA (Appendix B).

(c) Operations Zone

Palmer Station facilities are largely concentrated within a small area on Gamage Point. The Operations Zone is designated as the area of Gamage Point encompassing the station buildings, together with adjacent masts, aerials fuel storage facilities and other structures and extending to the permanent ice edge of the Marr Ice Piedmont (Map 4).

(d) Antarctic Specially Protected Areas (ASPAs)

Two Antarctic Specially Protected Areas, ASPA No 113 Litchfield Island and ASPA No 139 Biscoe Point, are located within the ASMA (Maps 7 and 8). Revised management plans for both sites were adopted by the Antarctic Treaty Parties in 2004. All entry is prohibited unless in accordance with a Permit issued by an appropriate national authority.

6(iv) Location of other protected areas within close proximity of the Area

In addition to ASPA No 113 and ASPA No 139 within the Area, the only other protected area within close proximity is ASPA No 146, South Bay, Doumer Island, 25km south-east of Palmer Station (Map 1). There are no Historic Sites and Monuments within the Area, with the nearest being HSM No 61, Base A, Port Lockroy, Goudier Island, 30km east of Palmer Station (Map 1).

7. General code of conduct

The Code of Conduct in this section is the main instrument for the management of activities in the Area. It outlines the overall management and operational principles for the Area. More specific environmental, scientific and visitor guidelines are provided in the appendices.

7(i) Access to and movement within the Area

Access to the Area is generally by ship (Map 4), with occasional access by helicopter. There are no special restrictions on the transit of vessels through the Area, with the exception of seasonal buffer zones extending 50m from the shore at a small number of islands designated as Restricted Zones (see Section 6(iii)(a)). Prior to visiting Palmer Station, radio contact should always be made to obtain guidance on local activities being conducted in the region (Map 3).

Tour ships, yachts and National Program vessels may stand offshore and access Palmer Station and the surrounding coast and islands by small boat, taking into account the access restrictions applying within designated zones. The region of safe small boat operations and preferred small boat landing sites within the area local to Palmer Station are shown on Map 3 (see also Appendix A).

Access to Restricted Zones between 1 October – 15 April inclusive is restricted to those conducting essential scientific research, monitoring or maintenance, including the nearshore marine area within 50m of the coast of these zones (see Section 6(iii)(a) for details). Access to ASPAs is prohibited except in accordance with a Permit issued by an appropriate national authority.

Aircraft operating within the Area should follow the 'Guidelines for the operation of aircraft near concentrations of birds in Antarctica' (Resolution 4, XXVII Antarctic Treaty Consultative Meeting). The primary helicopter landing site at Palmer Station is a flat, rocky area approximately 400m east of Palmer Station. Helicopter approach should be high over the peninsula east of Palmer Station or up the channel from SE (refer to Palmer Station page in the Anvers Island section of the *Wildlife Awareness Manual* (Harris 2006)). Overflight of wildlife colonies should be avoided throughout the Area, and specific overflight restrictions apply at Litchfield Island (ASPA No 113) and Biscoe Point (ASPA No 139) (Maps 7 & 8 and specific provisions in the ASPA management plans).

Movement on land within the Area is generally on foot, although vehicles are used in the Operations Zone. A route leading from Palmer Station up onto the Marr Ice Piedmont is marked by flags to avoid crevassed areas. The precise route varies according to conditions and visitors should obtain the latest information on the route from Palmer Station. In the winter, snowmobiles are sometimes used on this route. All movement should be undertaken carefully to minimise disturbance to animals, soil and vegetated areas.

7(ii) Activities that are or may be conducted within the Area

Activities that may be conducted in the Area include:

- scientific research, or the logistical support of scientific research, that will not jeopardise the values of the Area;

- management activities, including the maintenance or removal of facilities, clean-up of abandoned work-sites, and monitoring the implementation of this Management Plan; and
- tourist or private expedition visits consistent with the provisions of this Management Plan and the Visitor Guidelines (Appendix B);
- media, arts, education or other official national program visitors;
- harvesting of marine living resources, which should be conducted in accordance with the provisions of this Management Plan and with due recognition of the important scientific and environmental values of the Area. Any such activities should be conducted in coordination with research and other activities taking place, and could include development of a plan and guidelines that would help to ensure that harvesting activities did not pose a significant risk to the other important values of the Area.

All activities in the Area should be conducted in such a manner so as to minimize environmental impacts. Specific guidelines on the conduct of activities within the Area, including within specific zones, can be found in the Appendices.

7(iii) Installation, modification or removal of structures

Site selection, installation, modification or removal of temporary refuges or tents should be undertaken in a manner that does not compromise the values of the Area. Installation sites should be re-used to the greatest extent possible and the location recorded. The footprint of installations should be kept to the minimum practical.

Scientific equipment installed in the Area should be clearly identified by country, name of principal investigator, contact details, and date of installation. All such items should be made of materials that pose minimal risk of contamination to the area. All equipment and associated materials should be removed when no longer in use.

7(iv) Location of field camps

Temporary field camps may be made where required for research, and in accordance with the Restricted Zone and ASPA provisions. Field camps should be located on non-vegetated sites, or on thick snow or ice cover when practical, and should avoid concentrations of mammals or breeding birds. The location of field camps should be recorded, and previously occupied campsites should be re-used where appropriate. The footprint of campsites should be kept to the minimum practical.

Emergency caches are located on several islands within the Area for safety purposes, and are identified on Map 3. Please respect the caches and only use them in a genuine emergency, reporting any such use to Palmer Station so the cache can be restocked.

7(v) Taking or harmful interference with native flora and fauna

Taking (including killing or capturing) or harmful interference with native flora or fauna is prohibited, except by Permit issued in accordance with Annex II to the *Protocol on Environmental Protection to the Antarctic Treaty* (1998).

7(vi) Collection or removal of anything not brought into the Area

Material not covered by 7(v) above should only be removed from the area for scientific and associated educational purposes or essential management or conservation purposes, and should be limited to the minimum necessary to fulfill those needs. Material of human origin likely to compromise the values of the Area may be removed unless the impact of removal is likely to be greater than leaving

the material in place. If this is the case the appropriate authority should be notified. Do not disturb experimental sites or scientific equipment.

7(vii) Restrictions on materials and organisms which can be brought into the Area

Visitors should seek to minimize the risk of introduction of non-native species to the maximum extent practical.

7(viii) Waste disposal / management

All wastes other than human wastes and domestic liquid waste shall be removed from the Area. Human and domestic liquid wastes from stations or field camps may be disposed of into the sea below the high water mark. In accordance with Article 4, Annex III of the Protocol on Environmental Protection, wastes shall not be disposed of into freshwater streams or lakes, onto ice-free areas, or onto areas of snow or ice which terminate in such areas or have high ablation.

7(ix) Requirements for Reports

Reports of activities in the Area should be maintained by the Management Group to the greatest extent possible, and made available to all Parties. In accordance with Article 10 of Annex V of the Protocol on Environmental Protection, arrangements should be made for collection and exchange of reports of inspection visits and on any significant changes or damage within the Area.

Tour operators should record their visits to the Area, including the number of visitors, dates, and any incidents in the Area.

8. Exchange of information

In addition to the normal exchange of information by means of the annual national reports to the Parties of the Antarctic Treaty, and to SCAR and COMNAP, Parties operating in the Area should exchange information through the Management Group. All National Antarctic Programs planning to conduct scientific activities within the Area should, as far as practical, notify the Management Group in advance of their nature, location and expected duration, and any special considerations related to the deployment of field parties or scientific instrumentation within the Area.

All tour ships and yachts should, as far as practical, provide the Management Group with details of scheduled visits in advance.

All those planning to conduct marine harvesting activities within the Area should, as far as practical, notify the Management Group in advance of their nature, location and expected duration, and of any special considerations related to how these activities could impact on scientific investigations being carried out within the Area.

Information on the location of scientific activities within the Area should be disseminated as far as practical.

9. Supporting documentation

This Management Plan includes the following supporting documents as appendices:

- Appendix A: Scientific and Environmental Guidelines (including guidelines for Restricted Zones);

- Appendix B: Visitor Guidelines (including guidelines for the Visitor Zone);
- Appendix C: Plant, bird and mammal species recorded within the South-west Anvers Island and Palmer Basin ASMA;
- Appendix D: References.

APPENDIX A

Supporting Guidelines and Data

Scientific and Environmental Guidelines (including guidelines for Restricted Zones)

The coastal marine environmental of the West Antarctic Peninsula has become an important site for scientific research, with a history of study going back some fifty years. This code suggests how you can help to protect the values of the area for future generations and ensure that your presence in the region will have as little impact as possible.

- Everything taken into the field must be removed. Do not dump any unwanted material on the ground or in the water.
- Do not collect specimens or any natural material of any kind, including fossils, except for approved scientific and educational purposes.
- For those based at Palmer Station, stay within the safe boating limits: these are approximately 5km (3 miles) from the station and no closer than 300m from the glacier front along the Anvers Island coastline (Map 3).
- Visit only approved islands at approved times. Do not harass wildlife. Do not disturb mummified seals or penguins.
- When traveling on foot, stay on established trails whenever possible. Do not walk on vegetated areas or rock formations. Some of the biological communities in them have taken several thousand years to develop.
- Ensure that equipment and supplies are properly secured at all times to avoid dispersion by high winds. High velocity winds can arrive suddenly and with little warning.
- Avoid any activities that would result in the dispersal of foreign substances (e.g., food, fuel, reagents, litter). Do not leave any travel equipment behind.

Fuel and chemicals

- Take steps to prevent the accidental release of chemicals such as laboratory reagents and isotopes (stable or radioactive). When permitted to use radioisotopes, precisely follow all instructions provided.
- Ensure you have spill kits appropriate to the volume of fuel or chemicals you have and are familiar with their use.

Sampling and experimental sites

- All sampling equipment should be clean before being brought into the field.
- Once you have drilled a sampling hole in sea ice or dug a soil pit, keep it clean and make sure all your sampling equipment is securely tethered.
- Avoid leaving markers (e.g. flags) and other equipment for more than one season without marking them clearly with your event number and duration of your project.

Glaciers

- Minimize the use of liquid water (e.g., with hot water drills) which could contaminate the isotopic and chemical record within the glacier ice.
- Avoid the use of chemical-based fluids on the ice.

- If stakes or other markers are placed on a glacier, use the minimum number of stakes required to meet the needs of the research; where possible, label these with event number and project duration.

Restricted Zones

- Research in Restricted Zones should be carried out with particular care to avoid or minimize trampling of vegetation and disturbance of wildlife;
- Minimize any disturbance to birds during the breeding season (1 October to 15 April) except for compelling scientific reasons;

All visits to and activities within Restricted Zones should be recorded, in particular records should be kept of the type and quantity of all sampling.

APPENDIX B

Visitor Guidelines (including guidelines for the Visitor Zone)

These guidelines are for commercial tour operators and private expeditions, as well as for National Antarctic Program staff when undertaking recreational activities within the Area.

- Visitor activities should be undertaken in a manner so as to minimize adverse impacts on the south-west Anvers Island and Palmer Basin ecosystem and/or on the scientific activities in the Area;
- Tour operators should provide visit schedules to National Programs operating in the Area in advance of their visits, which should be circulated to the Management Group as soon as they become available;
- In addition to the above, tour vessels and yachts planning to visit Palmer Station should make contact with the station at least 24 hours before arrival to confirm details of the visit;
- At Palmer Station, no more than 40 passengers should be ashore at any time;
- Small boat cruising should avoid any disturbance of birds and seals, and take account of the 50m operation limit around Restricted Zones;
- Visitors should maintain a distance of 5 meters from birds or seals, to avoid causing them disturbance. Where practical, keep at least 15 meters away from fur seals;
- Visitors should avoid walking on any vegetation including mosses and lichens;
- Visitors should not touch or disturb scientific equipment, research areas, or any other facilities or equipment;
- Visitors should not take any biological, geological or other souvenirs, or leave behind any litter;
- Within the group of islands in Arthur Harbor, tourist landings should be confined to the designated Visitor Zone.

Visitor Zone (Torgersen Island)

Visits to Torgersen Island should be undertaken in accordance with the general visitor guidelines outlined above. Further site-specific guidelines are as follows:

- Landings on Torgersen Island should be made at the designated small boat landing site at 64°46’17.8"S, 64°04’31"W on the northern shore of the island;
- No more than 40 passengers should be ashore at any time;

Visitors should limit their visit to the Visitor Zone portion of the island, as the Restricted Zone is a control site for scientific research (Map 5).

APPENDIX C

Plant, bird and mammal species recorded within the South-west Anvers Island and Palmer Basin ASMA

Table C.1: Plant species recorded within the Area (extracted from British Antarctic Survey Plant Database (2007)).

Flowering plants	**Lichens**
Colobanthus quitensis	*Acarospora macrocyclos*
Deschampsia antarctica	*Amandinea petermannii*
Liverworts	*Buellia anisomera, B. melanostola, B. perlata, B. russa*
Barbilophozia hatcheri	*Catillaria corymbosa*
Cephaloziella varians	*Cetraria aculeata*
Lophozia excisa	*Cladonia carneola, C. deformis, C. fimbriata, C. galindezii, C. merochlorophaea var. novochloro, C. pleurota, C. pocillum, C. sarmentosa, C. squamosa*
Mosses	*Coelopogon epiphorellus*
Andreaea depressinervis, A. gainii var. gainii, A. regularis M	*Haematomma erythromma*
Bartramia patens	*Himantormia lugubris*
Brachythecium austrosalebrosum	*Lecania brialmontii*
Bryum archangelicum, B. argenteum, B. boreale, B. pseudotriquetrum	*Lecanora polytropa, L. skottsbergii*
Ceratodon purpureus	*Leptogium puberulum*
Chorisodontium aciphyllum	*Massalongia carnosa*
Dicranoweisia crispula, D. dryptodontoides	*Mastodia tessellata*
Grimmia reflexidens	*Melanelia ushuaiensis*
Hymenoloma grimmiaceum	*Ochrolechia frigida*
Kiaeria pumila	*Parmelia cunninghamii, P. saxatilis*
Platydictya jungermannioides	*Physcia caesia, P. dubia*
Pohlia cruda, P. nutans	*Physconia muscigena*
Polytrichastrum alpinum	*Pseudephebe minuscula, P. pubescens*
Polytrichum juniperinum, P.piliferum, P. strictum	*Psoroma cinnamomeum, P. hypnorum*
Sanionia uncinata	*Rhizoplaca aspidophora*
Sarconeurum glaciale	*Rinodina turfacea*
Schistidium antarctici, S. urnulaceum	*Sphaerophorus globosus*
Syntrichia magellanica	*Stereocaulon alpinum*
Syntrichia princeps, S. sarconeurum	*Umbilicaria antarctica, U. decussata*
Warnstorfia laculosa	*Usnea antarctica, U. aurantiaco-atra*
	Xanthoria candelaria
	Xanthoria elegans

Notes: The number of species recorded within the Area = 83.

Table C.2: Bird and mammal species recorded within the Area (Parmelee et al. 1977; W. Fraser pers. comm. 2007).

Common name	Scientific name	Status within Area
Birds		
chinstrap penguin	*Pygoscelis antarctica*	Confirmed breeder
Adélie penguin	*Pygoscelis adeliae*	Confirmed breeder
gentoo penguin	*Pygoscelis papua*	Confirmed breeder
southern giant petrel	*Macronectes giganteus*	Confirmed breeder
blue-eyed shag	*Phalacrocorax* [atriceps] *bransfieldensis*	Confirmed breeder
kelp gull	*Larus dominicanus*	Confirmed breeder
Wilson's storm petrel	*Oceanites oceanites*	Confirmed breeder
sheathbill	*Chionis alba*	Confirmed breeder
south polar skua	*Catharacta maccormicki*	Confirmed breeder
brown skua	*Catharacta loennbergi*	Confirmed breeder
Antarctic tern	*Sterna vittata*	Confirmed breeder
southern fulmar	*Fulmarus glacialoides*	Frequent visitor
Antarctic petrel	*Thalassoica antarctica*	Frequent visitor
cape petrel	*Daption capense*	Frequent visitor
snow petrel	*Pagadroma nivea*	Frequent visitor
emperor penguin	*Aptenodytes forsteri*	Occasional visitor
king penguin	*A. patagonicus*	Occasional visitor
macaroni penguin	*Eudyptes chrysolophus*	Occasional visitor
rockhopper penguin	*Eudyptes chrysocome*	Occasional visitor
Magellanic penguin	*Spheniscus magellanicus*	Occasional visitor
black-browed albatross	*Diomedea melanophris*	Occasional visitor
gray-headed albatross	*D. chrystosoma*	Occasional visitor
northern giant petrel	*Macronectes halli*	Occasional visitor
black-bellied storm petrel	*Fregetta tropica*	Occasional visitor
red phalarope	*Phalaropus fulicarius*	Occasional visitor
South Georgia pintails	*Anas georgica*	Occasional visitor
black-necked swan	*Cygnus melancoryphus*	Occasional visitor
sandpiper	(sp. unknown)	Occasional visitor
cattle egret	*Bubulcus ibis*	Occasional visitor
Arctic tern	*Sterna paradisaea*	Occasional visitor
Seals (no data on breeding or numbers available)		
Weddell seal	*Leptonychotes weddellii*	Frequent visitor
southern elephant seal	*Mirounga leonina*	Frequent visitor
crabeater seal	*Lobodon carcinophagus*	Frequent visitor
leopard seal	*Hydrurga leptonyx*	Frequent visitor
Antarctic fur seals	*Arctocephalus gazella*	Frequent visitor
Whales and dolphins (no data on breeding or numbers available)		
fin whale	*Balaenoptera physalus*	Observed
humpback whale	*Megaptera novaeangliae*	Observed
sei whale	*Balaenoptera borealis*	Observed
southern right whale	*Eubalaena australis*	Observed
minke whale	*Balaenoptera bonaerensis*	Observed
killer whale	*Orcinus orca*	Observed
hourglass dolphins	*Lagenorhynchus cruciger*	Observed

APPENDIX D

References

Baker, K.S. 1996. Palmer LTER: Palmer Station air temperature 1974 to 1996. *Antarctic Journal of the United States* **31**(2): 162-64.

CCAMLR 2006a. Schedule of Conservation Measures in force 2006/07 season. CCAMLR, Hobart, Australia.

CCAMLR 2006b. Statistical Bulletin, Vol. 18 (1996*2005). CCAMLR, Hobart, Australia.

Day, T.A., C.T. Ruhland, C.W. Grobe & F. Xiong 1999. Growth and reproduction of Antarctic vascular plants in response to warming and UV radiation reductions in the field. *Oecologia* **119**: 24-35.

Detrich III, H.W. 1987. Formation of cold-stable microtubules by tubulins and microtubule associated proteins from Antarctic fishes. *Antarctic Journal of the United States* **22**(5): 217-19.

Domack E., D. Amblàs, R. Gilbert, S. Brachfeld, A. Camerlenghi, M. Rebesco, M. Canals & R. Urgeles 2006. Subglacial morphology and glacial evolution of the Palmer deep outlet system, Antarctic Peninsula. *Geomorphology* **75**(1-2): 125-42.

Ducklow, H.W., K.S. Baker, D.G. Martinson, L.B. Quetin, R.M. Ross, R.C. Smith, S.E. Stammerjohn, M. Vernet & W. Fraser 2007. Marine pelagic ecosystems: The West Antarctic Peninsula. Special Theme Issue, Antarctic Ecology: From Genes to Ecosystems. *Philosophical Transactions of the Royal Society of London* **362**: 67-94.

Eastman, J.T. 2005. The nature and diversity of Antarctic fishes. *Polar Biology* **28**(2): 93-107.

Emslie, S.D., W.R. Fraser, R.C. Smith & W. Walker 1998. Abandoned penguin colonies and environmental change in the Palmer Station area, Anvers Island, Antarctic Peninsula. *Antarctic Science* **10**(3): 257-68.

Fraser, W.R. & Trivelpiece, W.Z. 1996. Factors controlling the distribution of seabirds: winter-summer heterogeneity in the distribution of Adélie penguin populations. In: R. Ross, E. Hofmann, & L. Quetin (eds) *Foundations for ecological research west of the Antarctic Peninsula*. *Antarctic Research Series* **70**. American Geophysical Union, Washington, DC: 257-52.

Fraser, W.R. & Hofmann, E.E. 2003. A predator's perspective on causal links between climate change, physical forcing and ecosystem response. *Marine Ecology Progress Series* **265**: 1-15.

Fraser, W.R. & Patterson, D.L. 1997. Human disturbance and long-term changes in Adélie penguin populations: a natural experiment at Palmer Station, Antarctic Peninsula. In: B. Battaglia, J. Valencia & D. Walton (eds) *Antarctic communities: species, structure and survival*. Cambridge University Press, Cambridge: 445-52.

Fraser, W.R., W.Z. Trivelpiece, D.G. Ainley & S.G. Trivelpiece 1992**.** Increases in Antarctic penguin populations: reduced competition with whales or a loss of sea ice due to global warming? *Polar Biology* **11**: 525-31.

Fenton, J.H.C. & Lewis Smith, R.I. 1982. Distribution, composition and general characteristics of the moss banks of the maritime Antarctic. *British Antarctic Survey Bulletin* **51**: 215-36.

Fowbert, J.A. & Lewis Smith, R.I. 1994. Rapid population increases in native vascular plants in the Argentine Islands, Antarctic Peninsula. *Arctic and Alpine Research* **26**: 290-96.

Harris, C.M. 2001. Revision of management plans for Antarctic Protected Areas originally proposed by the United Kingdom and the United States of America: 2001 field visit report. Unpublished report, Environmental Research & Assessment, Cambridge.

Harris, C.M. (ed) 2006. *Wildlife Awareness Manual: Antarctic Peninsula, South Shetland Islands, South Orkney Islands*. First Edition. Wildlife Information Publication No 1. Prepared for the UK Foreign & Commonwealth Office and HMS *Endurance*. Environmental Research & Assessment, Cambridge.

Heywood, R.B. 1984. Antarctic inland waters. In: R. Laws (ed) *Antarctic ecology* (Volume 1). Academic Press, London: 279-344.

Hooper, P.R. 1962. The petrology of Anvers Island and adjacent islands. *FIDS Scientific Reports* **34**.

Huiskes, A.H.L., D. Lud, T.C.W. Moerdijk-Poortviet, & J. Rozema 1999. Impact of UV-B radiation on Antarctic terrestrial vegetation. In: J. Rozema (ed) *Stratospheric ozone depletion; the effects of enhancing UV-B radiation on terrestrial ecosystems*. Blackhuys Publishers, Leiden: 313-37.

Kennicutt II, M.C. 1990. Oil spillage in Antarctica: initial report of the National Science Foundation-sponsored quick response team on the grounding of the *Bahia Paraiso*. *Environmental Science and Technology* **24**: 620-24.

Kennicutt II, M.C., T.J. McDonald, G.J. Denoux & S.J. McDonald 1992a. Hydrocarbon contamination on the Antarctic Peninsula I. Arthur Harbor – subtidal sediments. *Marine Pollution Bulletin* **24**(10): 499-506.

Kennicutt II, M.C., T.J. McDonald, G.J. Denoux & S.J. McDonald 1992b. Hydrocarbon contamination on the Antarctic Peninsula I. Arthur Harbor – inter- and subtidal limpets (*Nacella concinna*). *Marine Pollution Bulletin* **24**(10): 506-11.

Kennicutt II, M.C & Sweet, S.T. 1992. Hydrocarbon contamination on the Antarctic Peninsula III. The *Bahia Paraiso* – two years after the spill. *Marine Pollution Bulletin* **24**(9-12): 303-06.

Komárková, V. 1983. Plant communities of the Antarctic Peninsula near Palmer Station. *Antarctic Journal of the United States* **18**: 216-18.

Komárková, V. 1984. Studies of plant communities of the Antarctic Peninsula near Palmer Station. *Antarctic Journal of the United States* **19**: 180-82.

Komárková, V., S. Poncet & J. Poncet 1985. Two native Antarctic vascular plants, *Deschampsia antarctica* and *Colobanthus quitensis*: a new southernmost locality and other localities in the Antarctic Peninsula area. *Arctic and Alpine Research* **17**(4): 401-16.

Lascara, C.M., E.E. Hofmann, R.M. Ross & L.B. Quetin 1999. Seasonal variability in the distribution of Antarctic krill, *Euphausia superba*, west of the Antarctic Peninsula. *Deep Sea Research Part I: Oceanographic Research Papers* **46**(6): 951-84.

Lewis Smith, R.I. & Corner, R.W.M. 1973. Vegetation of the Arthur Harbour-Argentine Islands region of the Antarctic Peninsula. *British Antarctic Survey Bulletin* **33-34**: 89-122.

Lewis Smith, R.I. 1979. Peat forming vegetation in the Antarctic. In: E. Kivinen, L. Heikurainen & P. Pakarinen (eds), *Classification of peat and peatlands*. University of Helsinki, Helsinki: 58-67.

Lewis Smith, R.I. 1982. Plant succession and re-exposed moss banks on a deglaciated headland in Arthur Harbour, Anvers Island. *British Antarctic Survey Bulletin* **51**: 193-99.

Lewis Smith, R.I. 1996. Terrestrial and freshwater biotic components of the western Antarctic Peninsula. In: R. Ross, E. Hofmann, & L. Quetin (eds) *Foundations for ecological research west of the Antarctic Peninsula*. *Antarctic Research Series* **70**. American Geophysical Union, Washington, DC: 15-59.

Lewis Smith, R.I. 2003. The enigma of *Colobanthus quitensis* and *Deschampsia antarctica* in Antarctica. In A. Huiskes, W. Gieskes, J. Rozema, R. Schorno, S. van der Vies & W. Wolff (eds) *Antarctic biology in a global context*. Backhuys Publishers, Leiden: 234-39.

Longton, R.E. 1967. Vegetation in the maritime Antarctic. In: J. Smith (ed) A discussion on the terrestrial Antarctic ecosystem. *Philosophical Transactions of the Royal Society of London* **252B**(777): 213-35.

McDonald, S., M. Kennicutt II, K. Foster-Springer & M. Krahn 1992. Polynuclear aromatic hydrocarbon exposure in Antarctic fish. *Antarctic Journal of the United States* **27**(5): 333-35.

Moline, M.A. & Prezelin, B.B. 1996. Palmer LTER 1991-1994: long term monitoring and analysis of physical factors regulating variability in coastal Antarctic phytoplankton biomass, in situ productivity and taxanomic composition over subseasonal, seasonal and interannual time scales phytoplankton dynamics. *Marine Ecology Progress Series* **145**: 143-60.

Parker, B.C. 1972. Conservation of freshwater habitats on the Antarctic Peninsula. In: B. Parker (ed) *Conservation problems in Antarctica*. Allen Press Inc., Lawrence, Kansas: 143-162.

Parker, B.C. & Samsel, G.L. 1972. Fresh-water algae of the Antarctic Peninsula. 1. Systematics and ecology in the U.S. Palmer Station area. In: G. Llano (ed) *Antarctic terrestrial biology*. *Antarctic Research Series* **20**. American Geophysical Union, Washington, DC: 69-81.

Parmelee, D.F., W.R. Fraser & D.R. Neilson 1977. Birds of the Palmer Station area. *Antarctic Journal of the United States* **12**(1-2): 15-21.

Parmelee, D.F. & Parmelee, J.M. 1987. Revised penguin numbers and distribution for Anvers Island, Antarctica. *British Antarctic Survey Bulletin* **76**: 65-73.

Patterson, D.L. 2001. The effects of human activity and environmental variability on long-term changes in Adélie penguin populations at Palmer Station, Antarctica. Unpublished MSc thesis in Fish & Wildlife Management, Montana State University, Bozeman.

Patterson, D.L., E.H. Woehler, J.P. Croxall, J. Cooper, S. Poncet & W.R. Fraser (in press). Breeding distribution and population status of the northern giant petrel *Macronectes halli* and the southern giant petrel *M. giganteus*. *Marine Ornithology* (submitted).

Penhale, P.A., J. Coosen & E.R. Marshcoff 1997. The *Bahai Paraiso*: a case study in environmental impact, remediation and monitoring. In: B. Battaglia, J. Valencia & D. Walton (eds) *Antarctic Communities: species, structure and survival*. Cambridge University Press, Cambridge: 437-44.

Poncet, S. & Poncet, J. 1987. Censuses of penguin populations of the Antarctic Peninsula 1983-87. *British Antarctic Survey Bulletin* **77**: 109-29.

Smith, R.C. & Stammerjohn, S.E. 2001. Variations of surface air temperature and sea-ice extent in the western Antarctic Peninsula (WAP) region. *Annals of Glaciology* **33**(1): 493-500.

Smith, R.C., K.S. Baker, W.R. Fraser, E.E. Hofmann, D.M. Karl, J.M. Klinck, L.B. Quetin, B.B. Prézelin, R.M. Ross, W.Z. Trivelpiece & M. Vernet 1995. The Palmer LTER: A long-term ecological research program at Palmer Station, Antarctica. *Oceanography* **8**(3): 77-86.

Smith, R.C., S.E. Stammerjohn & K.S. Baker. 1996. Surface air temperature variations in the western Antarctic Peninsula region. In: R. Ross, E. Hofmann, & L. Quetin (eds) *Foundations for ecological research west of the Antarctic Peninsula. Antarctic Research Series* **70**. American Geophysical Union, Washington, DC: 105-12.

Smith, R.C., K.S. Baker & S.E. Stammerjohn. 1998. Exploring sea ice indexes for polar ecosystem studies. *BioScience* **48**: 83-93.

Smith, R.C., D. Ainley, K.S. Baker, E. Domack, S. Emslie, W.R. Fraser, J. Kennett, A. Leventer, E. Mosley-Thompson, S.E. Stammerjohn & M. Vernet. 1999. Marine Ecosystem Sensitivity to Climate Change. *BioScience* **49**(5): 393-404.

Smith, R.C., K.S. Baker, H.M. Dierssen, S.E. Stammerjohn, & M. Vernet 2001. Variability of primary production in an Antarctic marine ecosystem as estimated using a multi-scale sampling strategy. *American Zoologist* **41**(1): 40-56.

Smith, R.C., W.R. Fraser, S.E. Stammerjohn & M. Vernet 2003. Palmer Long-Term Ecological Research on the Antarctic marine ecosystem. In: E. Domack, A. Leventer, A. Burnett, R. Bindschadler, P. Convey & M. Kirby (eds) *Antarctic Peninsula climate variability: historical and paleoenvironmental perspectives. Antarctic Research Series* **79**. American Geophysical Union, Washington, DC: 131-44.

Stammerjohn, S.E. & Smith, R.C. 1996. Spatial and temporal variability of western Antarctic Peninsula sea ice coverage. In: R. Ross, E. Hofmann, & L. Quetin (eds) *Foundations for ecological research west of the Antarctic Peninsula. Antarctic Research Series* **70**. American Geophysical Union, Washington, DC: 81-104.

Stammerjohn, S.E. & Smith, R.C. 1997. Opposing Southern Ocean climate patterns as revealed by trends in regional sea ice coverage. *Climatic Change* **37**: 617-39.

Stammerjohn, S.E., M.R. Drinkwater, R.C. Smith & X. Liu 2003. Ice-atmosphere interactions during sea-ice advance and retreat in the western Antarctic Peninsula region. *Journal of Geophysical Research* **108** (C10) 10: 1029/2002JC001543.

Thiele D., K. Asmus, S. Dolman, C.D. Falkenberg, D. Glasgow, P. Hodda, M. McDonald, E. Oleson, A. Širovic, A. Souter, S. Moore & J. Hildebrand 2004. International Whaling Commission – Southern Ocean GLOBEC/CCAMLR collaboration: Cruise Report 2003-2004. *Journal of Cetacean Research & Management* SC/56/E24.

Trivelpiece W.Z. & Fraser, W.R. 1996. The breeding biology and distribution of Adélie penguins: adaptations to environmental variability. In: R. Ross, E. Hofmann, & L. Quetin (eds) *Foundations for ecological research west of the Antarctic Peninsula*. *Antarctic Research Series* **70**. American Geophysical Union, Washington, DC: 273-85.

Woehler, E.J. (ed) 1993. *The distribution and abundance of Antarctic and Subantarctic penguins.* SCAR, Cambridge.

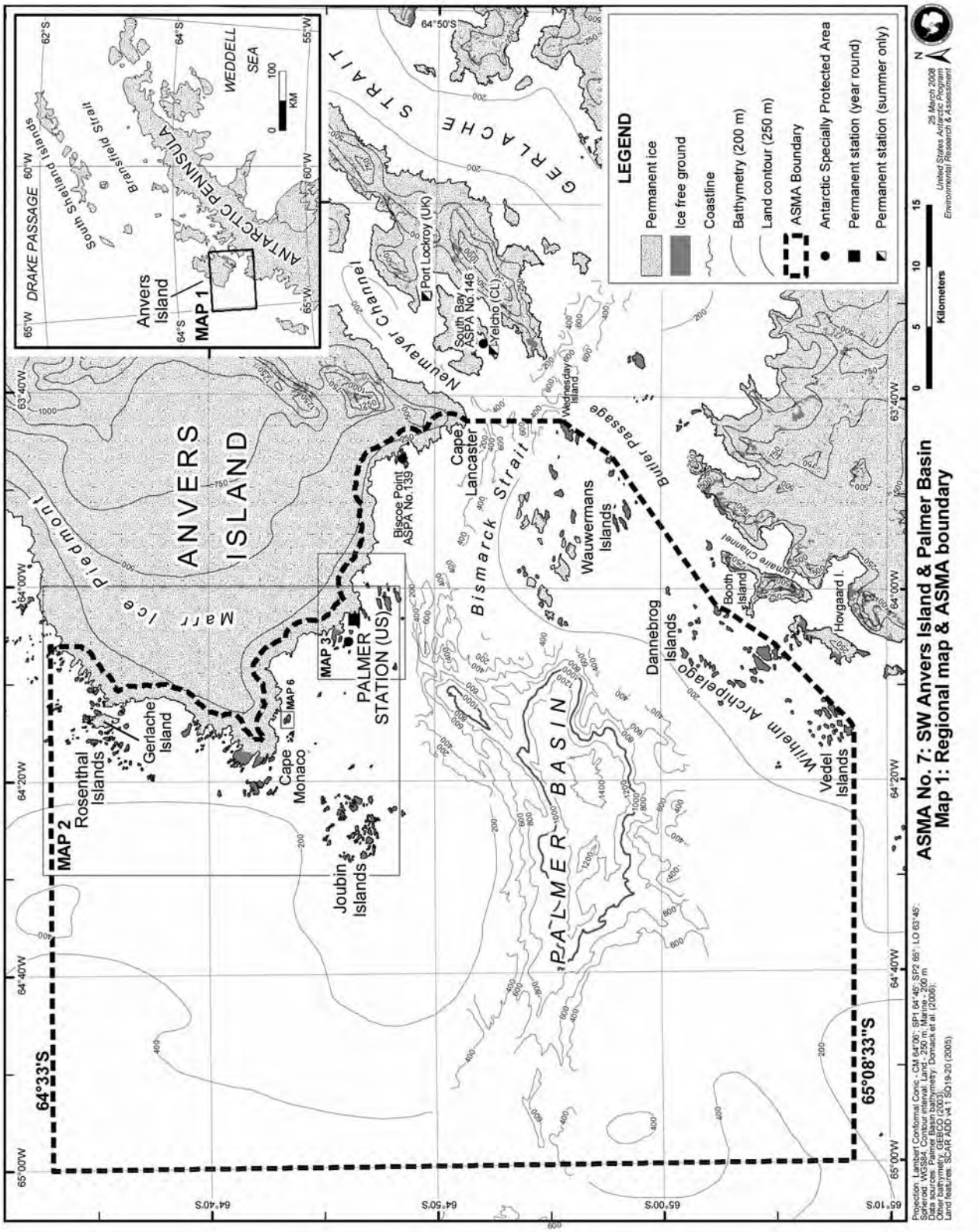
Personal communications

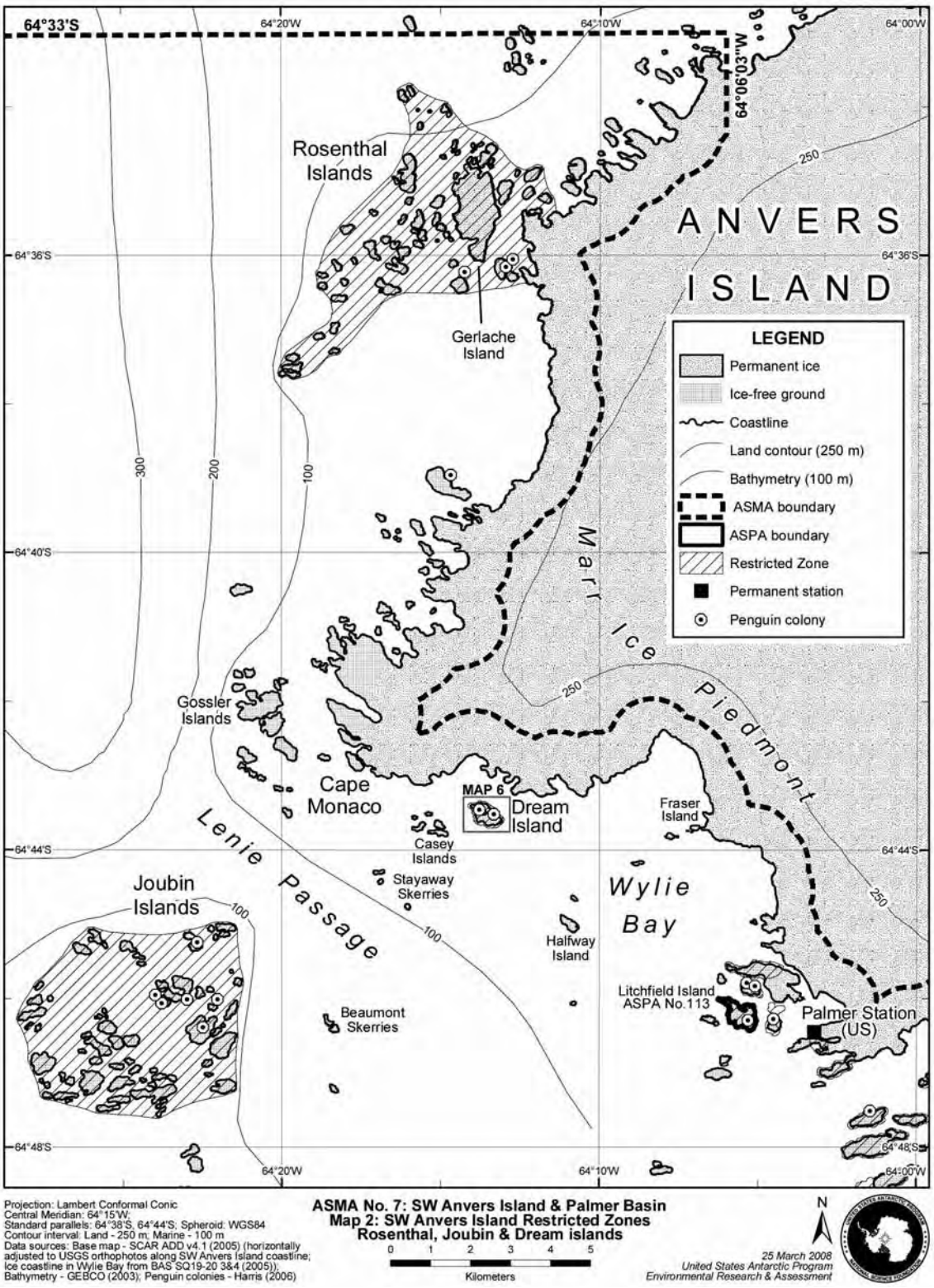
Fraser, W. various personal communications 2003-08;

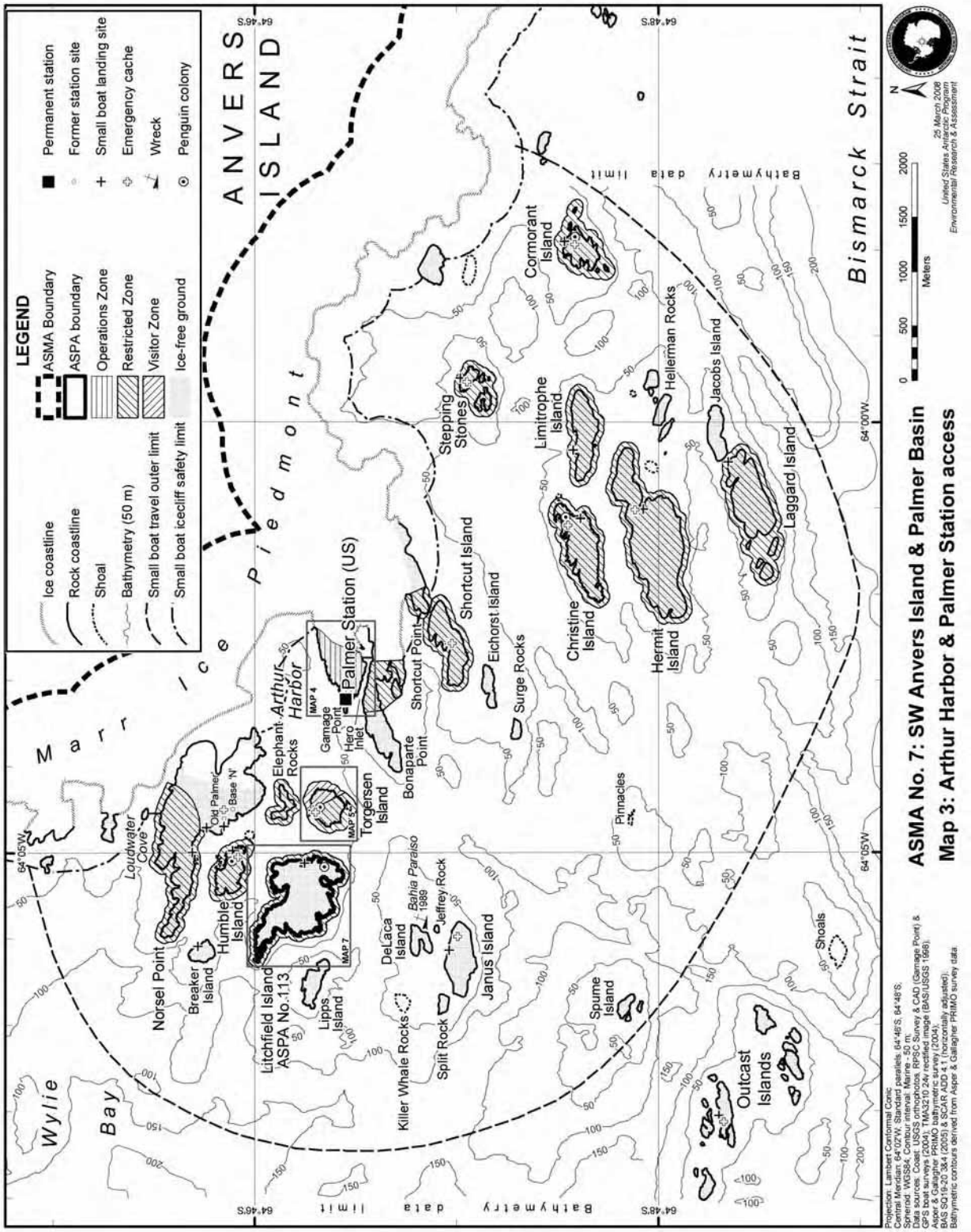
Patterson, D. 2006;

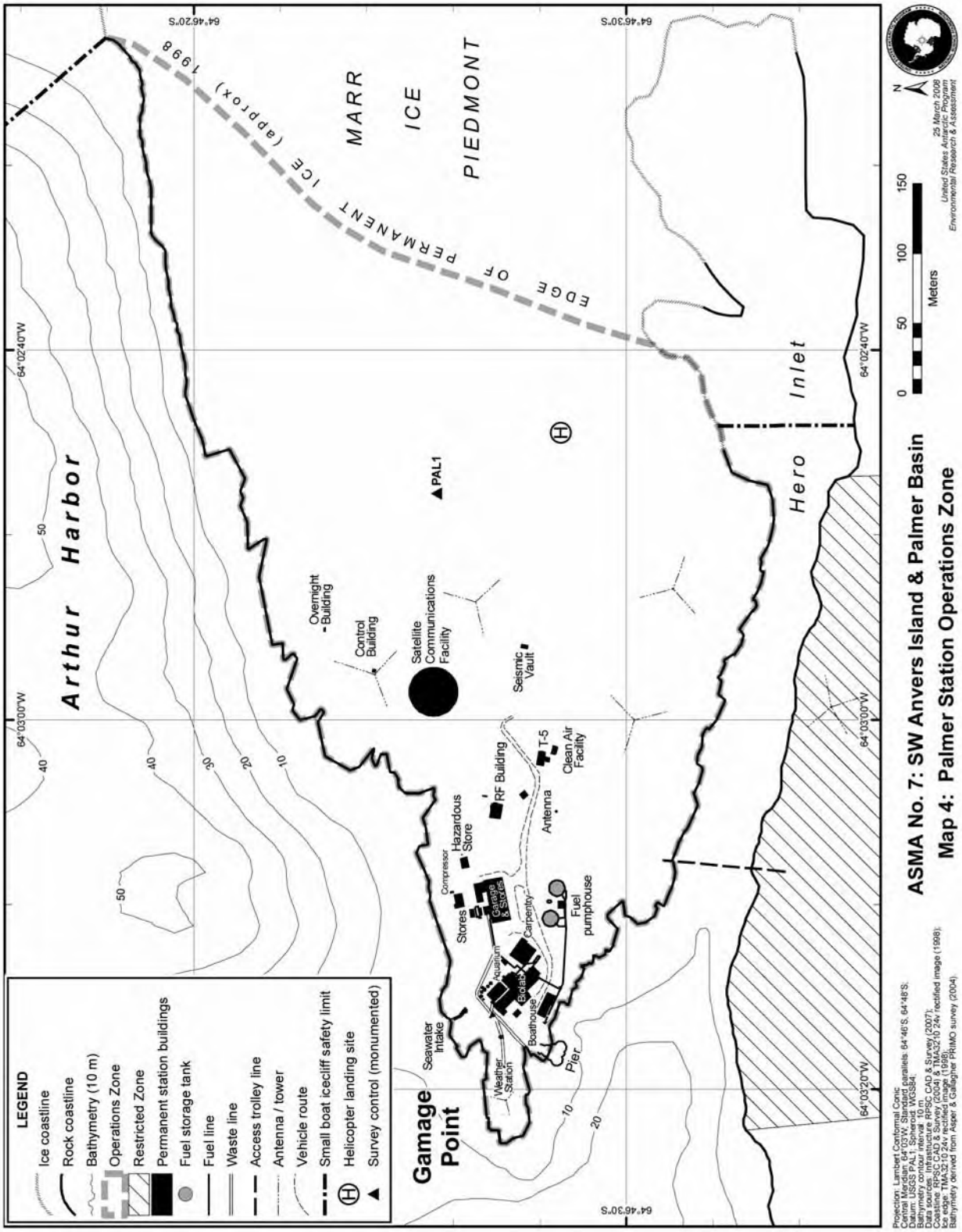
Lee, R. 2007;

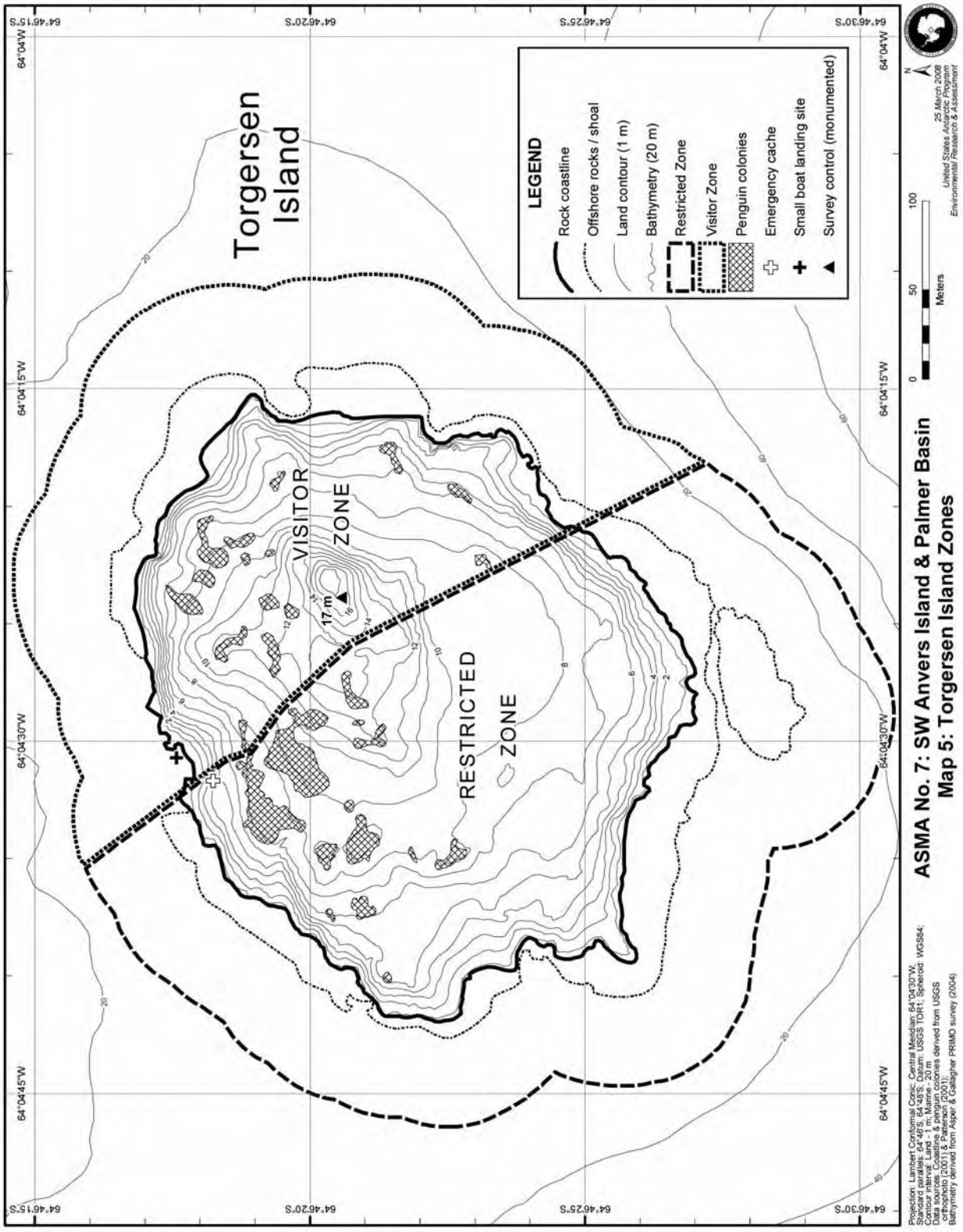
Lewis Smith, R. 2007.

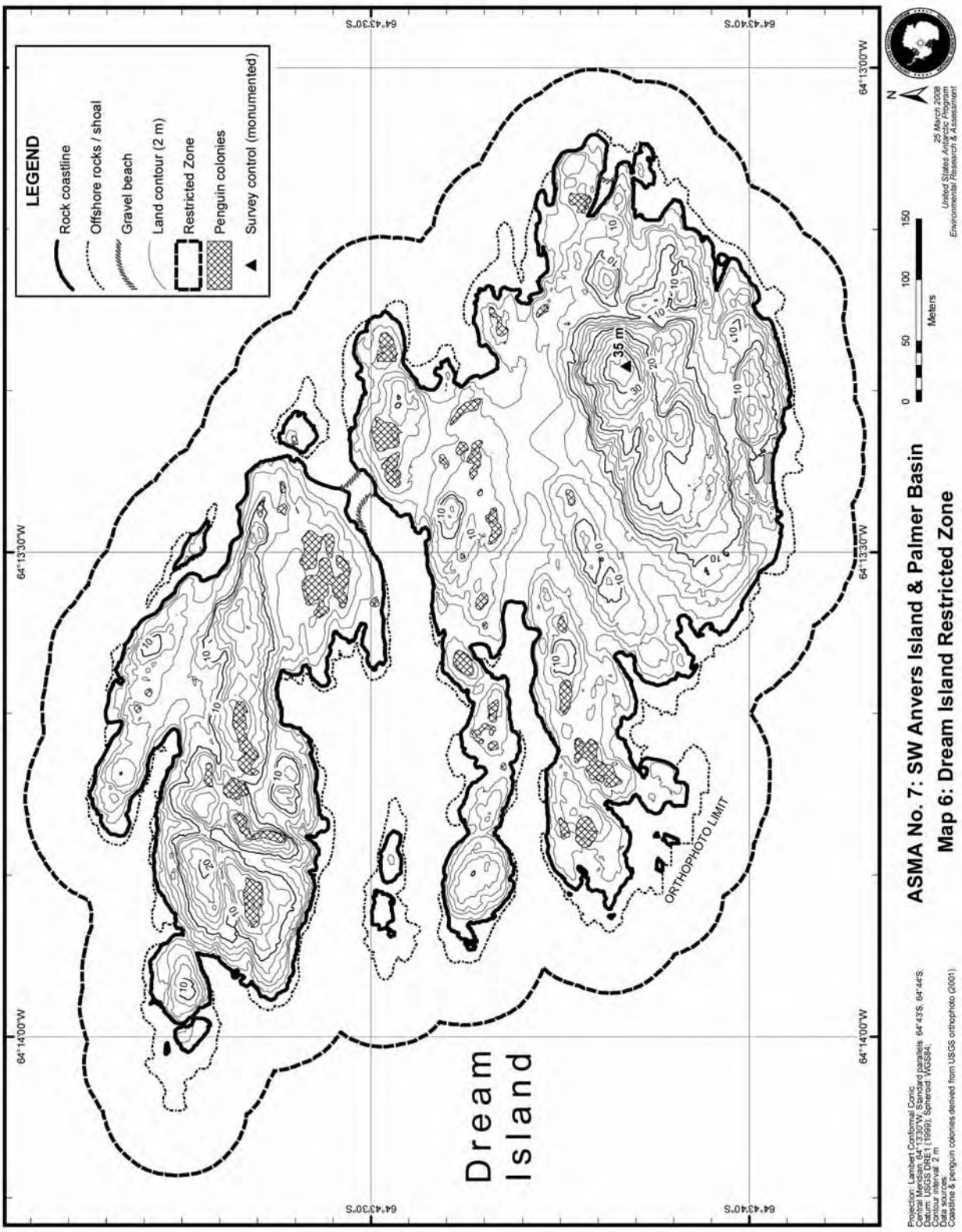

ASMA No. 7: SW Anvers Island & Palmer Basin
Map 1: Regional map & ASMA boundary
LEGEND
Permanent ice
Ice free ground
Coastline
Bathymetry (200 m)
Land contour (250 m)
ASMA Boundary
Antarctic Specially Protected Area
Permanent station (year round)
Permanent station (summer only)
ANVERS ISLAND
PALMER BASIN
PALMER STATION (US)
Biscoe Point ASPA No.139
South Bay ASPA No.146
Port Lockroy (UK)
Yelcho (CL)
Cape Lancaster
Wednesday Island
Wauwermans Islands
Dannebrog Islands
Booth Island
Hovgaard I.
Vedel Islands
Joubin Islands
Rosenthal Islands
Gerlache Island
Cape Monaco
Cape Tuxen
Anvers Island
MAP 1
MAP 2
MAP 3
MAP 6
DRAKE PASSAGE
WEDDELL SEA
ANTARCTIC PENINSULA
South Shetland Islands
Barnsfield Strait
Gerlache Strait
Neumayer Channel
Bismarck Strait
Butler Passage
Lemaire Channel
Wilhelm Archipelago
Pradelmont Ice Marr
64°33'S
65°08'33"S
64°50'S
63°40'W
64°00'W
64°20'W
64°40'W
65°00'W
64°40'S
64°50'S
65°00'S
65°10'S
Kilometers
25 March 2008
United States Antarctic Program
Environmental Research & Assessment

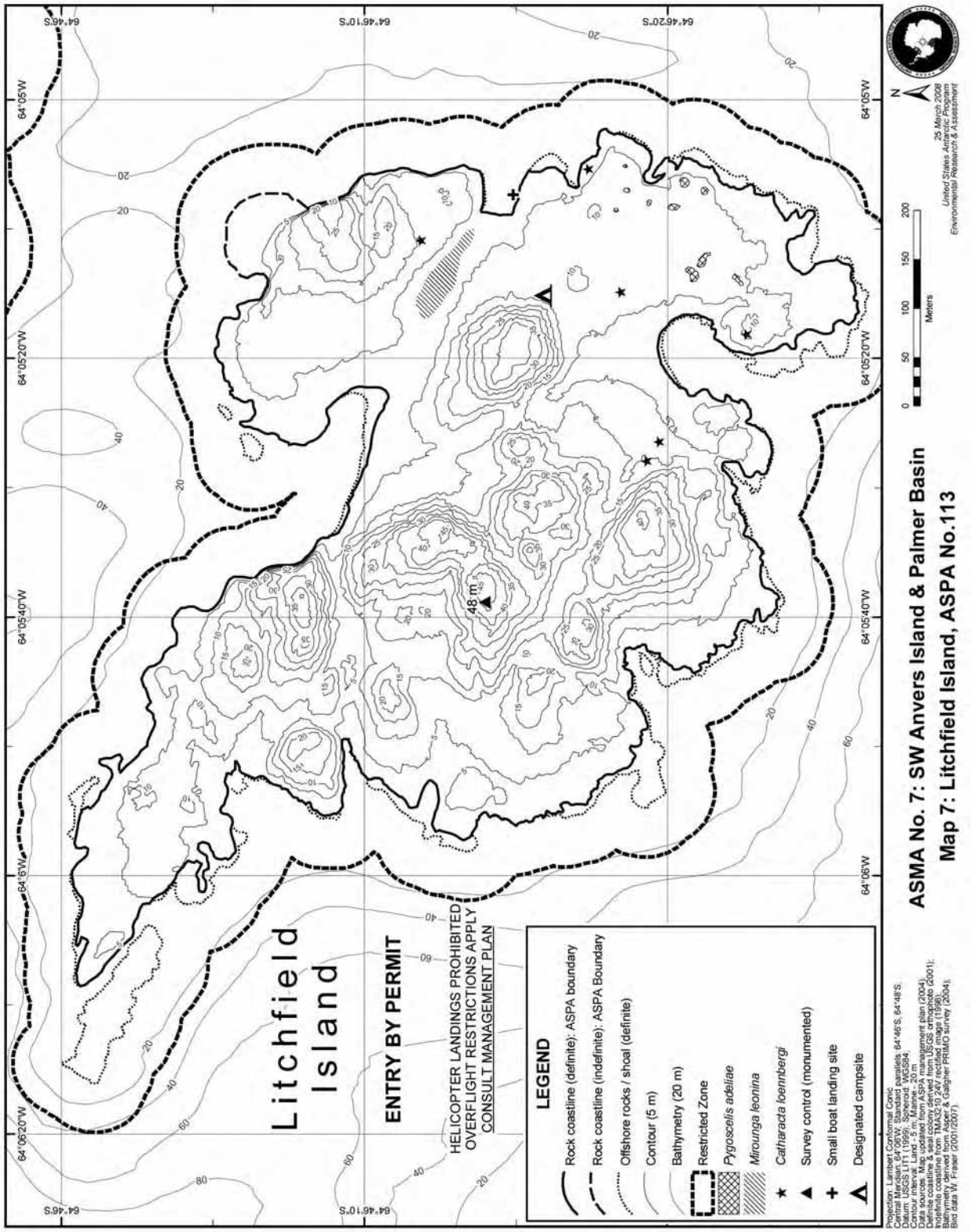

64°33'S
64°20'W
64°10'W
64°00'W
64°03'30"W
64°36'S
64°40'S
64°44'S
64°48'S
Rosenthal Islands
Gerlache Island
ANVERS ISLAND
LEGEND
Permanent ice
Ice-free ground
Coastline
Land contour (250 m)
Bathymetry (100 m)
ASMA boundary
ASPA boundary
Restricted Zone
Permanent station
Penguin colony
Mar Ice Piedmont
Gossler Islands
Cape Monaco
MAP 6
Dream Island
Fraser Island
Casey Islands
Stayaway Skerries
Lenie Passage
Joubin Islands
Wylie Bay
Halfway Island
Litchfield Island ASPA No.113
Palmer Station (US)
Beaumont Skerries
300
200
100
250
N
Projection: Lambert Conformal Conic
Central Meridian: 64°15'W;
Standard parallels: 64°38'S, 64°44'S; Spheroid: WGS84
Contour interval: Land - 250 m; Marine - 100 m
Data sources: Base map - SCAR ADD v4.1 (2005) (horizontally adjusted to USGS orthophotos along SW Anvers Island coastline; Ice coastline in Wylie Bay from BAS SQ19-20 3&4 (2005)); Bathymetry - GEBCO (2003); Penguin colonies - Harris (2006)
ASMA No. 7: SW Anvers Island & Palmer Basin
Map 2: SW Anvers Island Restricted Zones
Rosenthal, Joubin & Dream islands
0 1 2 3 4 5
Kilometers
25 March 2008
United States Antarctic Program
Environmental Research & Assessment

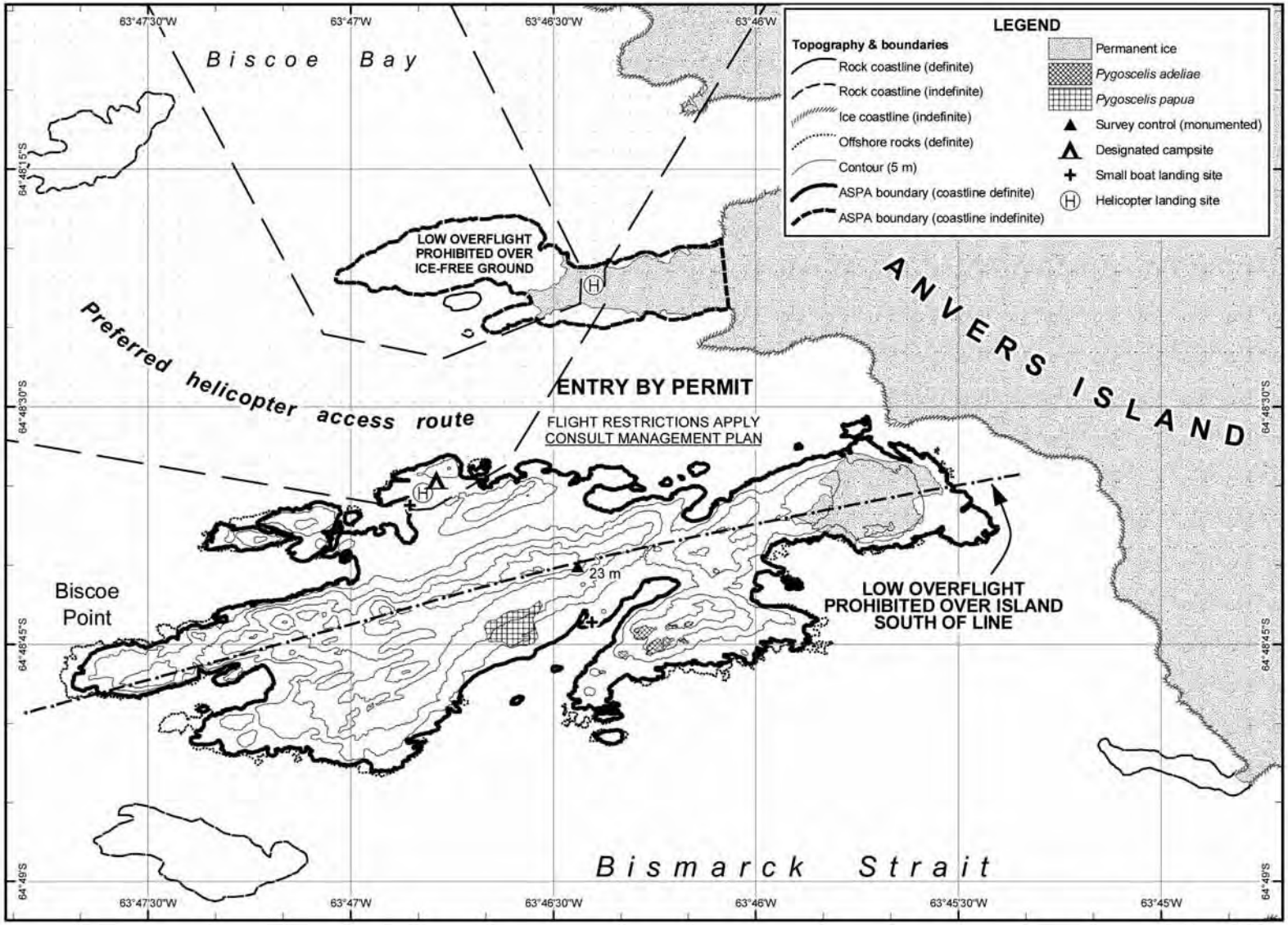

LEGEND
Ice coastline
Rock coastline
Shoal
Bathymetry (50 m)
Small boat travel outer limit
Small boat icecliff safety limit
ASMA Boundary
ASPA boundary
Operations Zone
Restricted Zone
Visitor Zone
Ice-free ground
Permanent station
Former station site
Small boat landing site
Emergency cache
Wreck
Penguin colony
ANVERS ISLAND
Marr Ice Piedmont
Bismarck Strait
Wylie Bay
Palmer Station (US)
Arthur Harbor
Old Palmer
Base 'N'
Loudwater Cove
Elephant Rocks
Gamage Point
Hero Inlet
Torgersen Island
Bonaparte Point
Shortcut Point
Shortcut Island
Eichorst Island
Surge Rocks
Stepping Stones
Cormorant Island
Limitrophe Island
Christine Island
Hermit Island
Hellerman Rocks
Jacobs Island
Laggard Island
Pinnacles
Spume Island
Shoals
Outcast Islands
Norsel Point
Breaker Island
Humble Island
Litchfield Island
ASPA No.113
Lipps Island
DeLaca Island
Bahia Paraiso 1989
Jeffrey Rock
Janus Island
Killer Whale Rocks
Split Rock
MAP 4
MAP 5
MAP 7
64°05'W
64°00'W
64°46'S
64°48'S
data limit
Bathymetry
0 500 1000 1500 2000
Meters
N
ASMA No. 7: SW Anvers Island & Palmer Basin
Map 3: Arthur Harbor & Palmer Station access
25 March 2008
United States Antarctic Program
Environmental Research & Assessment
Projection: Lambert Conformal Conic
Central Meridian: 64°02'W. Standard parallels: 64°46'S, 64°48'S.
Spheroid: WGS84; Contour interval: Marine - 50 m.
Data sources: Coast: USGS orthophotos; RPSC Survey & CAD (Gamage Point) & GPS boat surveys (2004); TM43210 24v rectified image (BAS/USGS 1996).
Antarctic Digital Database (ADD) Coastline (2004).
BAS SQ19-20, 384 (2005) & SCAR ADD 4.1 (horizontally adjusted).
Bathymetric contours derived from Aspe & Gallagher PRIMO survey data.


LEGEND
Ice coastline
Rock coastline
Bathymetry (10 m)
Operations Zone
Restricted Zone
Permanent station buildings
Fuel storage tank
Fuel line
Waste line
Access trolley line
Antenna / tower
Vehicle route
Small boat icecliff safety limit
Helicopter landing site
Survey control (monumented)
Arthur Harbor
Hero Inlet
MARR ICE PIEDMONT
EDGE OF PERMANENT ICE (approx) 1998
Gamage Point
PAL1
Overnight Building
Control Building
Satelite Communications Facility
Seismic Vault
RF Building
T-5
Clean Air Facility
Antenna
Hazardous Store
Compressor
Stores
Garage & Stores
Carpentry
Fuel pumphouse
Aquarium
Biolab
Boathouse
Seawater Intake
Weather Station
Pier
64°46'20"S
64°46'30"S
64°02'40"W
64°03'00"W
64°03'20"W
0
50
100
150
Meters
N
ASMA No. 7: SW Anvers Island & Palmer Basin
Map 4: Palmer Station Operations Zone
25 March 2008
United States Antarctic Program
Environmental Research & Assessment
Projection: Lambert Conformal Conic
Central Meridian 64°03'W; Standard parallels 64°46'S, 64°48'S.
Datum: USGS PAL1; Spheroid WGS84.
Bathymetry contour interval 10 m.
Data sources: Operations zone: RPSC CAD & Survey (2007).
Coastline: RPSC CAD & Survey (2004) & TMA3210 24v rectified image (1998).
Ice edge: TMA3210 24v rectified image (1998).
Bathymetry derived from Aspen & Gallagher PRIMO survey (2004).


Torgersen Island
VISITOR ZONE
RESTRICTED ZONE
17 m
LEGEND
Rock coastline
Offshore rocks / shoal
Land contour (1 m)
Bathymetry (20 m)
Restricted Zone
Visitor Zone
Penguin colonies
Emergency cache
Small boat landing site
Survey control (monumented)
64°46'15"S
64°46'20"S
64°46'25"S
64°46'30"S
64°04'W
64°04'15"W
64°04'30"W
64°04'45"W
0
50
100
Meters
N
25 March 2008
United States Antarctic Program
Environmental Research & Assessment
ASMA No. 7: SW Anvers Island & Palmer Basin
Map 5: Torgersen Island Zones
Projection: Lambert Conformal Conic; Central Meridian 64°04'30"W;
Standard parallels 64°45'S, 64°47'S; Datum: USGS 70A1; Spheroid: WGS84;
Contour interval: Land - 1 m; Marine - 20 m
Data sources: Coastline & penguin colonies derived from USGS
orthophoto (2001) & Peterson (2001);
Bathymetry derived from Alper & Gallagher PRIMO survey (2004)


LEGEND
Rock coastline
Offshore rocks / shoal
Gravel beach
Land contour (2 m)
Restricted Zone
Penguin colonies
Survey control (monumented)
Dream Island
35 m
ORTHOPHOTO LIMIT
64°43'30"S
64°43'40"S
64°14'00"W
64°13'30"W
64°13'00"W
N
0
50
100
150
Meters
25 March 2008
United States Antarctic Program
Environmental Research & Assessment
ASMA No. 7: SW Anvers Island & Palmer Basin
Map 6: Dream Island Restricted Zone
Projection: Lambert Conformal Conic
Central Meridian: 64°13'30"W, Standard parallels: 64°43'S, 64°44'S
Datum: USGS DRE1 (1999), Spheroid: WGS84
Contour interval: 2 m
Data sources:
Coastline & penguin colonies derived from USGS orthophoto (2001)


Litchfield Island
ENTRY BY PERMIT
HELICOPTER LANDINGS PROHIBITED
OVERFLIGHT RESTRICTIONS APPLY
CONSULT MANAGEMENT PLAN
48 m
LEGEND
Rock coastline (definite): ASPA boundary
Rock coastline (indefinite): ASPA Boundary
Offshore rocks / shoal (definite)
Contour (5 m)
Bathymetry (20 m)
Restricted Zone
Pygoscelis adeliae
Mirounga leonina
Catharacta loennbergi
Survey control (monumented)
Small boat landing site
Designated campsite
ASMA No. 7: SW Anvers Island & Palmer Basin
Map 7: Litchfield Island, ASPA No.113
0 50 100 150 200
Meters
N
25 March 2008
United States Antarctic Program
Environmental Research & Assessment


LEGEND
Topography & boundaries
Rock coastline (definite)
Rock coastline (indefinite)
Ice coastline (indefinite)
Offshore rocks (definite)
Contour (5 m)
ASPA boundary (coastline definite)
ASPA boundary (coastline indefinite)
Permanent ice
Pygoscelis adeliae
Pygoscelis papua
Survey control (monumented)
Designated campsite
Small boat landing site
Helicopter landing site
Biscoe Bay
Anvers Island
Bismarck Strait
LOW OVERFLIGHT PROHIBITED OVER ICE-FREE GROUND
Preferred helicopter access route
ENTRY BY PERMIT
FLIGHT RESTRICTIONS APPLY
CONSULT MANAGEMENT PLAN
LOW OVERFLIGHT PROHIBITED OVER ISLAND SOUTH OF LINE
23 m
Biscoe Point
63°47'30"W
63°47'W
63°46'30"W
63°46'W
63°45'30"W
63°45'W
64°48'15"S
64°48'30"S
64°48'45"S
64°49'S
Projection: Lambert Conformal Conic
Central Meridian: 63°46'W, Standard parallels: 64°48'S, 64°50'S.
Datum: USGS 8IS1 (1999). Spheroid: WGS84; Contour interval: Land - 5 m;
Data sources: Map updated from ASPA management plan (2004).
Definite coastline derived from USGS orthophoto (2001);
Indefinite coastline derived from TMA3208 006V rectified image (1996).
Penguin colonies & other features from orthophoto & GPS survey (ERA 2001).
ASMA No. 7: SW Anvers Island & Palmer Basin
Map 8: Biscoe Point, ASPA No.139
0 100 200 300 400
Meters
N
25 March 2008
United States Antarctic Program
Environmental Research & Assessment

II. Measures

Measure 2 (2008)

Antarctic Specially Protected Area No 168: Mount Harding, Grove Mountains, East Antarctica

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas and approval of Management Plans for those Areas;

Noting that the Committee for Environmental Protection has recommended that Mount Harding, Grove Mountains, East Antarctica, be designated as a new Antarctic Specially Protected Area, and has endorsed the Management Plan for this area annexed to this Measure;

Recognising that this area supports outstanding environmental, scientific, historic, aesthetic or wilderness values, or ongoing or planned scientific research, and would benefit from special protection;

Desiring to designate Mount Harding, Grove Mountains, East Antarctica as an Antarctic Specially Protected Area and to approve the Management Plan for this Area;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) Mount Harding, Grove Mountains, East Antarctica be designated as Antarctic Specially Protected Area No 168; and
2) the Management Plan which is annexed to this Measure be approved.

Management Plan for Antarctic Specially Protected Area No 168

MOUNT HARDING, GROVE MOUNTAINS, EAST ANTARCTICA

1. Introduction

The Grove Mountains (72°20'-73°10'S, 73°50'-75°40'E) are located approximately 400km inland (south) of the Larsemann Hills in Princess Elizabeth Land, East Antarctica, on the eastern bank of the Lambert Rift(Map A). Mount Harding (72°512 -72°572 S, 74°532 -75°122 E) is the largest mount around Grove Mountains region, and located in the core area of the Grove Mountains that presents a ridge-valley physiognomies consisting of nunataks, trending NNE-SSW and is 200m above the surface of blue ice (Map B).

The primary reason for designation of the Area as an Antarctic Specially Protected Area is to protect the unique geomorphological features of the area for scientific research on the evolutionary history of East Antarctic Ice Sheet (EAIS), while widening the category in the Antarctic protected areas system.

Research on the evolutionary history of EAIS plays an important role in reconstructing the past climatic evolution in global scale. Up to now, a key constraint on the understanding of the EAIS behaviour remains the lack of direct evidence of ice sheet surface levels for constraining ice sheet models during known glacial maxima and minima in the post-14 Ma period.

The remains of the fluctuation of ice sheet surface preserved around Mount Harding, will most probably provide the precious direct evidences for reconstructing the EAIS behaviour. There are glacial erosion and wind-erosion physiognomies which are rare in nature and extremely vulnerable, such as the ice-core pyramid, the ventifact, etc. These glacial-geological features have not only important scientific values, but also rare wildness and aesthetic values and the disorderly human activities would cause perpetual, unrepairable damage to it.

The Chinese Antarctic Research Expedition (CHINARE) has visited the Grove Mountains for several times from1998 to 2006, focusing on research on geological tectonics, glacial geology and landscape, meteorology, ice-cap movement and mass balance, surveying and mapping, especially on fluctuation of Antarctic icecap surface since the Pliocene, and these research results in some new discoveries. The Australian Antarctic Programme has for many years visited the Grove Mountains to conduct a range of geoscience and glaciology research and support activities. It currently maintains a continuous GPS station on Tianhe Range and expects to continue to access the region for research and operational purposes. Besides, Russian Antarctic Research Expedition has ever tripped there in 1958 and 1973 for a short stay, but whether they have arrived at this area is unclear.

2. Description of values

The Mount Harding area designated as the site for the specially protected area (Map A) has the precious physiognomies of glacier erosion preserved in the ice sheet of inland Antarctic, which is of great scientific, aesthetic and wilderness values. The aim of this protected area is to preserve its scientific, aesthetic and wilderness values.

2(i) Scientific values

A lot of remains of ice sheet advance and retreat are preserved in Mount Harding, which are the direct evidence of the changes of cold and warm in the global environment since Pliocene. In this area, the scientists have found the rare extreme cold desert soil, the sedimentary rocks formed in the Neogene Period that are not consolidated completely, as well as the valuable spore pollen assemblages in those paleo-soils and sedimentary rocks. All of this implies there existed a warm climate event in this area; probably resulting in a large-scale retreat of the EAIS, and its margin might be even beyond the Grove Mountains, 400km south from its present coast of the EAIS.

The unique geomorphological features in this area includes the integral geologic-geomorphic remains and a series of special physiognomy, such as ice-core pyramid, ventifacts, ice-cored moraine (end moraine and lateral moraine), cold-desert soil, sedimentary erratics, pool of melted water, roche moutonee, etc.

2(ii) Aesthetic and wilderness values

A legacy of the various magnificent landscapes remains in this area, from pool of melted water, ice-core moraine, ice-core pyramid to ventifacts (photos 1-6).

Human beings have visited for many years this area, other area within Grove Mountains region to conduct for a range of scientific activities. It mainly includes scientists and support staff from China, Australia and Russia. In the future, especially during the 2007-2008 IPY, human activities perhaps will increase in this area.

3. Management objectives

The purpose of establishing a specially protected area for the remains of ice sheet advance and retreat around Mount Harding, Grove Mountains, East Antarctica, is to:

- Facilitate long-term scientific research while avoiding direct or cumulative damage to vulnerable geomorphological features;
- Allow compelling scientific research that cannot be carried out elsewhere;
- Authorize other scientific activities consistent with the management objectives;
- Allow visits for managerial purposes in support of the objectives of the Management Plan.

4. Management activities

Copies of the Management Plan (attached with maps) shall be made available at the Zhongshan Station (China), Davis Station (Australia), Progress Station (Russia), and the map of the protected area should be put up at conspicuous positions in the stations mentioned above (special restrictions of access to the protected area, and the equilibrium line separating the zone of net ablation from the inland zone of net accumulation, as well as a series of the special physiognomies unique to the inland ice sheet of East Antarctica within the protected area should be indicated in the map).

National Antarctic Programs operating in the region shall consult with each other and exchange information to ensure that activities in the Area are undertaken in a manner consistent with the aims and objectives of this Management Plan.

Visits should be paid to this area regularly (once every five years) so as to assess whether the objective of protection in this area is achieved and to ensure that various managerial measures are in place.

The Management Plan should be reviewed at least once every five years and, if necessary, updated or revised.

In case the Antarctic ice sheet continuously retreats so that the new remains of advance and retreat of EAIS are exposed in the vicinity of the protected area and the extent of remains of ice sheet advance and retreat expands, the boundary of the protected area should be updated periodically so as to include the newly exposed remains of ice cap advance and retreat in the area. This should be taken into consideration in examining the Management Plan.

5. Period of designation

Designated for an indefinite period.

6. Description of the Area

6(i) Geographical co-ordinates, boundary marks, general climate condition in summer and physiognomy

The Area is irregular, and approximately rectangular in shape, with a width of about 10km from east to west, a length of about 12km from south to north and an total area of about 120km^2 (Map A).

The proposed ASPA boundary was defined to in order to ensure that the unique geomorphological features, formed in ice sheet advance and retreat in Mount Harding, can be specially protected as a whole.

Geographical Co-ordinates

The Specially protected Area of Mount Harding, Grove Mountains, includes the open blue-ice zone from the moraine on the west side of Mount Harding to the east side of the Zakharoff Ridge as well as a number of nunataks, detritus zone, and moraine etc. within it (Map B). Its geographical co-ordinates are: 72°512 -72°572 S, 74°532 -75°122 E.

Boundary marks

The western boundary of the Area is the moraine on the west side of Mount Harding, with its northern end turning eastward to the open blue-ice detritus zone on the east side of the Zakharoff Ridge via the north flank of the northern ridge of Mount Harding and the northern end of the Zakharoff Ridge, turning southwards to the northern end of Davey Nunataks, and then heading westwards to the southern end of the Xi Lake moraine to close the whole area. The geographical coordinates of the nine control points located at its boundary are counter clockwise: 1. 74°57'E, 72°51' S, 2. 74°54'E, 72°53' S, 3. 74°53'E, 72°55' S, 4. 74°54'E, 72°57' S, 5. 75°00'E, 72°57' S, 6. 75°10'E, 72°57' S, 7. 75°12'E, 72°55' S, 8. 75°11'E, 72°52' S, 9. 75°08'E, 72°51' S.

No markers or signs are currently in place to mark the boundary.

General climate condition in summer

With an average altitude of more than 2000 meters in the Grove Mountains, the daily temperature range and strong wind frequency are greater than those at Zhongshan Station. When affected by the warm-moist current from the north, snowfall would appear constantly in this area, while under the control of the east current, the weather would mainly be sunny. The trend of daily wind speed change is greater than that at Zhongshan Station, where the maximum wind speed appears at around

05:00 am; the lowest records are seen from 16:00 and 17:00 in the afternoon, and minimum wind speed might appears at about 17:00 pm. Same as Zhongshan Station, the Grove Mountains area is influenced by the katabatic wind, but with a greater force than Zhongshan Station.

From December 1998 to January 1999, the average highest and lowest air temperature in the Grove Mountains area were -13.1°C and -22.6°C respectively, and the estimated average daily temperature range could be -9.5°C. In this area, in January in particular, the air temperature and snow temperature saw an obvious change during a day, where the average air temperature was -18.5°C, and the snow surface temperature was about -17.9°C, that is, the average snow temperature was higher than the average air temperature.

Physiognomy

Mount Harding in the central GMs is shaped as a crescent open to the north-west. Both the northern and southern ends are steep crests, protruding ~200m above the recent ice surface. The central segment of the ridge-line between two summits descends progressively until it reaches the ice surface in a central col, with a relic ice tongue hanging on the lee side. A stagnant field of blue ice, tens of km2 wide, lies inside the crescent. All of this, shining each other with the vast blue ice, forms the magnificent, beautiful scene of ice-eroded ice field geomorphology.

The nunataks within the area may be divided into two groups. The one in the west is the tall nunataks represented by Mount Harding, and the other is a small part of the area including the low linear nunatak chain on the Zakharoff Ridge. The stoss slopes of rocky nunataks show smoothly abraded bedrock, with surfaces sparsely erratic till patches. The lee and lateral sides of the nunataks show generally sharp bluffs, resulting from both ice flow scraping and collapse along sub-vertical crevasses of rocks. The nunataks leave pair of "wake zone" of superglacial debris tens km in length on the ice surface, marking the path of present local ice flow.

The upper parts of the higher nunataks are usually jagged ridge populating with well-developed ventifacts on the summits, facing the dominant wind from the SE. The scarcity of glacial erosive imprints, also meters of depth inside the hard rock delved by wind- force blowing out indicate that these higher slopes are ice free since rather long time. But the lower parts of slopes beneath ~100m above ice surface have the features of recent glacial erosion such as fresh trimlines and erratics. Some of small nunataks are typical "roches moutonnée" resulted from the past ice flow overriding. This regional borderline between wind and glacial erosions are considered to represent a former height of ice surface since certain phase, probably early Quaternary glaciations, and the later rises of ice surface did not exceed this limit.

Mount Harding is the largest nunatak in the Grove Mountains. On the west side of the crescent ridge there is a large stretch of lake shaped stagnant blue ice plain (Kunming Lake, Xi Lake) and a dozen ice-cored pyramids (ice-cored cone) are visible at the juncture of the ice lake and the foot of the rocky nunataks.

The geological and glacial phenomena or landscapes that deserve special protection include (Map C).

Ventifact (photo 1, 2): As a result of long-term blow and erosion by fierce winds, there have developed a large number of ventifacts with peculiar shape around the southern summit of Mount Harding. These ventifacts are the typical wind-erosion physiognomy rarely seen on the earth and are subject to the perpetual damage by disorderly human activities.

Ice-core pyramids (ice-cored cones, photo 3): Along the northern and southern banks of "Kunming Lake" are scattered a dozen ice-core pyramids. These ice-core pyramids are cone shaped with a height of 20-40m and a base diameter of 50-80m. These pyramids are the best marks for directly measuring the pneumatolysis of blue ice and of great importance to the research on the material

balance and evolutionary history of the EAIS. They are extremely vulnerable and any human climbing behaviour will lead to their perpetual alteration and destruction.

Floating ice-cored moraine (photo 4): On the north-west side of the stagnant blue ice pool lie some of linear floating moraine. These moraines are about 100m wide, 25-35m high and kilometres long. On the surface of the moraine there is a gravel bed with a thickness of 50-100 cm, below which is the blue ice. These exotic rock masses provide precious source material for studying the tectonics of the underlying base rocks of EAIS. The spore pollen assemblages contained in the sedimentary erratics are the key evidence of the large-scale retreat event of the EAIS during the Pliocene. Any walking or climbing activities will very probably cause the irreparable damage to these moraine dykes.

Cold-desert soil: Several cold-desert soil patches were found on the southern slope of Mount Harding above the regional erosion limit of 100m. The existence of such soils indicates also that the ice fluctuation has never been higher than this limit after the formation of soils because any higher rise of the ice would have scraped all of them away.

Microfossil assemblages in the sedimentary erratics: More than 25 species of Neogene microfossil of plant have been identified from such outwash sedimentary boulders. These spore and pollen assemblages provide useful information on the evolution of the EAIS since they are derived from a suite of glaciogenic strata hidden beneath the EAIS. Most of the pollen and spores are originated from local sources as in situ assemblages, representing a continental flora.

Pool of ice melted water (photo5): At the foot of the lee side of huge nunataks are often developed pools of ice melted water, large or small, each with an area from several dozen square meters up to a thousand square meters. The surface ice of these pools is extremely smooth and transparent, and the air bubbles are rich inside the ice from the bottom. The occurrence of the pool of ice melted water suggests the existence of a megathermal event.

Blue ice cliff: On the east side of the protected area are distributed blue ice cliffs or blue ice precipices, with the length of several thousand meters, usually 30-50m high, with a slope of 40-70°.

Roche moutonnees (photo 6): Typical roche moutonnees are distributed on the east and south sides of the protected area. They are peculiar in shape, have a large number of footprints of ice flow on their surfaces, and possess very high wilderness, aesthetic and scientific values.

Paleo-sedimentary basin (ice sheet leading edge): A paleo-ice erosion basin with the marginal sedimentary layer, at the front edge of ice sheet in the Pliocene is inferred to lie below the blue ice basin on the west side of Mount Harding. It is probably a brand-new type of subglacial lakes. Exploration of these paleo-sedimentary lake basins may yield the precious sedimentary records on the paleo-climatic and environmental changes during the Pliocene in this area.

6(ii) Geological condition

These nunataks consist mainly of upper amphibolite to granulite facies metamorphic rocks, syn-orogenic to late orogenic granite, and post tectonic granodioritic aplite and pegmatite. The absence of active structures and earthquakes, and the lack of Cenozoic volcanism suggest that this region, along with Prydz Bay, have been geologically stable at least since the Late Mesozoic Epoch. New geological evidence obtained from this area shows that in the inland East Antarctica there exists a huge "Pan-African" stage orogenic zone from the Prydz Bay, Grove Mountains to the Prince Charles Mountains, which should be the last segmented suture zone of the Gondwana land.

6(iii) Access to, and movement within or over, the Area

Access to the area may be gained overland by vehicle or by aircraft landing on snow- and ice-covered sites within or adjacent to the Area.

6(iv) Location of structures within and adjacent to the site

Australia maintains a continuous GPS station on Tianhe Ridge at 72°54’29.17479"S, 74°54’36.43606"E. The station consists of a GPS antenna mounted on a geodynamic survey pillar, three rugged cases containing batteries and GPS receivers, a solar panel frame holding four solar panels and a wind turbine. In addition there are three survey reference marks surrounding the GPS pillar, approximately 20m distant.

6(v) Location of other protected areas in the vicinity

There are no other protected areas nearby.

6(vi) Special Zones within the Area

There are no special zones proposed in this area.

7. Permit

Entry into the Area is prohibited unless a Permit issue by an appropriate national authority.

Conditions for issuing a Permit to enter the Area are that:

- Scientific research activities that cannot be carried out in any place other than this area; and the applicant for a Permit who needs to collect rock specimens or samples shall make an application. Before the permit is issued, the applicant shall demonstrate to the appropriate competent authorities that the specimens or samples already collected from other parts of the world so far cannot fully meet the needs of the researches (tasks) proposed;
- Managerial activities for the purpose of realizing the objectives of the Management Plan, such as inspection, maintenance and review;
- The actions permitted are in accordance with the Management Plan;
- The actions permitted will not jeopardize the values of the Area;
- Those who are within the specially protected area must carry with them the Permit or its valid copy;
- The period of validity must be stated in the Permit;
- Report on the activities must be submitted to the national authorities issuing the Permit and in charge of polar issues.

7(i) Access to and movement within the Area

Entry by land vehicles such as snowmobile and aircraft should avoid destroying the local equilibrium line separating the zone of net ablation from the inland zone of net accumulation, paleo-soil distribution zone, ventifacts, blue-ice cliff, ice-core pyramid, and other geological and natural physiognomy of important scientific research and environmental values.

As there have many ice crevice in this area, it is recommend that entry by snowmobile would drive down the route along the two sides of which Chinese expedition has set colourful poles for the sake of safety.

Aircraft operations within the Area should be mindful of the mountainous terrain.

Climbing up the ice-core pyramids, walking on the floating moraine dyke and roches montannees is strictly prohibited.

7(ii) Activities allowed to be conducted in the Area, including restrictions on time and place

Scientific researches which have to be carried out in the Area (cannot be conducted in any other parts of the world or in other areas of Antarctica) and which must not damage the value of the Area.

Major management activities, including monitoring, inspection, maintenance or review.

Other activities in support of scientific research or management within the Area, or essential for operational support of activities within or beyond the wider Grove Mountains area.

7(iii) Installation, modification and removal of structures

No structures or facilities shall be erected in the Area except those for conducting essential scientific and managerial activities or for the purpose of scientific research, as specified in the Permit.

All the facilities to be set up and installed within the Area shall be specified in the Permit issued by the competent authority of the particular country. Where possible, such installations should avoid sensitive geomorphological features.

Their permitting country, year of installation, principal investigators or responsible persons shall be clearly indicated. When no longer needed, these facilities shall be removed in time and so shall other abandoned equipment or materials as far as possible.

7(iv) Location of field camps

For safety reasons, the camping sites must be selected in such a way as not to destroy or affect the special geological and natural physiognomy.

If not destroying the local and adjacent geological and natural physiognomy, Camping is allowed within the Area when necessary for purposes consistent with this Management Plan and where authorised in a Permit. In this area, the encampment near Mount Harding (No 9) and the encampment near Zakharoff Ridge (No 8) are the preferred camping site, shown in Map B. Camping should choose snow or ice surface or rock surface to avoid the remnants of ice sheet.

7(v) Restrictions on materials and organisms which may be brought into the site

No depots of food or other supplies are to be left within the Area beyond the time period or activity for which they are required.

No live animals, plant material or micro-organisms shall be deliberately introduced into the Area.

All necessary precautions shall be taken to prevent accidental introduction.

All material introduced shall be for a stated period, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so as to minimise the risk of environment impacts.

7(vi) Taking of, or harmful interference with, native flora and fauna

No native flora and fauna are present.

7(vii) The collection or removal of materials not imported by the permit holder

Material may be Collected or removed from the Area only in accordance with a Permit and should be limited to the minimum necessary to meet scientific or management needs.

Material of human origin likely to compromise the values of the Area, and which was not brought into the Area by the Permit holder or otherwise authorised, may be removed unless the impact of the removal is likely to be greater than leaving the material in situ. If this is the case, the appropriate national authority must be notified and approval obtained.

7(viii) Disposal of waste

At a minimum, all the wastes (non-human or human) should be managed in accordance with Annex III and not disposed of into freshwater streams or lakes, onto ice-free areas, or onto areas of snow or ice which terminate in such areas of high ablation.

7(ix) Measures that may be necessary to continue to meet the aims of the Management Plan

None.

7(x) Reporting requirements

After each Permit is issued, the responsible Permit holder shall prepare and submit a report on the activities conducted in the Area in the Visit Report form suggested by SCAR. The report shall be submitted to the competent authorities specified in the Permit as soon as possible, but no later than 6 months after the visit ends. Such reports shall be kept indefinitely and easily made available to the interested Parties, CCAMLR and COMNAP. If necessary, documentation of human activities within the area shall be provided to the above-mentioned parties.

The investigators should finish their investigation report within six months after the research activities are concluded. A copy of such report should be submitted to national authority so as to make revision and re-examination of the Management Plan in accordance with the requirements of the Antarctic Treaty. The report should include all the contents of the accepted Visit Report Form suggested by SCAR as well as other information as required according to the country's laws and regulations. The permit issuing authority should provide the information on these reports so that organizations such as SCAR, COMNAP and the interested countries may consult them.

8. Supporting documentation

Australian Antarctic Division (AAD, 2007): Australian Antarctic Programme Approved Science Projects for season 2006/07, *http://its-db.aad.gov.au/proms/public/projects/projects_by_program.cfm?season=0607&PG_ID=5*.

Report on the 22nd CHINARE Scientific Activity [2005/2006](2006), Chinese Arctic and Antarctic Administration.

Liu Xiaochun; Jahn Bor-ming, Zhao Yue, Li Miao, Li, Huimin; Liu Xiaohan (2006). Late Pan-African granitoids from the Grove Mountains, East Antarctica: Age, origin and tectonic implications. Precambrian Research, 145: 131-154.

Zhang Shengkai, E Dongchen, LiFei, et al (2006). The establishment of GPS network in Grove Mountains, East Antarctica. Chinese Journal of Polar Science 17(2):111-116.

CHENG Xiao, ZHANG Yan-mei(2006). Detecting Ice Motion with Repeat-pass ENVISAT ASAR Interferometry over Nunataks Region in Grove Mountain, East Antarctic—The Preliminary Result, Journal of Remote Sensing 10(1):118-122.

IPY-ACE core program, 2006

Dongchen E, Chunzia Zhou, Mingsheng Liao(2005). Application of SAR interferometry in Grove Mountains, East Antarctica. SCAR Report, 2005, 23: 42-46.

Dongchen E., Shengkai Zhang, Li Yan, Fei Li (2005). The establishment of GPS control network and data analysis in the Grove Mountains, East Antarctica. SCAR Report, 2005, 23: 46-49.

Aimin Fang, Xiaohan Liu, Xiaoli Li, Feixin Huang, Liangjun Yu (2005). Cenozoic glaciogenic sedimentary record in the Grove Mountains of East Antarctica. Antarctic Science 17(2): 237-240.

J. Taylor, M. J. Siegert, A.J. Payne, M.J. Hambrey, P.E. O'Brien, A.K. Cooper, & G. Leitchenkov (2004). Topographic controls on post-Oligocene changes in ice-sheet dynamics, Prydz Bay, East Antarctica, Geology 32 (3) :197-200.

Fang Aimin, Liu Xiaohan, Lee Jong Ik, Li Xiaoli, Huang Feixin (2004). Sedimentary environments of the Cenozoic sedimentary debris found in the moraines of the Grove Mountains, East Antarctica and its climatic implications. Progress in Natural Science 14(3): 223-234.

Huang Feixin, Liu Xiaohan, Kong Ping; Ju Yitai, Fang Aimin, Li Xiaoli, Na Chunguang (2004). Bedrock exposure ages in the Grove Mountains, interior East Antarctica. Chinese Journal of Polar Research 16(1):22-28.

Fang Aimin, Liu Xiaohan, Wang Weiming, Yu Liangjun, Li Xiaoli, Huang Feixin (2004). Preliminary study on the spore-pollen assemblages found in the cenozoic sedimentary rocks in Grove Mountains, East Antarctica. Quaternary Sciences 24(6):645-653.

Report on the 19th CHINARE Scientific Activity [2002/2003](2003), Chinese Arctic and Antarctic Administration.

X.H. Liu, Y, Zhao, X.C. Liu, & L.J. Yu, (2003) Geology of the Grove Mountains in East Antarctica-New Evidence for the Final Suture of Gondwana Land, Science in China (D), 46 (4): 305-319.

Zhao Y, Liu X H, Liu X C, Song B(2003). Pan-African events in Prydz Bay, East Antarctica, and their implications for East Gondwana tectonics. In: Yoshida M, Windley B F, Dasgupta S. (eds) Proterozoic East Gondwana: Supercontinent Assembly and Breakup. Geological Society, London, Special Publications, 206: 231-245.

Liu X, Zhao Z, Zhao Y, Chen J and Liu X Hÿ2003 ÿ. Pyroxene exsolution in mafic granulites from the Grove Mountains, East Antarctica: constraints on the Pan-African metamorphic conditions. European Journal of Mineralogy 15:55-65.

X.L. Li, X.H. Liu, Y.T. Ju & F.X. Huang(2003). Properties of soils in Grove Mountains, East Antarctica, Science in China (D) ÿ46 (7):683-693.

Qin Xiang (2003). A brief introduction to research on the snow and ice of the Grove Mountains, Antarctica, during the Third Chinese research expedition. Bingchuan Dongtu, 25 (4): 477-478.

Cheng Xiao, Li Zhen, Massonnet, Didier [chairperson], Yu Shao, Zhang Yanmei(2003). Blue-ice domain discrimination using interferometric coherence in Antarctic Grove Mountains. 2003 EEE international geoscience and remote sensing symposium: July 21-25, 2003: Toulouse, France; International Geoscience and Remote Sensing Symposium, 2003, Volume 4: 2599-2601.

Fang Aimin, Liu Xiaohan, Lee Jong Ik, Li Xiaoli, Huang Feixin (2003). The significance of Cenozoic sedimentary rocks found in Grove Mountains, East Antarctica. Chinese Journal of Polar Research 15 (2): 138-150.

LI Xiaoli, LIU Xiaohan, FANG Aimin, JU Yitai, YAN Fuhua (2003). Pliocene sporopollen in the Grove Mountains, East Antarctica, Marine geology & Quaternary geology 23(1):35-39.

Johnston, Gary, Digney, Paul, Manning, John [editor](2002).Extension of the Australian Antarctic geodetic network in Grove Mountains. Third Antarctic geodesy symposium: July 18-20, 2001: Saint Petersburg, Russian Federation; SCAR Report 21: 34-37.

Whitehead J M & McKelvey B C(2002). Cenozoic glacigene sedimentation and erosion at the Menzies Range, southern Prince Charles Mountains, Antarctica. Journal of Glaciology 48 (2): 207-247.

Liu Xiaochun, Zhao Yue (2002). Geological aspects of the Grove Mountains, East Antarctica—— New evidence for the final suture of Gondwana Land. Royal Society of New Zealand Bulletin 35:161-166.

Liu X H, Zhao Y, Liu X C, Yu L Z (2002). Geological aspects of the Grove Mountains, East Antarctica. Science in China (Series D) 32(6): 457-468.

Yu Liangjun, Liu Xiaohan, Zhao Yue, Ju Yitai (2002). Preliminary study on metamorphic mafic rocks in the Grove Mountains, East Antarctica. Chinese Journal of Polar Research 14 (2): 93-104.

Mikhalsky, E. V., Sheraton, J. W., Beliatsky, B. V.(2001). Preliminary U-Pb dating of Grove Mountains rocks: implications for the Proterozoic to Early Palaeozoic tectonic evolution of the Lambert Glacier-Prydz Bay area (East Antarctica). Terra Antarctica 8 (1): 3-10.

B.C. McKelvey, M.J. Hambrey, D.M. Harwood (2001). The Pagodroma Group - a Cenozoic record of the East Antarctic ice sheet in the northern Prince Charles Mountains, Antarctic Science, 13 (4) :455-468.

Liu X, Zhao Y and Liu X H(2001). The Pan-African granulite facies metamorphism and syn-tectonic magmatism in the Grove Mountains, East Antarctica. Journal of Conference Abstracts, Cambridge Publications, Cambridge, United Kingdom, 6:379.

Sun Jiabing, HuoDongmin, ZhouJunqi and SunZhaohui (2001). The digital mapping of satellite images by free of ground control and the analysis of land form blue ice and meteorites distribution in the Grove Mountains. Chinese Journal of Polar Science 13(1).

Report on the 16th CHINARE Scientific Activity [1999/2000](2000), Chinese Arctic and Antarctic Administration.

Cheng Yanjie, Lu Longhua, Bian Lingen, Liu Xiaohan (2000). Summer weather characteristics on the Grove Mountain of Antarctica. Chinese Journal of Polar Science11 (2): 123-130.

Report on the 15th CHINARE Scientific Activity [1998/1999](1999), Chinese Arctic and Antarctic Administration.

Cheng Yanjie, Lu Longhua, Bian Lingen, Liu Xiaohan (1999). Summer weather characteristics of Grove Mountain area in East Antarctica. Chinese Journal of Polar Research 11(4): 291-300.

Cheng Yanjie, Lu Longhua and Bian Lingen (1999).Summer weather characteristics of Grove Mountain area in East Antarctica Chinese Journal of Polar Science 14(1):291-300.

Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas - Appendix to Resolution 2(1998).

Domack E, et al (1998). Late Quaternary sediment facies in Prydz Bay, East Antarctica and their relationship to glacial advance onto the continental shelf. Antarctic Science 10(3):236^ÿ246.

Barker P F, et al. (1998). Ice sheet history from Antarctic continental margin sediments: the ANTOSTRAT approach. Terra Antarctica, 5:737-760.

D.E. Sugden, D.R. Marchant, Jr. N. Potter, R.A. Souchez, G.H. Denton, C.C. Swisher III, J.L. Tison (1995). Preservation of Miocene glacier ice in East Antarctica, Nature 376(3):412-414.

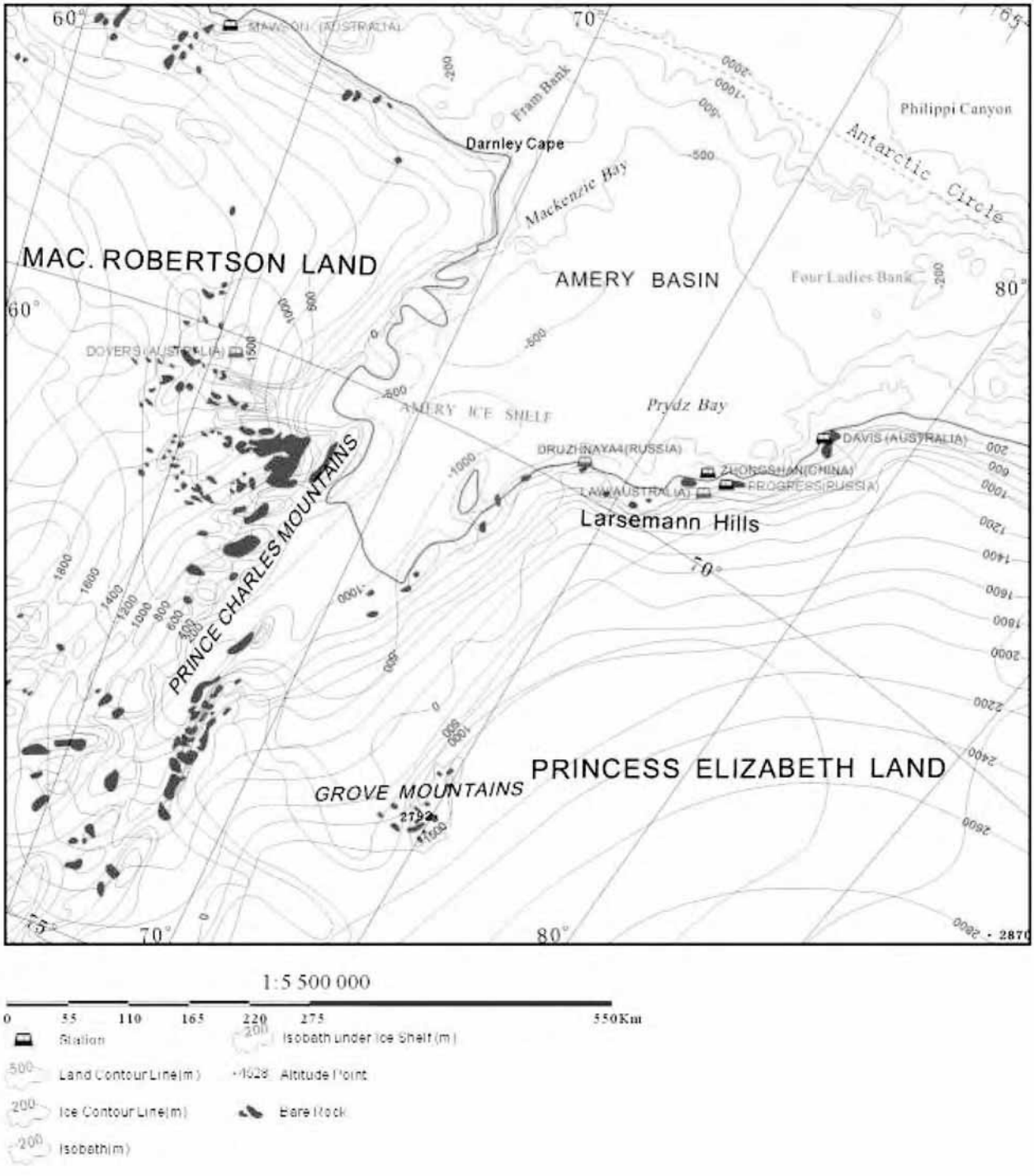
D.E. Sugden, D.R. Marchani, & G.H. Destos, The case for a stable East Antarctic Ice Sheet the background, Geografiska Annaler, 75A, (1993) 151-153.

9. Maps

- Map A: A1: Position of Grove Mountain. A2: Grove Mountains Area, Antarctica
- Map B: Protected Area around Mount Harding, Grove Mountains, Antarctica
- Map C: Location of Nunataks and Direction of Ice Flow around Mount Harding, Grove Mountains, Antarctica.

Map A1. Position of Grove Mountains

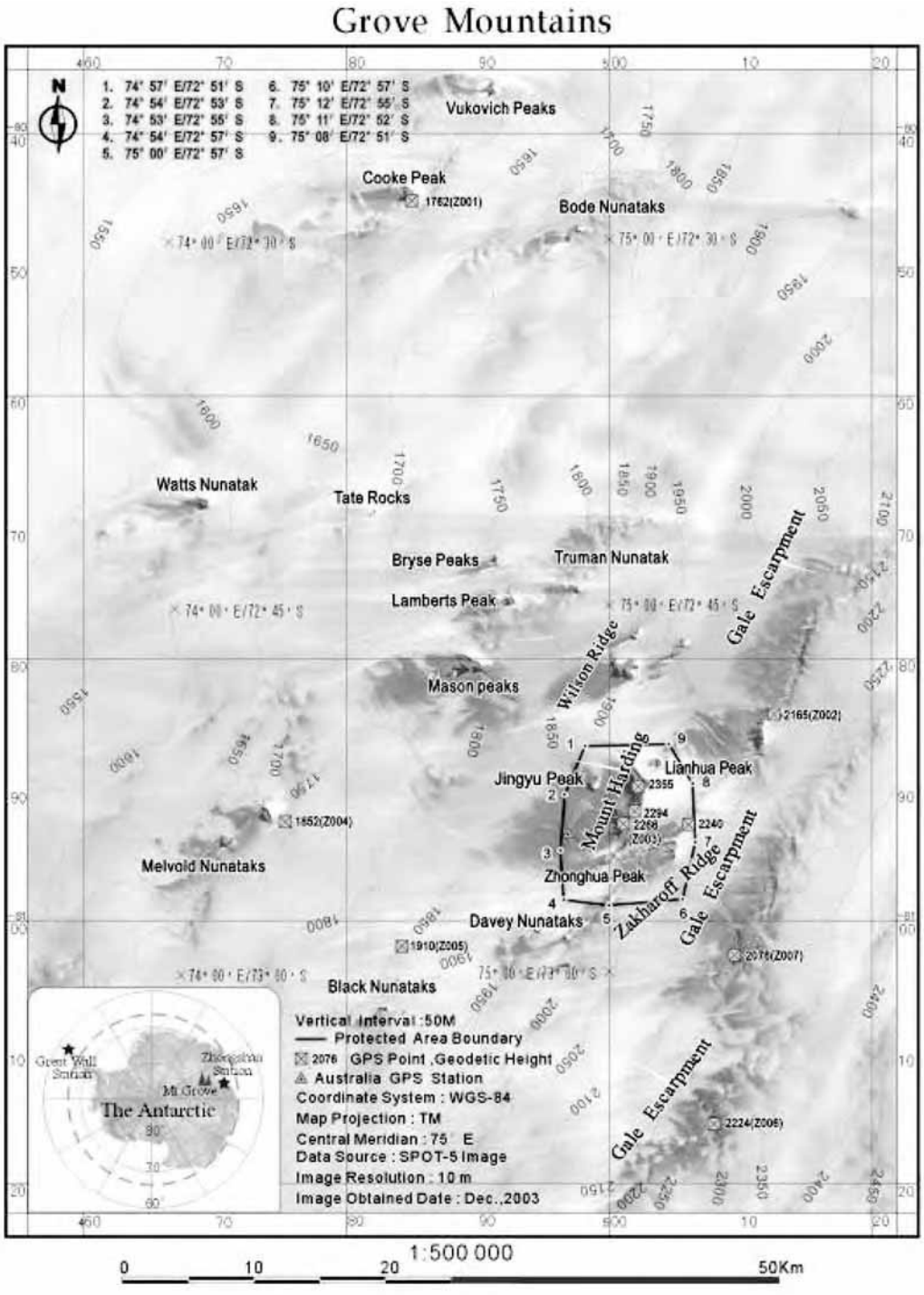
Mapping Standard: Projection: Normal Stereographic Horizontal datum:WGS-84
Manufacturer: Chinese Antarctic Centre of Surveying and Mapping, Wuhan University



Map A2. Grove Mountains Area, Antarctica

Mapping standards: Projection: TM, Horizontal datum: WGS-84

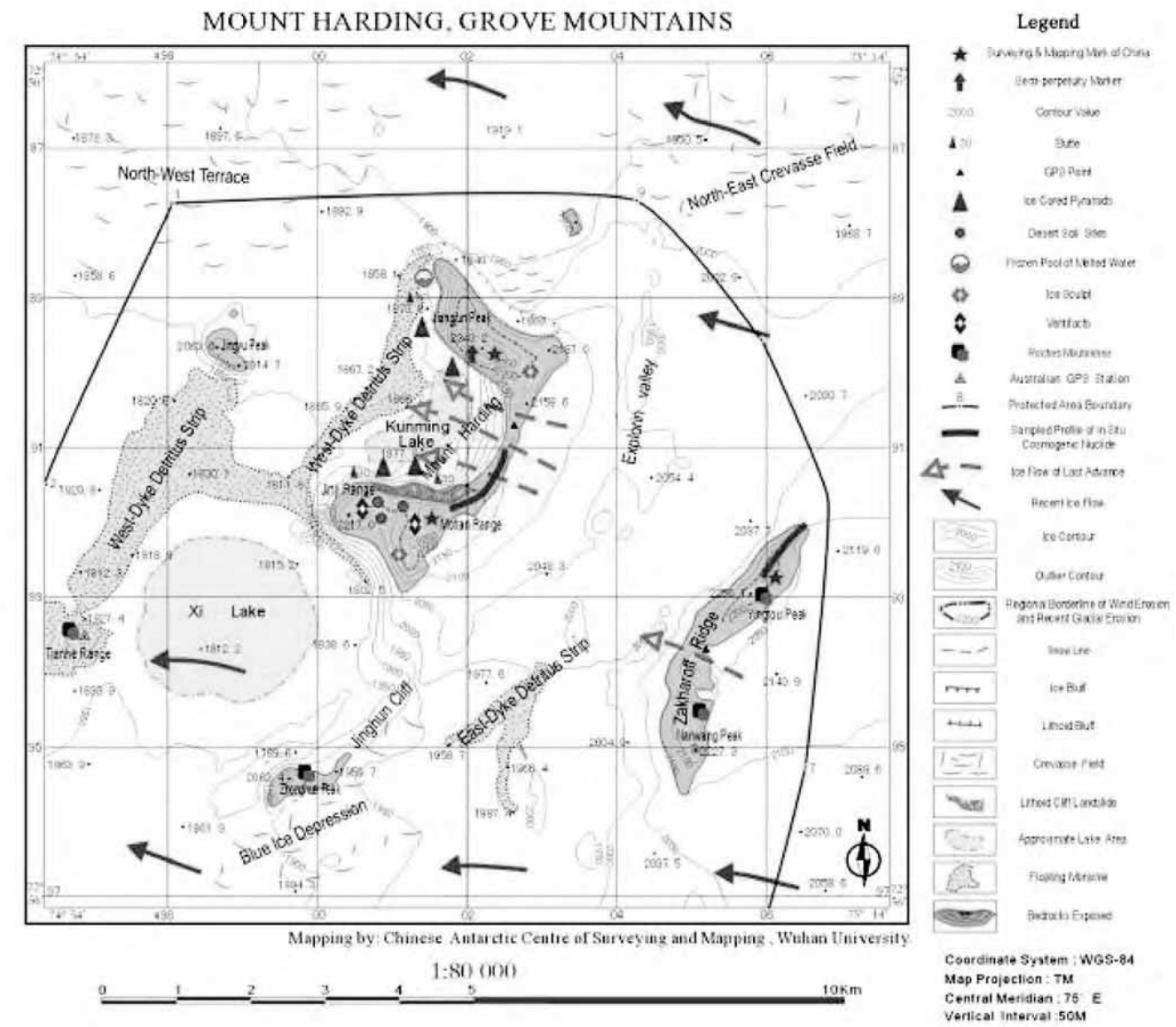
Manufacturer: Chinese Antarctic Centre of Surveying and Mapping, Wuhan University



Map B. Protected Area around Mount Harding, Grove Mountains, Antarctica

Mapping standards: Projection: TM Horizontal datum: WGS-84

Manufacturer: Chinese Antarctic Centre of Surveying and Mapping, Wuhan University



Map C. Location of Nunataks and Direction of Ice Flow around Mount Harding, Grove Mountains, Antarctica

Mapping standards: Projection: TM Horizontal datum: WGS-84

Manufacturer: Institute of Geology and Geophysics, Chinese Academy of Sciences

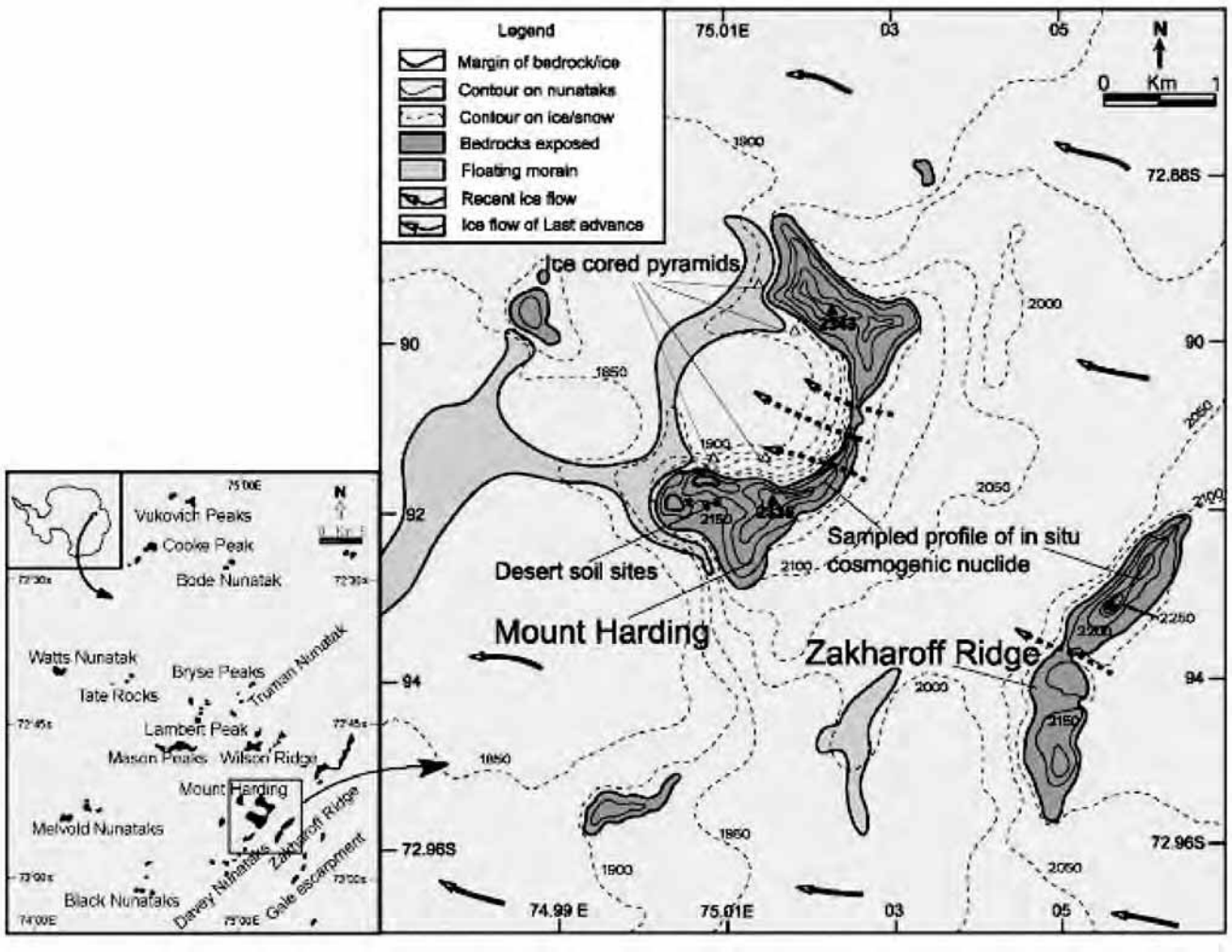


Photo 1: Ventifact, taken on January 13th, 2003

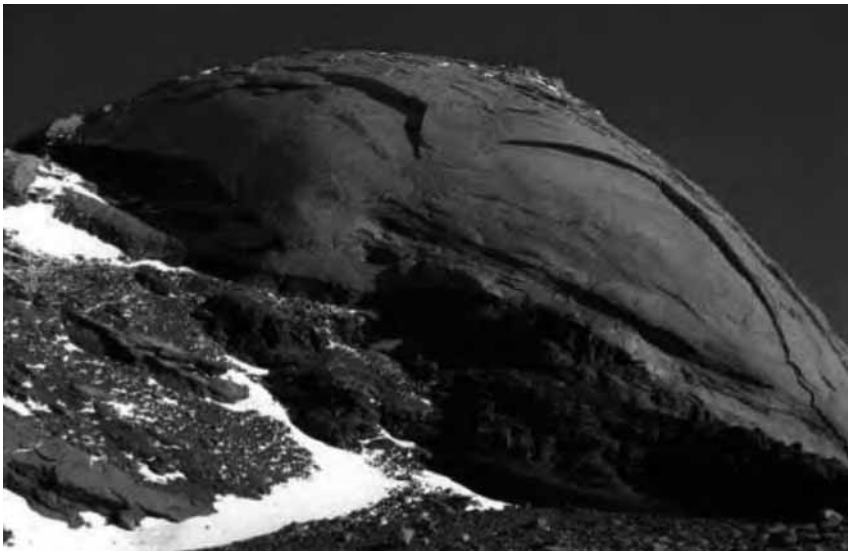
Photo 2: Ventifact, taken on January 13th, 2003

Photo3: Ice-core pyramid, taken on January 12th, 2003

Photo 4: Hanging moraine dyke, taken on January 14th, 2003

Photo 5: Pool of ice melted water, taken on January 14th, 2003

Photo 6: Roches montannees, taken on January 12th, 2003



Measure 3 (2008)

Antarctic Specially Protected Area No 169: Amanda Bay, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas and approval of Management Plans for those Areas;

Noting that the Committee for Environmental Protection has recommended that Amanda Bay, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica be designated as a new Antarctic Specially Protected Area, and has endorsed the Management Plan for this Area annexed to this Measure;

Recognising that this area supports outstanding environmental, scientific, historic, aesthetic or wilderness values, or ongoing or planned scientific research, and would benefit from special protection;

Desiring to designate Amanda Bay, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica as an Antarctic Specially Protected Area and to approve the Management Plan for this Area;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) Amanda Bay, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica be designated as Antarctic Specially Protected Area No 169; and

2) the Management Plan which is annexed to this Measure be approved.

Management Plan for Antarctic Specially Protected Area No 169

AMANDA BAY, INGRID CHRISTENSEN COAST, PRINCESS ELIZABETH LAND, EAST ANTARCTICA

Introduction

Amanda Bay is located on the Ingrid Christensen Coast of Princess Elizabeth Land, East Antarctica at 69°15' S, 76°49'59.9" E. (Map A). The Antarctic Specially Protected Area (ASPA) is designated to protect the breeding colony of several thousand pairs of emperor penguins annually resident in the south-west corner of Amanda Bay, while providing for continued collection of valuable long-term research and monitoring data and comparative studies with colonies elsewhere in East Antarctica.

Only two other emperor penguin colonies along the extensive East Antarctic coastline are protected within ASPAs (ASPA 120, Point Géologie Archipelago and ASPA 167 Haswell Island). Amanda Bay is more easily accessed, from vessels or by vehicle from research stations in the Larsemann Hills and Vestfold Hills, than many other emperor penguin colonies in East Antarctica. This accessibility is advantageous for research purposes, but also creates the potential for human disturbance of the birds.

The Antarctic coastline in the vicinity of Amanda Bay was first sighted and named the Ingrid Christensen Coast by Captain Mikkelsen in command of the Norwegian ship Thorshavn on 20 February 1935. Oblique aerial photographs of the coastline were taken by the Lars Christensen expedition in 1937 and by the US Operation Highjump in 1947 for reconnaissance purposes. In the 1954/55 summer, the Australian National Antarctic Research Expedition (ANARE) on the Kista Dan explored the waters of Prydz Bay, and the first recorded landing in the area was made by a sledging party led by Dr. Phillip Law on 5 February 1955 on Lichen Island (69°19'59.9"S, 75°31'59.9 E). Extensive aerial photography was flown by ANARE from 1957 to 1960.

The first recorded visit to Amanda Bay itself took place in August 1957, when a surveying party observed an astro fix at the Larsemann Hills. During the return flight to Davis, the area was photographed and named Amanda Bay after the newly-born daughter of the pilot, RAAF Squadron Leader Peter Clemence. Between 1957 and 1997 the colony is known to have been visited approximately once every for years (see Appendix 1), however in recent years there has been increased visitation from research scientists, station personnel on overland traverses, and commercial tourism operators.

1. Description of Values to be Protected

The Area is primarily designated to protect the breeding colony of emperor penguins located at Amanda Bay for their intrinsic and scientific values. The colony lies adjacent to the highly productive area of Prydz Bay and provides an ideal opportunity for comparative studies with emperor penguin colonies of the Mawson Coast further to the west.

The emperor penguin colony consists of several thousand pairs located on the fast ice in the south-west corner of the bay. The current range of the number of breeding pairs at the colony is unknown as no systematic census has been carried out since 1983 when Cracknell (1986) counted 2339 chicks and 2448 adults in the colony on 29/30 September (see Appendix 1). Since that count was conducted half way through the breeding season, it is not possible to accurately estimate the size of

the breeding population, however it gives an indication of a minimal number of breeders present in that year.

Emperor penguins *Aptenodytes forsteri* live all year in Antarctic waters and have a circumpolar breeding distribution. Colonies occur chiefly in three main areas: (1) the Weddell Sea and Dronning Maud Land; (2) Enderby and Princess Elizabeth Lands; and (3) the Ross Sea. There may be as many as 40 known breeding colonies; the majority of these have not been visited or systematically counted for decades, so the total breeding population is not accurately known. Most colonies are located between 20°W and 110°E along the coast of East Antarctica, and there is a concentration of breeding pairs at six colonies in the Ross Sea East (160°E to 170°E). The latitudes of colonies range from 66°S to 78°S. Emperor penguin colonies are typically located on the winter fast ice in areas where the ice forms early in the year and remains stable until early summer. Only three colonies are known to be located on land: one on Dion Island in Marguerite Bay, on the western Antarctic Peninsula (ASPA 107, 67°52‘S, 68°43’W); one near Taylor Glacier, Mac. Robertson Land (ASPA 101, 67°28’S, 60°53’E); and one in the area of Richardson Lakes near Amundsen Bay in Enderby Land (66° 45’S, 50° 38’E).

2. Aims and objectives

Management at Amanda Bay aims to:

- avoid degradation of, or substantial risk to, the emperor penguin colony by preventing / minimising unnecessary human disturbance;
- provide for ongoing research and monitoring of the emperor penguin colony, and other compelling scientific activity which cannot be undertaken elsewhere; and
- gather survey data on the population status of the emperor penguin colony on a regular basis.

3. Management activities

The following management activities will be undertaken to protect the values of the Area:

- signs illustrating the location and boundaries, with clear statements of entry restrictions, shall be placed at appropriate locations on the boundary of the Area to help avoid inadvertent entry;
- information about the Area (describing the boundary and all special restrictions that apply) and copies of this Management Plan shall be made available at research/field stations in the Vestfold Hills and Larsemann Hills, and shall be provided to all ships visiting the vicinity;
- visits shall be made to the Area as necessary (where practicable, not less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure that management activities are adequate; and
- the Management Plan shall be reviewed at least every five years and updated as required.

4. Period of designation

Designated for an indefinite period.

5. Maps

The following maps are provided:

- Map A: Amanda Bay Antarctic Specially Protected Area, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica. Location Amanda Bay on Ingrid Christensen Coast. Map Specifications: Projection: Lambert Conical Conformal; Horizontal Datum: WGS84; Vertical Datum: Mean Sea Level.
- Map B: Amanda Bay Antarctic Specially Protected Area, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica. Location of Emperor Penguin Colony and Physical Features. Map Specifications: Horizontal Datum: WGS84; Vertical Datum: Mean Sea Level.

6. Description of the Area

6(i) Geographical co-ordinates, boundary markers and natural features

Amanda Bay (69°15'S, 76°49'59.9"E) lies south-west of the Brattstrand Cliffs, between the Vestfold Hills to the north-east and the Larsemann Hills to the south-west on the Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica (Map A). Amanda Bay is approximately 3km wide and 6km long, and opens north-west into Prydz Bay. The south-west side of the bay is flanked by the Flatnes Ice Tongue secured by Cowell Island at its western corner. The southern and eastern sides are bounded by continental ice cliffs. There are small islets towards the centre of the bay and several un-named islands a few kilometres offshore.

The Amanda Bay Antarctic Specially Protected Area comprises the rocks, islands and water, including fast ice, lying within an irregular area, covering the general area of Amanda Bay, commencing at a point to the north-east of Hovde Island at the terminus of the Hovde Glacier, 76°53'54.48"E, 69°13'25.77"S; then south along the coastline at the base of the Hovde Glacier ice cliffs, to a point at 76°53'44.17"E, 69°16'22.72"S; then west along the coastline at the base of a series of ice-free bluffs to a point 76°49'37.47"E, 69°16'58'48"S; then north along the base of the Flatnes Ice Tongue ice cliffs, to a point at the terminus of the Flatnes Ice Tongue, 76°46'41.07'E, 69°14'44.37"S; then a straight line in a north-easterly direction connecting with the originating point at 76°53'54.48"E, 69°13'25.77"S (Map B).

Emperor Penguins

The Amanda Bay emperor penguin colony occupies fast ice in the south-west corner of Amanda Bay, between two small islands to the east and the glacier tongue to the west. The colony has occupied a number of sites within Amanda Bay location since its discovery in 1957.

In September – October 1986, the colony occupied an area of some 100m by 500m during winter. This was in an area about 3.3km south of that reported in 1961, but probably similar to the position reported in May 1960. In September – October 1986, the colony was divided into two major groups, the first occupying a dark–stained slope of consolidated snow, ice and excreta based on a strip of moraine landward of the tide cracks at the foot of the ice-cliffs. The second group was on the flat sea ice just seaward of the main tide crack zone. In October that year, open water was approximately 38km from the colony and there was a continuous movement of adults and chicks between the two groups. In winter 1997, the colony consisted of six groups of ranging in size and covering a site some 2.5km by 5km on the fast ice, approximately 10km from open water. The strong circular currents in Prydz Bay render the sea ice unstable for most of the year, and in so doing provide the penguins with good access northwards to open water for feeding.

The Amanda Bay colony was viewed from the air on three occasions in 1956/57, once in 1960 and again in December 1981. The only recorded ground count before 1970 was made on a one day visit on 21 May 1960. The Frozen Sea Expedition spent seven days at the colony, 27 September - 3 October and on 18 October 1983, and expeditioners made additional observations on sea ice offshore from the colony. This was the most recent thorough census, although observations during subsequent periodic visits from research stations in the Larsemann Hills and Vestfold Hills confirm the continued presence of the colony.

Other Biota

There are limited accounts of other fauna and no published accounts of flora in the immediate vicinity, although lichens have been collected from Hovde Island and the emergent headland moraine at the head of the bay at the edge of the polar plateau and the nunataks beyond. Adélie penguins (*Pygoscelis adeliae*), south polar skuas (*Catharacta maccormicki*), Wilson's storm petrels (*Oceanites oceanicus*) and Weddell seals (*Leptonychotes weddelli*) have been observed.

Climate

Limited data exists for the meteorology of Amanda Bay. The nearest areas with a substantial record of meteorological data are the Vestfold Hills (Davis), 75km to the north-east, and the Larsemann Hills (Zhongshan and Progress II station), 22km to the south-west. The prevailing wind within Amanda Bay appears to be highly variable east-south-east. The prevailing winds at Davis are north-east to east and of moderate strength, but in the Larsemann Hills violent southerly winds are often encountered. For most quarters of the wind, Amanda Bay would present ice cliffs to windward and leeward of the colony. Aerial photography has shown Amanda Bay to be almost completely filled by fast ice even during summer months.

Approximately 22km to the south-west of Amanda Bay are the Larsemann Hills, where there are permanent Russian and Chinese research stations. A major feature of the climate of the Larsemann Hills is the existence of persistent, strong katabatic winds that blow off the plateau from the north-east on most summer days. Daytime air temperatures from December to February frequently exceed 4°C and can exceed 10°C, with the mean monthly temperature a little above 0°C. Mean monthly winter temperatures are between -15°C and -18°C. Pack ice is extensive inshore throughout summer months, and the fjords and embayments are rarely ice-free. Precipitation occurs as snow and is unlikely to exceed 250 mm water equivalent annually.

Davis station, 75km to the south-west, experiences a mean monthly temperature range from +1°C in January to -18°C in July. Winds are predominantly from between north to east. The mean annual wind speed is 18km/hr. The windiest month is November, while the lightest winds are on average recorded in April. Snowfall is very light at Davis, and most snow accumulation is a result of drift snow blown from the plateau between March and October. The Vestfold Hills area is subject to frequently cloudy skies, very low absolute humidity, and a small amount of snowfall. The climate of Davis is less severe than most other locations in Antarctica because of the sheltering from katabatic winds by the Vestfold Hills. The extent of pack ice in September and October can reach as far north as 55°S. The fast ice edge in winter is usually between 5km to 15km south-west of Davis; the fast ice breaks up and is carried out to sea, usually in January.

Geology

Rock outcrops in southern Prydz Bay, comprising the Svenner Islands, the Brattstrand Cliffs, Amanda Bay, the Larsemann Hills, Bolingen Island, Søstrene Island, the Munro Kerr Mountains and Landing Bluff consist of interleaved paragneiss with high temperature mineral assemblages and structures about 500 Ma in age (Pan African). The paragneiss preserves no conclusive evidence of earlier

metamorphism, but the orthogneiss has local relics of high-grade metamorphism at 1000 Ma The Pan-African event involved crustal thickening and burial of the paragneiss, followed by exhumation. There are also a number of intrusions that post-date peak metamorphism, including granitoid plutons and widespread pegmatic dykes which cross-cut both paragneiss and the plutons. One such granitoid pluton is found at Amanda Bay. This is K-feldspar rich and post-dates early foliations in the country gneiss. It has biotite foliation and contains garnet, spinel, apatite, and is thought to be syn-tectonic.

6(ii) Special Zones within the Area

There are no special zones within the Area.

6(iii) Location of structures within and adjacent to the Area

There are no structures within the Area.

6(iv) Location of other Protected Areas in the vicinity

There are no other protected areas in the near vicinity of Amanda Bay. Marine Plain, Antarctic Specially Protected Area No 143 (68°36'S, 78°07'E) and Hawker Island, Antarctic Specially Protected Area No 167 (68°35'S, 77°50'E) are located approximately 75km north-east in the Vestfold Hills. The Larsemann Hills, Antarctic Specially Managed Area No 6, is located approximately 22km to the south-west (69°30'S 76°19'58"E).

7. Permit conditions

Entry into the Area is prohibited except in accordance with a Permit issued by an appropriate national authority. Conditions for issuing a Permit to enter the Area are that:

- the actions permitted will not jeopardise the values of the Area;
- the actions permitted are in accordance with this Management Plan;
- the Permit, or an authorised copy, shall be carried within the Area;
- a visit report shall be supplied to the authority named in the Permit;
- permits shall be issued for a finite period;
- Permit Holders shall notify the appropriate authority of any activities or measures undertaken that were not authorised permit; and
- all census and GPS data shall be made available to the permitting authority and to the Parties responsible for the development of the Management Plan.

7(i) Access to and movement within or over the Area

The coastline of Amanda Bay is partially comprised of a very large ice wall. Whenever possible, vehicle access should be from sea ice to the north of the colony, or overland from the south of the Area. Visitors to the Area are to take precautions to reduce vehicular and other disturbance to the penguins, and should avoid crossing between the colony and the sea.

It should be noted that conditions at Amanda Bay are seasonably variable, and when traversing the Area caution should be exercised. As a consequence it is not possible to be prescriptive about helicopter landing sites and access routes. Conditions should be assessed on each visit and caution exercised in accordance with the provisions of this Management Plan.

Vehicles should be kept at least 500m from any bird or concentrations of birds.

The following conditions apply to the use of helicopters:

- overflight of the colony is prohibited;
- helicopters may not land, take off or fly within 1000m of the colony;
- helicopters are to approach the Area from the north over the sea ice and, where sea ice conditions permit, land outside the Area, with access being by foot;
- helicopters approaching to land in the Area must fly low over the sea ice to avoid disturbing breeding penguins in the colony; and
- helicopters are not to be refuelled within the Area.

There are no marked pedestrian routes within the Area. Unless disturbance is authorised by permit, pedestrians should keep at least 50m from the penguins.

7(ii) Activities which are or may be conducted within the Area, including restrictions on time and place

- Compelling scientific research, which cannot be undertaken elsewhere and which will not jeopardise the avifauna or the ecosystem of the Area.
- Essential management activities, including monitoring.
- Sampling, which should be the minimum required for the approved research programs.

As the penguins are particularly sensitive to disturbance during the following periods:

- from mid-May to late July, when they are incubating eggs;
- from late July to late September, when adults are brooding chicks; and
- from late November to late December when the chicks moult and fledge, and also during moult in late summer,
- authorised visitors should exercise particular care not to unduly disturb or interfere with the birds during these periods.

7(iii) Installation, modification, or removal of structures

Field huts should be placed well away from the penguin colony at a point outside the Area. As conditions at Amanda Bay are seasonally variable, specific locations are not designated. Other structures may be installed within the Area subject to a Permit.

Markers, signs, equipment and structures erected in the Area for scientific or management purposes must be secured and maintained in good condition, and removed when no longer required. All such items should be made of materials that pose a minimum risk of environmental harm and must be marked to clearly identify the permitting country, name of principal investigator, year of installation and date of expected removal.

7(iv) Field camps

Temporary camping is allowed within the Area when necessary for purposes consistent with this Management Plan and where authorised in a Permit. As conditions at Amanda Bay are seasonally variable, specific campsite locations are not designated, but camping within 500m of the emperor penguin colony should be avoided.

7(v) Restrictions on materials and organisms which may be brought into the Area

No poultry products are to be taken into the Area, other than foods containing pasteurized egg powder, stock cubes, powdered soups and canned soups that contain poultry.

No depots of food or other supplies are to be left within the Area beyond the time period or activity for which they are required.

No live animals, plant material or micro-organisms shall be deliberately introduced into the Area.

The precautions listed in section 8(ix) shall be taken to minimise the risk of accidental introductions.

No herbicides or pesticides shall be brought into the Area. Any other chemicals, including radionuclides or stable isotopes, which may be introduced for scientific or management purposes specified in a Permit, shall be removed from the Area at or before the conclusion of the activity for which the Permit was granted.

Fuel is not to be stored in the Area unless required for essential purposes connected with the activity for which the Permit has been granted. All such fuel shall be removed at or before the conclusion of the permitted activity. Permanent or multi-year fuel depots are not permitted.

All material introduced shall be for a stated period, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so as to minimise the risk of environment impacts.

7(vi) Taking of, or harmful interference with, native flora and fauna

Taking of or harmful interference with native flora and fauna is prohibited except in accordance with a Permit. Where taking or harmful interference with animals is involved this should, as a minimum standard, be in accordance with the SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica.

7(vii) Collection and removal of anything not brought into the Area by the Permit Holder

Material may be collected or removed from the Area only in accordance with a Permit and should be limited to the minimum necessary to meet scientific or management needs.

Material of human origin likely to compromise the values of the Area, and which was not brought into the Area by the Permit holder or otherwise authorised, may be removed unless the impact of the removal is likely to be greater than leaving the material *in situ*. If this is the case, the appropriate national authority must be notified and approval obtained.

7(viii) Disposal of waste

All wastes, including all solid human wastes, shall be removed from the Area.

7(ix) Measures that may be necessary to ensure that the aims and objectives of the Management Plan can continue to be met

Permits may be granted to enter the Area to carry out biological monitoring and Area inspection activities, which may involve the collection of samples for analysis or review; the erection or maintenance of scientific equipment and structures, and signposts; or for other protective measures.

Any specific sites of long-term monitoring shall be appropriately marked and a GPS position obtained for lodgement with the Antarctic Data Directory System through the appropriate national authority.

Ornithological research shall be limited to activities that, where practicable, are non-invasive and non-disruptive to the breeding birds present within the Area. Invasive and/or disruptive research shall only be authorised if it will have only a temporary and transient effect on the population.

Visitors shall take special precautions against the introduction of alien organisms to the Area. Of particular concern are pathogenic, microbial or vegetation introductions sourced from soils, flora or fauna at other Antarctic sites, including research stations, or from regions outside Antarctica. To

minimise the risk of introductions, before entering the Area, visitors shall thoroughly clean footwear and any equipment to be used in the Area, particularly sampling equipment and markers.

7(x) Requirements for reports

Visit reports shall provide detailed information on all census data; maps and a description of locations of any new colonies or nests not previously recorded; a brief summary of research findings; comments indicating measures taken to ensure compliance with Permit conditions; and, where appropriate, copies of photographs take to illustrate reported matters.

Visitors are requested to make recommendations relevant to the management of the Area, in particular as to whether the values for which the ASPA was designated are being adequately protected and whether management measures are effective.

The report should be submitted as soon as practicable after the visit to the ASPA has been completed, but no later than six months after the visit has occurred. A copy of the report should be made available to the Permit issuing authority and to the parties responsible for development of the Management Plan (if different) for the purposes of reviewing the Management Plan in accordance with the Antarctic Treaty system requirements. Reports should include a completed SCAR Visit Report, or such information as required by national laws. The permitting authority should maintain a record of the report for an indefinite period and shall make this available to SCAR, CCAMLR, COMNAP, and to interested parties upon request.

7(xi) Emergency provision

Exceptions to restrictions outlined in the Management Plan are in an emergency as specified in Article 11 of Annex V of the Protocol on Environmental Protection to the Antarctic Treaty (the Protocol).

8. Supporting documentation

Some or all of the data used within this paper were obtained from the Australian Antarctic Data Centre (IDN Node AMD/AU), a part of the Australian Antarctic Division (Commonwealth of Australia).

Budd, G.M. (1961). The biotopes of emperor penguin rookeries. *Emu*, 61, 171-89.

Budd, G.M. (1962). Population studies in rookeries of the emperor penguin *Aptenodytes forsteri. Proceedings of the Zoological Society*, London 139, 365-388.

Cracknell, G.S. (1986). Population counts and observations at the emperor penguin *Aptenodytes forsteri* colony at Amanda Bay, Antarctica. *Emu*, 86(2): 113-117

Crohn, P.W. (1959). A contribution to the geology and glaciology of the western part of the Australian Antarctic Territory. *Bull. Bur. Miner. Resour. Geol. Geophys*., Aust., No 32.

Easther, R. (1986). Winter journey to the Amanda Bay emperor penguin rookery. *ANARE News* September 1986: 14.

Fitzsimons, I. (1988). Amanda Bay region geology studies fill important information gap. *ANARE News*, March 1988: 5.

Fitzsimons, I. (1997). The Brattstrand Paragneiss and the Søstrene Orthogneiss: A Review of Pan-African Metamorphism and Grevillian Relics in Southern Prydz Bay. In *The Antarctic Region: Geological Processes*. 121-130.

Gales, N.J., Klages, N.T.W., Williams, R. and Woehler, E.J. (1990). The diet of the emperor penguin, *Aptenodytes forsteri*, in Amanda Bay, Princess Elizabeth Land, Antarctica. *Antarctic Science*, 2(1): 23-28

Giese, M. and Riddle, M. (1999). Disturbance of emperor penguin *Aptenodytes forsteri* chicks by helicopters. *Polar Biology*, 22 (6): 366-371

Horne, R.S.C. (1983). The distribution of penguin breeding colonies on the Australian Antarctic Territory, Heard Island, the McDonald Islands and Macquarie Island. *ANARE Res. Notes No 9*.

Johnstone, G.W., Lugg, D.J. and Brown, D.A. (1973). The biology of the Vestfold Hills, Antarctica. Melbourne. Department of Science, Antarctic Division, *ANARE Scientific Reports, Series B (1) Zoology*. Publication No 123.

Kirkwood, R. and Robertson, G. (1997). Seasonal change in the foraging ecology of emperor penguins on the Mawson Coast, Antarctica. Marine *Ecology Progress Series* 156: 205-223.

Kirkwood, R. and Robertson, G. (1997). The energy assimilation efficiency of emperor penguins, *Aptenodytes forsteri*, fed a diet of Antarctic krill, Euphausia superba. *Physiological Zoology* 70: 27-32.

Kirkwood, R. and Robertson, G. (1997). The foraging ecology of female emperor penguins in winter. *Ecological Monographs* 67: 155-176.

Kirkwood, R. and Robertson, G. (1999). The occurrence and purpose of huddling by Emperor penguins during foraging trips. *Emu* 99: 40-45.

Korotkevich, E.S. (1964). Observations on birds during the first wintering of the Soviet Antarctic Expedition in 1956-1957. *Soviet Antarctic Expedition Information Bulletin,* Elsevier Publishing Company, Amsterdam. 149-152.

Lewis, D. (1984). Icebound in Antarctica. *National Geographic*, 166, 5: 634-663.

Lewis, D. (1987). *Icebound in Antarctica*. William Heinemann Australia, Richmond, Victoria

Lewis, D. and George, M., eds. (1984). The Initial Reports of the Mawson Anniversary and Frozen Sea Expeditions, nos. 4 and 11. Oceanic Research Foundation Occasional Publication 1:

Robertson, G. (1990). Huddles. *Australian Geographic*, 20: 76-94.

Robertson, G. (1992). Population Size and Breeding Success of Emperor Penguins *Aptenodytes forsteri* at the Auster and Amanda Glacier Colonies, Mawson Coast, Antarctica. *Emu*. 92: 62-71.

Robertson, G. and Newgrain, K. (1992). Efficacy of the tritiated water and 22Na turnover methods in estimating food and energy intake by Emperor penguins *Aptenodytes forsteri*. *Physiological Zoology,* 65: 933-951.

Robertson, Graham G. (1994). *The Foraging Ecology of Emperor Penguins (*Aptenodytes forsteri*) at two Mawson Coast Colonies, Antarctica*. PhD Thesis, University of Tasmania.

Robertson, G., Williams, R. Green, K. and Robertson, L. (1994). Diet composition of Emperor penguin chicks *Aptenodytes forsteri* at two Mawson Coast colonies, Antarctica. *Ibis,* 136: 19-31

Robertson, G. (1995). The foraging ecology of Emperor penguins *Aptenodytes forsteri* at two Mawson Coast colonies, Antarctica. *ANARE Reports* 138, 139.

Schwerdtfeger, W. (1970). The climate of the Antarctic. In: *Climates of the Polar Regions* (ed. S. Orvig), pp. 253-355.

Schwerdtfeger, W. (1984). Weather and climate of the Antarctic. In: *Climates of the Polar Regions* (ed. S. Orvig), p. 261.

Todd, F.S., *et. al.,* (1999). Observations in some emperor penguin *Aptenodytes forsteri* Colonies in East Antarctica. *Emu* 99:142-145.

Wienecke, B., Kirkwood, R., Robertson, G. (2004). Pre-moult foraging trips and moult locations of Emperor penguins at the Mawson Coast. *Polar Biology* 27: 83-91.

Wienecke, B.C., and Robertson, G. (1997). Foraging space of emperor penguins *Aptenodytes forsteri* in Antarctic shelf waters in winter. *Marine Ecology Progress Series* 159: 249-263.

Willing, R.L. (1958). Feeding habits of emperor penguins. *Nature*, 182: 194-95.

Willing, R.L. (1958). Australian discoveries of emperor penguin rookeries

in Antarctica during 1954-57. *Nature*, London, 182, 1393-1394.

Woehler, E.J. [comp.]; Poncet S. International Council of Scientific Unions. Scientific Committee on Antarctic Research. Bird Biology Subcommittee.; Scott Polar Research Institute. (1993). *The distribution and abundance of Antarctic and subantarctic penguins*. Cambridge: Scientific Committee on Antarctic Research (SCAR).

Woehler, E.J. *et. al.,* and International Council of Scientific Unions. Scientific Committee on Antarctic Research, Bird Biology Subcommittee, Commission for the Conservation of Antarctic Marine Living Resources, National Science Foundation [U.S.]. (2001). *A statistical assessment of the status and trends of Antarctic and sub-Antarctic seabirds*. Scientific Committee on Antarctic Research (SCAR)

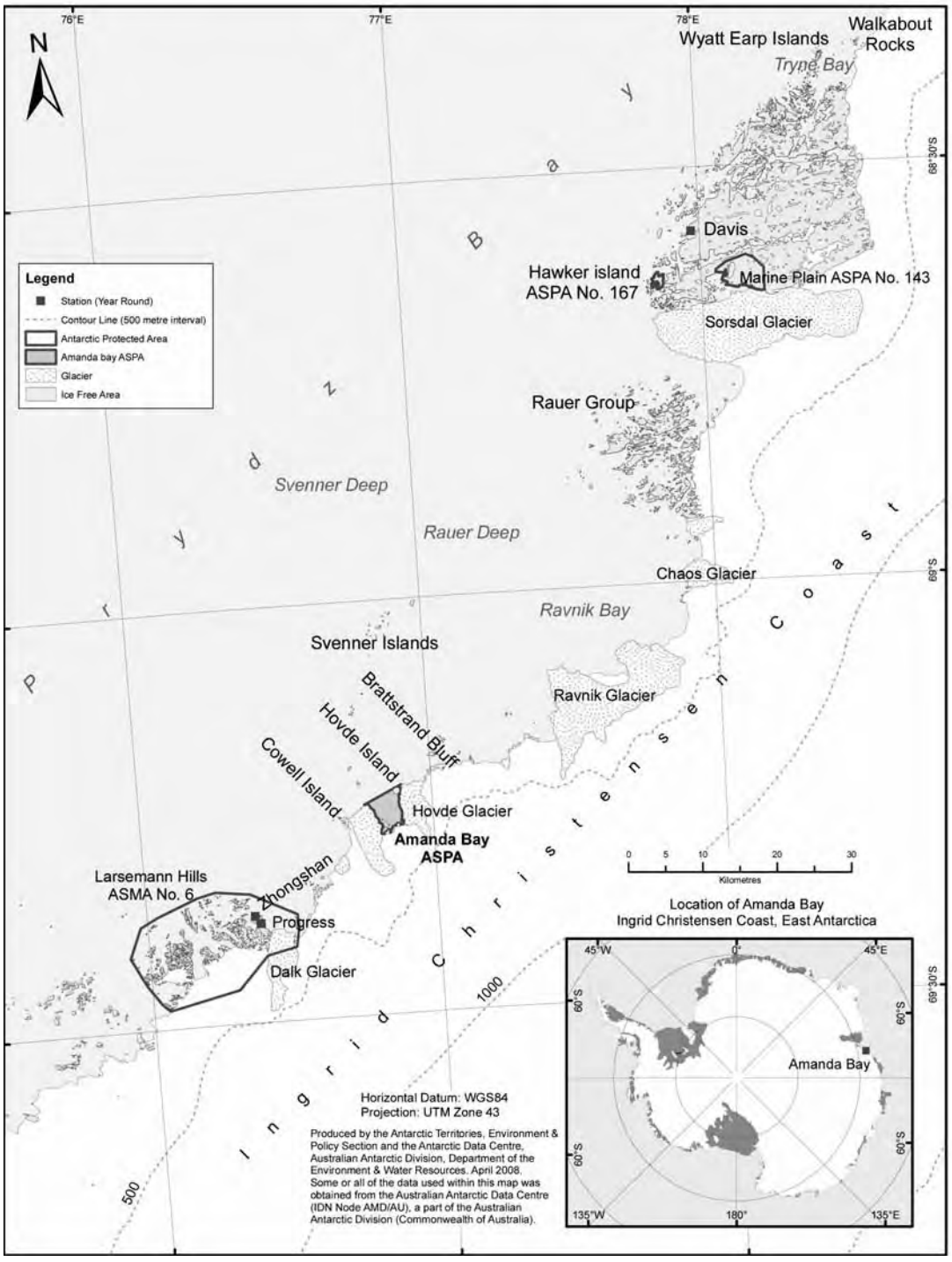
Woehler, E.J.; and Johnstone, G.W. (1991). Status and conservation of the seabirds of the Australian Antarctic Territory Islands. In *Seabird - status and conservation: a supplement*, Cambridge: International Council for Bird Preservation, 279-297

Appendix 1. History of emperor penguin population observations at Amanda Bay, 1956-1997

Date	Estimated number of penguins present in colony	Comments	Reference
1956/57	5000 birds along Ingrid Christensen Coast	General reference, no systematic census	Korotkevich 1964
September, 1957	1000 – 2000 birds	No systematic count, no distinction between adults and chicks	Willing 1958
1961	1500 adults	Unspecified reference, no date given, no systematic count conducted	ANARE in Horne 1983
29/30 Sep 1983	2339 ± 69 chicks, 2448 ± 23 adults	Adults: en masse count after Budd (1961), chicks: Combined en masse count group I and indirect count of group II (see Budd 1961)	Cracknell 1986
1987	9000 ?	Unspecified reference, no date, no specification of unit, no systematic census	ANARE in Woehler & Johnstone 1991
13 Dec 1992	5500 – 6000 chicks	Chicks in five groups, estimate based on grid counts	Todd 1999
21 Dec 1996	1000 – 5000 total birds	Rough estimate from overflight	Todd 1999
Nov 1997	8000 chicks	No systematic count, rough estimate	J. Gallagher, pers. comm, in Giese and Riddle 1999

Australian Government
Department of the Environment, Water, Heritage and the Arts
Australian Antarctic Division

Map A: Amanda Bay Antarctic Specially Protected Area No.169, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica. Location of Amanda Bay



Map B: Amanda Bay, Antarctic Specially Protected Area No 169, Ingrid Christensen Coast , Princess Elizabeth Land, East Antarctica. Location of Emperor Penguin Colony and Physical Features.

Measure 4 (2008)

Antarctic Specially Protected Area No 170: Marion Nunataks, Charcot Island, Antarctic Peninsula

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas and approval of Management Plans for those Areas;

Noting that the Committee for Environmental Protection has recommended that Marion Nunataks, Charcot Island, Antarctic Peninsula, be designated as a new Antarctic Specially Protected Area, and has endorsed the Management Plan for this area annexed to this Measure;

Recognising that this area supports outstanding environmental, scientific, historic, aesthetic or wilderness values, or ongoing or planned scientific research, and would benefit from special protection;

Desiring to designate Marion Nunataks, Charcot Island, Antarctic Peninsula as an Antarctic Specially Protected Area and to approve the Management Plan for this Area;

Recommend to their Governments the following Measure for approval in accordance with paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) Marion Nunataks, Charcot Island, Antarctic Peninsula be designated as Antarctic Specially Protected Area No 170; and
2) the Management Plan which is annexed to this Measure be approved.

II. Measures

Management Plan for Antarctic Specially Protected Area No 170

MARION NUNATAKS, CHARCOT ISLAND, ANTARCTIC PENINSULA

Introduction

Marion Nunataks (75°15' W, 69° 45' S) lie on the northern edge of Charcot Island, a remote ice-covered island to the west of Alexander Island, Antarctic Peninsula, in the eastern Bellingshausen Sea. Marion Nunataks form a 12km chain of rock outcrops on the mid-north coast of the island and stretch from Mount Monique on the western end to Mount Martine on the eastern end. The Area is 176km2 (maximum dimensions are 9.2km north-south and 19.2km east-west) and includes all of the known ice-free land on Charcot Island.

Past visits to the Area have been few, rarely more than a few days in duration and focussed initially on geological research. However, during visits between 1997 and 2000, British Antarctic Survey scientists discovered a rich biological site, located on the nunatak at 69°44'55" S, 75°15'00" W.

The nunatak has several unique characteristics including two lichens species that have not been recorded elsewhere in Antarctica, mosses that are rarely found at such southerly latitudes and, perhaps most significantly off all, a complete lack of predatory arthropods and Collembola which are common at all other equivalent sites within the biogeographical zone. The nunataks are extremely vulnerable to introduction of locally and globally non-indigenous species that could be carried unintentionally to the site by visitors.

The Area fits into the wider context of the Antarctic Protected Area system by protecting the unique species assemblage found on Marion Nunataks and being the first to protect a substantial area of ground that is representative of the permanent ice-cap and nunataks that exist commonly in the southern Antarctic Peninsula. The Area is therefore designated as an Antarctic Specially Protected Area to protect its outstanding environmental values and to facilitate ongoing and planned scientific research.

1. Description of values to be protected

The outstanding environmental values of the Area are based on the following unique species assemblages found in the terrestrial environment:

The terrestrial fauna is unique for the maritime Antarctic in that it appears to contain neither predatory arthropods nor Collembola (springtails), which are otherwise ubiquitous and important members of the terrestrial fauna of the zone. As such, the site provides unique opportunities for the scientific study of terrestrial biological communities from the maritime Antarctic where key ecological components are absent.

The Marion Nunataks flora includes an exceptional development of three mosses that are encountered only rarely at latitudes south of 65 °S (*Brachythecium austrosalebrosum*, *Dicranoweisia crispula* and *Polytrichium piliferum*).

The Area includes two lichen species that are previously unrecorded from Antarctica (*Psilolechia lucida* and *Umbilicaria* aff. *thamnodes*) and represents the furthest south known occurrence for several lichen species (including *Frutidella caesioatra*, *Massalongia* spp., *Ochrolechia frigida*, *Usnea aurantiaco-atra* and *Usnea trachycarpa*).

2. Aims and objectives

The aims and objectives of this Management Plan are to:

- Permit only research of a compelling scientific nature, which cannot be served elsewhere, particularly relating to the simple ecosystems and isolated terrestrial communities of the maritime Antarctic.
- Minimise the risk of introduction of locally non-native soils, plants, animals and microorganisms into the Area and avoid changes to the structure and composition of the terrestrial biota.
- Avoid degradation of the values of the Area by preventing unnecessary human disturbance and sampling in the Area.

3. Management activities

Management activities that involve visits to the Area and erection of permanent structures may themselves significantly increase the risk of irreversible human impact, through introductions of locally non-native species. The emphasis for management of the site should be to avoid (1) unnecessary visits to the Area and (2) erection of permanent structures such as location notice boards and signs. The following management activities are to be undertaken to protect the values of the Area:

- Due to the sensitive nature of the Area and the severity of the consequences should non-native species be introduced, management visits shall be kept to an absolute minimum.
- Field parties shall be fully briefed by the national authority on the values that are to be protected and the precautions and mitigation measures detailed in this Management Plan.
- National Antarctic Programmes operating in the region are encouraged to consult together with a view to minimising human impact.

4. Period of designation

Designation is for an indefinite period of time.

5. Maps

- Map 1. Charcot Island in relation to Alexander Island and the Antarctic Peninsula. Map specifications: Projection: WGS84 Antarctic Polar Stereographic. Standard parallel: 71 °S. Central meridian 55 °W.
- Map 2. Charcot Island including the Marion Nunataks Antarctic Specially Protected Area boundary. Map specifications: Projection: Universal Transverse Mercator UTM Zone 18 S. Central meridian 75 °W. The map was produced from a Landsat image (reference number: 223109_26012002) from 26 January 2002.
- Map 3. Marion Nunataks with Antarctic Specially Protected Area boundary. The Area comprises the icesheet, nunataks, rocks, sea ice and islands lying within the rectangle. The Area does not include the marine environment below the low water mark. The circle shows the location of the known biological site. The penguin symbol shows the approximate location of the Adelie penguin colony. Map specifications: Projection: Universal Transverse

Mercator UTM Zone 18 S. Central meridian 75 °W. The map was produced from a Landsat image (reference number: 223109_26012002) from 26 January 2002.

- Map 4. Environmental domains analysis for Charcot Island (Morgan *et al.*, 2005; Landcare Research NZ) [see section 6(i) *Biogeography and environmental domains analysis*]. Map specifications: Projection: Universal Transverse Mercator UTM Zone 18 S. Central meridian 75 °W.

6. Description of the Area

6(i) Geographical coordinates, boundary markers and natural features

Charcot Island is roughly circular in shape, approximately 50km across and is separated from north-west Alexander Island (~100km away) by Wilkins Sound and Wilkins Ice shelf (Maps 1 and 2). Charcot Island is ice-covered with the exception of Marion Nunataks (69°45' S, 75°15' W), which form a 12km chain of rock outcrops that overlook the mid-north coast of Charcot Island, and consist predominantly of steep north–facing cliffs (Map 3). Mount Monique lies towards the western end of the Marion Nunataks chain and Mount Martine to the eastern end. The summits of both peaks are between 750 and 1000 metres above sea level.

The Area comprises the icesheet, nunataks, rocks, sea ice and islands [including Cheeseman Island (69°43'24" S, 75°11'00" W)] lying within a rectangle enclosed by the following coordinates (Map 3):

	Latitude	Longitude
1	69°43'00"	75°30'00"
2	69°43'00"	75°00'00"
3	69°48'00"	75°30'00"
4	69°48'00"	75°00'00"

There are no boundary markers delimiting the Area. The maximum dimensions of the Area are 9.2km north-south and 19.2km east-west. The Area does not include the marine environment below the low water mark. The protected land area is 176km^2 and includes all of the ice-free land on Charcot Island (known as of 2008). The Area also includes ice cap that extends at least 4km to the south and east of the nunataks, which is intended to act as a buffer zone to prevent accidental importation of species not native to the Area (see Map 3).

Reports suggest that no landing on Charcot Island has ever been made by sea. The steep ice cliffs on the north coast of Charcot Island, make access from the sea difficult.

Climatic conditions

No climatic data are available, but Charcot Island lies in the track of depressions approaching the Antarctic Peninsula from the west. Satellite imagery indicates that the island is predominantly covered by cloud, and may not become free of winter pack ice until late summer, if at all.

Biogeography and environmental domains analysis

Research by Smith (1984) and Peat *et al.* (2007) describes the recognised biogeographical regions present within the Antarctic Peninsula. Antarctica can be divided into three major biological

provinces: northern maritime, southern maritime and continental. Charcot Island lies within the southern maritime zone (Smith, 1984), approximately 600km north of the major biogeographic discontinuity that separates the Antarctic Peninsula and continental Antarctica known at the Gressitt Line (Chown and Convey, 2007).

According to Morgan *et al*. (2005), almost all of Charcot Island falls within environmental domain C of the environmental domains analysis for the Antarctic continent. Domain C is generally found at the base of the Antarctic Peninsula, and also includes most of Alexander Island and adjacent coastal, islands and low-lying areas connected to the main continent by ice shelf. The high latitude results in lower estimated solar radiation and a shorter period with normal diurnal patterns than more northerly environments. Seasonal temperature ranges are also more pronounced.

A small area of environmental domain B exists over Marion Nunataks. The different classification is due to the increased average slope at the nunataks compared to the surrounding ice sheet.

The only other protected area in domain C is ASPA No 147, Ablation Valley, Ganymede Heights, which is situated on the eastern coast of Alexander Island. ASPA No 147 is atypical of domain C as it encompasses a large biologically rich area of ice-free ground. Marion Nunataks are more representative of domain C with a substantial proportion of the Area consisting of permanent ice cap.

Geology

The rocks of Marion Nunataks are turbiditic sandstones and mudstones, similar in appearance to those found on nearby Alexander Island. However, geochronology and isotopic analyses from detrital minerals (grains that survive erosion, transport and deposition and so preserve information on the source rock) suggest that Charcot Island rocks are different to those on Alexander Island, and possibly the whole of the Antarctic Peninsula (Michael Flowerdew, pers. comm.).

Alexander Island rocks are thought to have formed from sediments eroded off rocks from the Antarctic Peninsula. However, Charcot Island sediments were originally deposited within a deep marine trench that formed as a result of the destruction of the Pacific plate beneath the edge of the ancient continent of Gondwana. The sedimentary rocks were scraped off the Pacific plate as it was destroyed and accreted to the Gondwana continent, causing them to be folded and methamorphosed under high pressure. Charcot Island sedimentary rocks are thought to be Cretaceous (deposited around 120 million years ago), and may have been transported over long distances in a relatively short time interval before becoming juxtaposed to Alexander Island around 107 million years ago.

All geological samples taken from Charcot Island have been sampled from within the Area.

Biology

The known terrestrial biological site (located on the nunatak at 69°44’55" S, 75°15’00" W) extends approximately 200m east-west, by a maximum of 50m north-south and harbours an extensive biota (Convey *et al.*, 2000). This vegetated bluff consists of rock gently sloping to the north-west, which rapidly steepens to broken cliffs which drop to the sea. Water has been observed to be freely available at the site during all summer visits between December 1997 and January 2000.

Biota in the known terrestrial biological site include:

- Bryophytes: 16 mosses (including *Andreaea* spp., *Bartramia patens*, *Bryum pseudotriquetrum*, *Brachythecium austrosalebrosum*, *Ceratodon purpureus*, *Dicranoweisia crispula*, *Grimmia reflexidens*, *Hennediella heimii*, *Hypnum revolutum*, *Pohlia* spp., *Polytrichum piliferum*, *Schistidium antarctici*, *Syntrichia princeps*) and one liverwort (*Cephaloziella varians*). The dominant species are *Andreaea* spp., *Dicranoweisia crispula* and *Polytrichum piliferum*, which are usually only common in the sub-Antarctic. The abundance of *B. austrosalebrosum*

is remarkable as it is a hydric species requiring a continuous supply of water. The mosses generally occur on wet rock slabs irrigated by trickling melt water from late snow patches which has allowed the formation of cushions c. 15 cm deep. (Smith, 1998; Convey *et al*., 2000).

- Foliose alga: *Prasiola crispa* (Smith, 1998; Convey *et al*., 2000).
- Lichens: 34 species, plus two identified to genus level. The dominant lichen species are *Pseudophebe minuscule*, *Umbilicaria decussata*, *Usnea sphacelata* and various crustose taxa (Smith, 1998; Convey *et al*., 2000). Lichen communities occupy much of the dry, windswept stony ground and ridges. Melt channels on sloping rock slabs are lined with large thalli (up to ~15 cm across) of *Umbilicaria antarctica*. The Area includes two lichen species that are previously unrecorded from Antarctica (*Psilolechia lucida* and *Umbilicaria aff. thamnodes*) and represents the furthest south known occurrence for several lichen species (including *Frutidella caesioatra*, *Massalongia* spp., *Ochrolechia frigida*, *Usnea aurantiaco-atra* and *Usnea trachycarpa*). Unusually, the widespread *Usnea antarctica* was not recorded from the site.
- Invertebrates: Seven species of Acari, seven Nematoda and four Tardigrada were present in collections from Marion Nunataks. Uniquely, neither acarine predators nor Collembola were recorded (Convey, 1999; Convey *et al*., 2000).
- Vertebrates: A small colony of 60 Adelie penguins (*Pygoscelis adeliae*) containing many chicks was reported from the small islands just to the north-west of Mount Monique (Henderson, 1976; Croxall and Kirkwood, 1979). If still present, this is the most southerly colony of Adelie penguins on the Antarctic Peninsula. Other than the penguin colony, the Area has little vertebrate influence. South polar skuas (*Catharacta maccormicki*) are observed in the Area and a single nest was found on moss turf. Other birds observed and considered likely to breed in the area were small numbers of Antarctic terns (*Sterna vittata*), snow petrels (*Pagodroma nivea*), Antarctic petrels (*Thalassoica antarctica*) and Wilson's storm petrels (*Oceanites oceanicus* Kühl) (Henderson, 1976; Smith, 1998; Convey *et al*., 2000).

Although all elements of the biota recorded are typical of the maritime Antarctic biogeographical zone (Smith, 1984), community composition differs strikingly in detail from that found at other sites in the biome. The apparent absence of Collembola, recorded at all other known maritime Antarctic sites, contrasts directly with their importance elsewhere. Numbers of other animal species recovered from Marion Nunataks, suggest population densities comparable with those found in many other coastal maritime Antarctic sites and at least an order of magnitude greater than those usually found in Continental Antarctic sites, or on south-east Alexander Island at the southern limit of the maritime Antarctic. The numerical contribution made by springtails to faunas elsewhere in the maritime Antarctic appears to be replaced by several smaller prostigmatid mites (*Nanorchestes nivalis* and *Eupodes minutes*) on Charcot Island. The absence of predatory taxa is also an exceptional element of the Charcot Island arthropod community, particularly given the arthropod population densities.

The terrestrial biological communities on Charcot Island are extremely vulnerable to accidental human-mediated introduction of both native Antarctic and alien biota. Convey *et al*. (2000) write:

> *'As visitors to this island will inevitably arrive from other locations within the [Antarctic] Maritime zone, the potential for accidental transfer in soil or vegetation adhering to boots or clothing, rucksacks, etc. is great. Extreme caution is therefore required to avoid the transfer of native species between isolated populations within the Maritime Antarctic, highlighting an urgent need for strict control measures to be applied to all visitors to the site and others like it to conserve them for the future.'*

Past human activity

The Area is extremely isolated and difficult to access, other than by air, and as a result has been visited by only a small number of people, and these visits have been generally brief. Charcot Island was discovered on 11 January 1910 by Dr Jean Baptiste Charcot of the French Antarctic Expedition. The first landing on the island was made on 21 November 1947 by the Ronne Antarctic Research Expedition (RARE) when parts of the island were photographed from the air (Searle, 1963).

A temporary hut (30 m^2) and airstrip were established by the Chilean Antarctic Expedition and Chilean Air Force (FACH) in November 1982. The camp was situated on ice a few kilometres east of Mount Martine (69°43'S 75°00'W), on what is now the eastern boundary of the Area. The hut was buried by snow during the winter of 1983 and no evidence of the station remains on the surface (Comité Nacional de Investigaciones Antárticas, 1983; Verónica Vallejos, pers. comm.).

British Antarctic Survey (BAS) geologists and cartographers made brief visits to Marion Nunataks in January 1975, 9-13 February 1976 and 17 January 1995. BAS biologists made day trips to the nunatak at 69°44'55" S, 75°15'00" W on 22 December 1997, 20-21 January 1999, 5 February 1999 and 16 January 2000. Reports suggest that there have been less than 10 field party visits to Marion Nunataks since their first visit in 1975. Visits have generally been limited to a few days or hours. Importantly, no further visits have been made to Marion Nunataks Area since the discovery of its unique ecosystems (Convey *et al.*, 2000). As a result, it is probable that the ecosystem still exists in it original pristine state and no introduction of macrobiota has occurred.

6(ii) Restricted zones within the Area

None.

6(iii) Location of structures within the Area

No installations or caches are known to exist in the Area. One cairn was constructed on the highest point (~126m above sea level) of the small nunatak at 69°44'55" S, 75°15'00" W during the 1975-76 United States Geological Survey-British Antarctic Survey Doppler Satellite Programme (Schoonmaker and Gatson, 1976). The 0.6m high cairn marks the site of Station Jon and contains a standard USGS brass Antarctica tablet stamped 'Jon 1975-1976' set loosely in faulted rock. A metal tent pole (2.4 m) was erected in the cairn; however, there was no record of it in visit reports from 1995 onwards (Anonymous, 1977; Morgan, 1995).

6(iv) Location of other ASPAs and ASMAs within close proximity

There are no other protected or managed areas nearby, with the nearest being ASPA No 147, Ablation Valley - Ganymede Heights, which is situated 270km away on the eastern coast of Alexander Island.

7. Permit conditions

Entry into the Area is prohibited except in accordance with a permit issued by an appropriate national authority under Article 3, paragraph 4, and Article 7 of Annex V to the Enviromental Protocol to the Antarctic Treaty.

Conditions for issuing a permit to enter the Area are that:

- it is issued only for a compelling scientific reason, which cannot be served elsewhere
- the activities permitted will not jeopardize the natural ecological system in the Area
- any management activities are in support of the objectives of the Management Plan

- the Permit, or an authorised copy, must be carried within the Antarctic Specially Protected Area
- a report is supplied to the authority or authorities named in the permit, which shall include a section on the environmental state of the Area
- any permit shall be issued for a stated period

7(i) Access to and movement within the Area

No access points are specified, but landings are usually most safely made by aircraft as access from the sea is made difficult due to step ice cliffs around much of the coastline.

Where possible, day visits to the Area are strongly recommended in order to reduce the requirement for camping equipment, and the associated risk of transferring locally non-native species. If scientific or management requirements cannot be met within the time scale of a single day visit, then longer visits requiring camping within the Area are permitted, but only after all other options have been full explored and rejected.

Entry of personnel or equipment arriving directly from other biological field sites to the Area is prohibited. It is a condition of entry into the Area that all visitors and equipment must travel via an Antarctic station or ship where thorough cleaning of clothing and equipment has been performed, as detailed in this Management Plan [section 7(ix)].

To protect the values of the Area and minimise the risk of introduction of locally non-native species, the following restrictions apply within the Area:

(a) Aircraft

Aircraft are only permitted to land in the Area if they have performed the measures as detailed in this Management Plan [section 7(ix)]. Otherwise aircraft must land outside the Area. Fixed and rotory wing aircraft are prohibited from landing within 100m of rock outcrops and associated flora and fauna within the Area.

Aircraft flying near the Adelie penguin colony on the small islands just to the north-west of Mount Monique (69°45’30" S, 75°25’00" W) must comply with the guidelines detailed in ‘Guidelines for the operation of aircraft near concentrations of birds in Antarctica’ (Antarctic Treaty Consultative Meeting, 2004).

(b) Land vehicles and sledges

Land vehicles shall not be taken into the Area unless essential for scientific, management or safety reasons.

Land vehicles and sledges are only permitted within the Area if they are compliant with the measures as detailed in this Management Plan [section 7(ix)].

Once inside the Area, skidoos, sledges and other land vehicles are prohibited within 100m of rock outcrops and associated flora and fauna. The remaining 100m of the approach to rock outcrops must be made on foot.

(c) Human movement

Pedestrian traffic shall be keep to an absolute minimum necessary to be consistent with the objectives of any permitted activities.

No pedestrian routes are designated but persons on foot should at all times avoid disturbance or damage to vegetation and periglacial features.

Visitors shall avoid walking on areas of visible vegetation or moist soil.

Strict personal quarantine precautions shall be taken as described in section 7(ix) of this Management Plan.

7(ii) Activities that are, or may be, conducted within the Area, including restrictions on time and place

Compelling scientific research that cannot be undertaken elsewhere and which will not jeopardize the ecosystem of the Area.

Essential management activities, including monitoring.

7(iii) Installation, modification or removal of structures

No structures may be erected in the Area, nor equipment installed, except for essential scientific or management activities, as specified in the permit. If equipment is installed every effort must be taken to ensure the equipment is sterile and free of imported seeds, spores, propagules, soil, microorganisms and invertebrates [see section 7(ix)]. Existing structures must not be removed.

7(iv) Location of field camps

Camping within the Area is only permitted if scientific and management objectives cannot be achieved during a day trip to the Area. Camping may also occur within the Area during an emergency.

Unless unavoidable for safety reason, tents should be erected on snow or ice, at least 500m from the nearest rock outcrops.

Field camp equipment must be cleaned and transported as described in section 7(ix) of this Management Plan.

7(v) Restrictions on materials and organisms that may be brought into the Area

It is essential that activities conducted by visiting scientists or managers do not introduce new species into the Area. No living animals, plant material or microorganisms shall be deliberately introduced into the Area. All necessary precautions shall be taken to prevent accidental introductions. All sampling equipment brought into the Area shall have been thoroughly cleaned [see section 7(ix)].

No poultry products, including food products containing uncooked dried eggs, shall be taken into the Area.

No herbicides or pesticides shall be brought into the Area. Any other chemicals, which may be introduced for a compelling scientific purpose specified in the Permit, shall be removed from the Area at or before the conclusion of the activity for which the Permit was granted.

Fuel, food and other materials are not to be deposited in the Area, unless required for essential purposes connected with the activity for which the Permit has been granted. All such materials introduced are to be removed when no longer required. Fuel, food and other materials must only be deposited on snow or ice that is at least 500m from the nearest rock outcrop. Permanent depots are not permitted.

7(vi) Taking or harmful interference with native flora and fauna

Any removal or disturbance of soil, vegetation or invertebrates is prohibited, except in accordance with a permit issued under Article 3 of Annex II to the Environmental Protocol by the appropriate

national authority. Any sampling is to be kept to an absolute minimum required for scientific or management purposes, and carried out using techniques which minimise disturbance to surrounding soil, ice structures and biota. Any sampling of experimental sites should be photographed and the location recorded in detail and reported to the permitting authority. When animal taking or harmful interference is involved this should, as a minimum standard, be in accordance with the 'SCAR code of conduct for the use of animals for scientific purposes in Antarctica'.

7(vii) Collection and removal of anything not brought into the Area by the permit holder

Material may be collected or removed from the Area only in accordance with a permit issued under Article 3 of Annex II by the appropriate national authority. Debris of man-made origin likely to compromise the values of the Area, which was not brought into the Area by the permit holder or otherwise authorised, may be removed from any part of the Area, unless the impact of removal is likely to be greater than leaving the material *in situ*. If this is the case, the appropriate authority should be notified.

7(viii) Disposal of waste

All wastes shall be removed from the Area, including all human waste.

7(ix) Measures that may be necessary to ensure that the aims and objectives of the Management Plan continue to be met

To help protect the ecological and scientific values derived from the isolation and low level of human impact at the Areas, visitors shall take special precautions against the introduction of non-native species. Of particular concern are animal or vegetation introductions sourced from:

- soils from any other Antarctic sites, including those near the stations
- soils from regions outside Antarctica

It is a condition of entry to the Area that visitors shall minimize the risk of introductions in accordance with the following measures:

(a) Aircraft

The interior and exterior of aircraft shall have been carefully inspected and cleaned as near as possible to the time of departure of the aircraft from the originating Antarctic station or ship. It is recommended that this include thorough sweeping and vacuuming of the inside of the aircraft and steam-cleaning or brushing of the exterior of the aircraft.

Any aircraft that has landed at other rock airstrips or near biologically rich sites since being cleaned at the Antarctic station or ship is not permitted to enter the Area.

Fixed-wing aircraft that departed from a gravel runway must have landed, or trailed their skis, on clean snow outside the Area in an attempt to dislodge any soil from the skis, before landing within the Area.

(b) Land vehicles and sledges

Before land vehicles and sledges enter the Area, all mud, soil, vegetation and excessive dirt and grease must have been removed. Ideally, this should have been completed on the originating Antarctic station or ship before transfer of the vehicles into the field.

Land vehicles shall not enter the Area if after cleaning they have been driven over areas of rock or soil outside the Area.

(c) Field camp equipment

All camping equipment, including emergency camping equipment, shall have been thoroughly cleaned (i.e. free of soil and propagules and, if practicable, sealed in plastic bags or sheeting) before being taken into the Area. This includes emergency camping equipment carried aboard any aircraft landing in the Area.

(d) Sampling equipment, scientific apparatus and field-site markers

To the greatest extent possible, all sampling equipment, scientific apparatus and markers brought into the Area shall have been sterilized, and maintained in a sterile condition, before being used within the Area. Sterilization should be by an accepted method, including UV radiation, autoclaving or by surface sterilisation using 70% ethanol or a commercially available biocide (e.g. Virkon®).

(e) General field equipment

General equipment includes harnesses, crampons, climbing equipment, ice axes, walking poles, ski equipment, temporary route markers, pulks, sledges, camera and video equipment, rucksacks, sledge boxes and all other personal equipment.

All equipment used inside the Area should be free of biological propagules such as seeds, eggs, insects, fragments of vegetation and soil. To the maximum extent practicable, all equipment used, or brought into the Area, shall have been thoroughly cleaned and sterilized at the originating Antarctic station or ship. Equipment shall have been maintained in this condition before entering the Area, preferably by sealing in plastic bags or other clean containers.

(f) Outer clothing

Outer clothing includes hats, gloves, fleeces or jumpers, jackets, fabric or fleece trousers, waterproof trousers or salopettes, socks, boots and any other clothing likely to be worn as a surface layer. Outer clothing worn inside the Area should be free of biological propagules such as seeds, eggs, insects, fragments of vegetation and soil. To the maximum extent practicable, footwear and outer clothing used, or brought into the Area, shall have been thoroughly laundered and cleaned since previous use. Particular attention should be given to removing seeds and propagules from Velcro®. New clothing, taken straight out of the manufacturer's packaging just before entering the Area, need not undergo cleaning.

Further procedures for ensuring non-native species are not transferred into the Area on boots and clothing depend upon whether the visit is via (i) a direct aircraft landing in the Area, or (ii) overland movement into the Area from outside its boundaries.

i. Direct aircraft landing in the Area

Sterile protective over-clothing shall be worn. The protective clothing shall be put on immediately prior to leaving the aircraft. Spare boots, previously cleaned using a biocide then sealed in plastic bags, should be unwrapped and put on just before entering the Area.

ii. Overland movement into the Area from outside its boundaries

Sterile protective over-clothing is not recommended as, once within the Area, significant amounts of travel over crevassed ground may be required and use of sterile protective over-clothing may interfere with safety equipment such as ropes and harnesses.

For overland movement into the Area, alternative measures must be used. Each visitor is required to bring at least two sets of outer clothing. The first set should be worn for the journey to the Area

boundary. The second set of outer clothing, which has previously be cleaned and sealed in plastic, should only be worn inside the Area. Immediately before entering the Area, visitors should change into their clean set of outer clothing. Spare boots, previously cleaned using a biocide then sealed in plastic bags, should be unwrapped and put on just before entering the Area. The removed unclean outer clothing should be stored in sealed, labelled plastic bags, preferably outside the Area.

On leaving the Area by overland travel, the clothing worn in the Area should be (1) removed and stored in a clean, labelled plastic bag until needed for any further trips into the Area, or (2) returned to the originating Antarctic station or ship for cleaning.

7(x) Requirements for reports

Parties shall require the principal holder of each permit issued by it to submit to the appropriate authority a report describing the activities undertaken within six months of the visit. Such reports should include, as appropriate, the information identified in the Visit Report Form suggested by SCAR. Under item 10 of this form (mode of transport to/from the area) particular note should be made of locations where aircraft took off and landed. Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary description of activities conducted by persons subject to their jurisdiction, in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the Management Plan and in organising the scientific use of the Area.

8. Bibliography

Anonymous. (1977). British Antarctic Survey Archives Service, Arc. Ref. ES2/EW360.1/SR17-18/7,8.

Antarctic Treaty Consultative Meeting. (2004). Guidelines for the operation of aircraft near concentrations of birds in Antarctica. ATCM Resolution 2 (2004).

Comité Nacional de Investigaciones Antárticas. (1983). Informe de las actividades Antárticas de Chile al SCAR. Santiago, Instituto Antártico Chileno.

Chown, S. L., and Convey, P. (2007). Spatial and temporal variability across life's hierarchies in the terrestrial Antarctic. Philosophical Transactions of the Royal Society B - Biological Sciences 362 (1488): 2307-2331.

Convey, P. (1999). Terrestrial invertebrate ecology. Unpublished British Antarctic Survey internal report ref. R/1998/NT5.

Convey, P., Smith, R. I. L., Peat, H. J. and Pugh, P. J. A. (2000). The terrestrial biota of Charcot Island, eastern Bellingshausen Sea, Antarctica: an example of extreme isolation. Antarctic Science 12: 406-413.

Croxall, J. P., and Kirkwood, E. D. (1979). The distribution of penguins on the Antarctic Peninsula and islands of the Scotia Sea. British Antarctic Survey, Cambridge.

Henderson, I. (1976). Summer log of travel and work of sledge kilo in northern Alexander Island and Charcot Island, 1975/1976. Unpublished British Antarctic Survey internal report ref. T/1975/K11.

Morgan, F., Leathwick, J., Price, R., and Keys, H. (2005). Environmental domains analysis for the Antarctic continent. Landcare Research Contract Report LC0405/106. Landcare Research New Zealand Ltd.

Morgan, T. (1995). Sledge echo travel report, 1994/5 season – geology in central Alexander Island. Unpublished British Antarctic Survey internal report ref. R/1994/K7.

Peat, H. J., Clarke, A., and Convey, P. (2007). Diversity and biogeography of the Antarctic flora. Journal of Biogeography 34: 132-146.

Schoonmaker, J. W., Gatson, K. W. (1976). U. S. Geological Survey/British Antarctic Survey Landsat Georeceiver Project. British Antarctic Survey Archives Service, Arc. Ref. ES2/EW360/56.

Searle, D. J. H. (1963). The evolution of the map of Alexander and Charcot Islands, Antarctica. The Geographical Journal 129: 156-166.

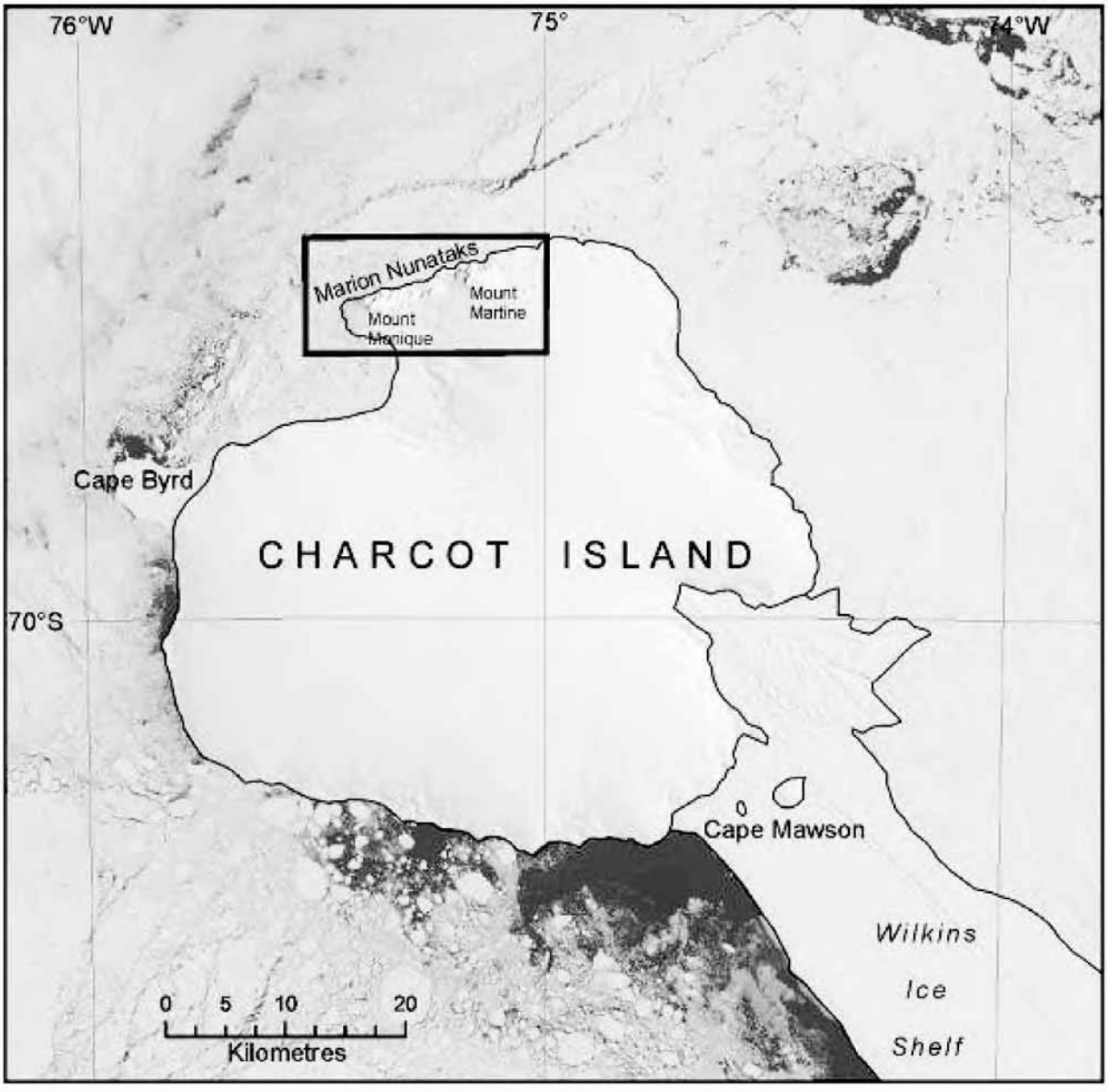
Smith, R. I. L. (1984). Terrestrial plant biology of the sub-Antarctic and Antarctic. In: Antarctic Ecolgy, Vol. 1. Editor: R. M. Laws. London, Academic Press.

Smith, R. I. L. (1998). Field report: sledge delta, November 1997 - January 1998. Unpublished British Antarctic Survey internal report ref. R/1997/NT3.

Map 1. Charcot Island in relation to Alexander Island and the Antarctic Peninsula. Map specifications: Projection: WGS84 Antarctic Polar Stereographic. Standard parallel: 71 °S. Central meridian 55 °W.

Map 2. Charcot Island including the Marion Nunataks Antarctic Specially Protected Area boundary.

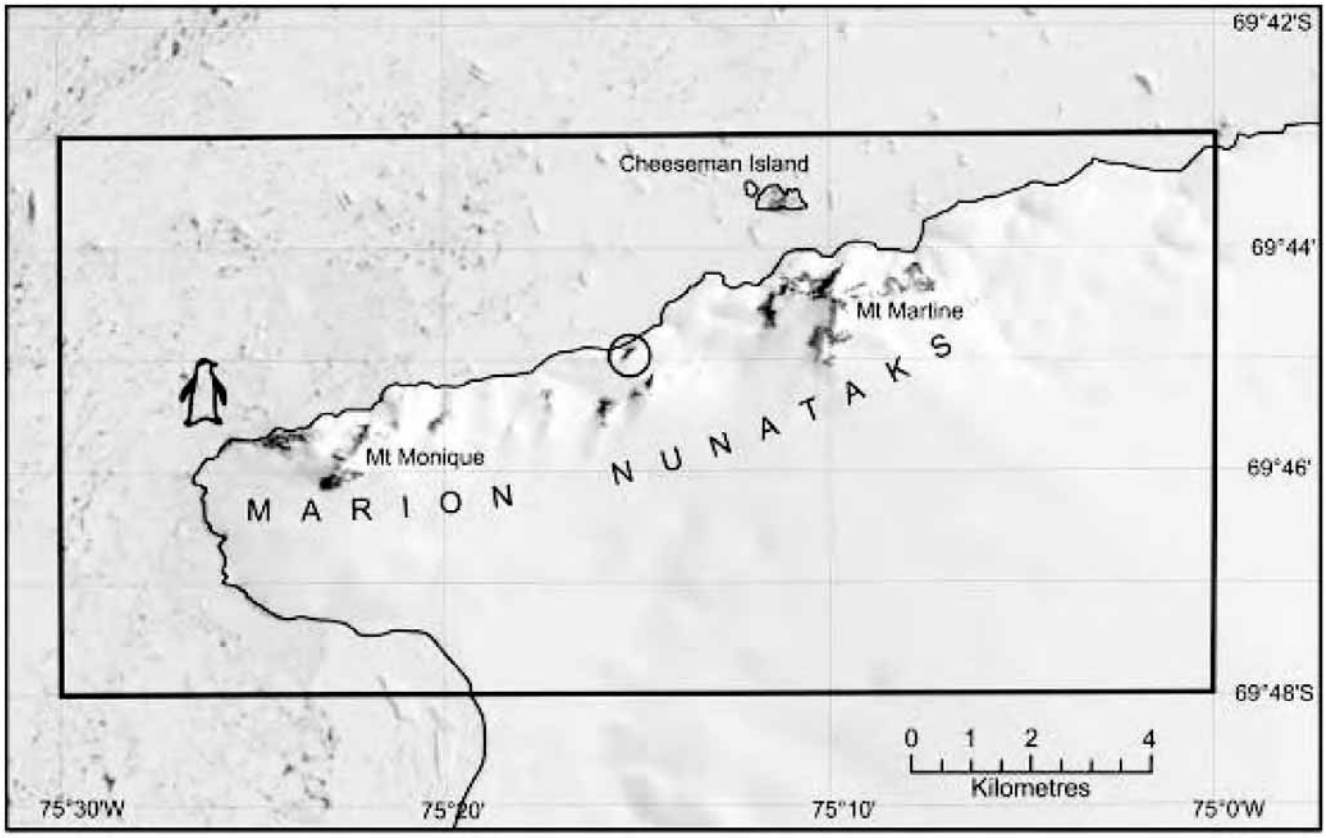
Map specifications: Projection: Universal Transverse Mercator UTM Zone 18 S. Central meridian 75 °W. The map was produced from a Landsat image (reference number: 223109_26012002) from 26 January 2002.



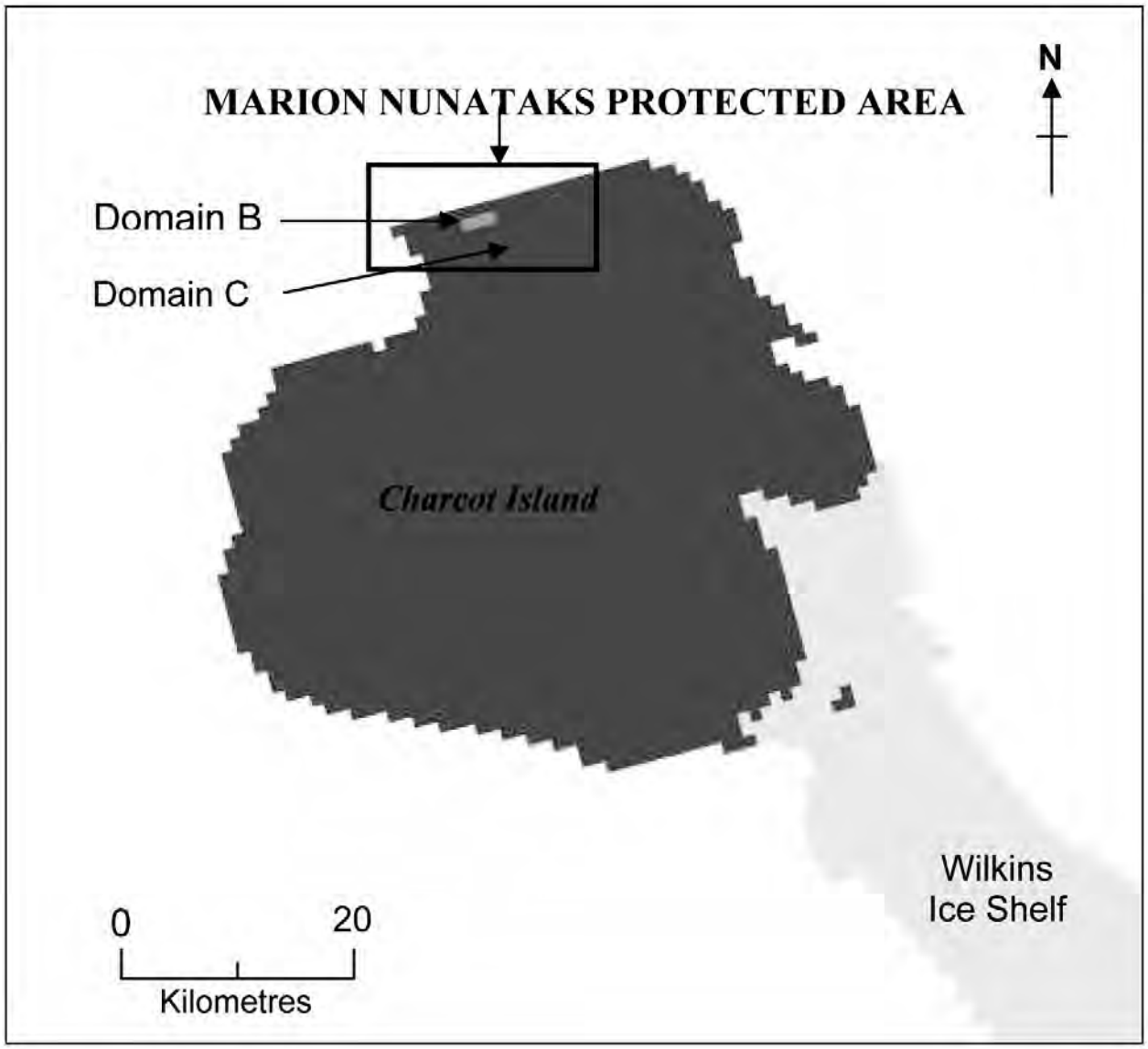
Map 3. Marion Nunataks with Antarctic Specially Protected Area boundary. The Area comprises the icesheet, nunataks, rocks, sea ice and islands lying within the rectangle. The Area does not include the marine environment below the low water mark.

The circle shows the location of the known biological site. The penguin symbol shows the approximate location of the Adelie penguin colony.

Map specifications: Projection: Universal Transverse Mercator UTM Zone 18 S. Central meridian 75 °W. The map was produced from a Landsat image (reference number: 223109_26012002) from 26 January 2002.



Map 4. Environmental domains analysis for Charcot Island (Morgan *et al.*, 2005; Landcare Research NZ) [see section 6(i) *Biogeography and environmental domains analysis*].
Map specifications: Projection: Universal Transverse Mercator UTM Zone 18 S. Central meridian 75 °W.



Measure 5 (2008)

Antarctic Specially Protected Area No 118 (Summit of Mount Melbourne, Victoria Land): Revised Management Plan

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas ("ASPA") and approval of Management Plans for those Areas;

Recalling

- Recommendation XIV-5 (1987), which designated Summit of Mount Melbourne, North Victoria Land as Site of Special Scientific Interest ("SSSI") No 24 and annexed a Management Plan for the Site;
- Resolution 3 (1996), which extended the expiry date of SSSI 24 from 31 December 1997 to 31 December 2000;
- Measure 2 (2000), which extended the expiry date of SSSI 24 from 31 December 2000 to 31 December 2005;
- Decision 1 (2002), which renamed and renumbered SSSI 24 as Antarctic Specially Protected Area No 118;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 118;

Desiring to replace the existing Management Plan for ASPA 118 with the revised Management Plan;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) the revised Management Plan for Antarctic Specially Protected Area No 118: Summit of Mount Melbourne, Victoria Land which is annexed to this Measure, be approved; and

2) the Management Plan for ASPA 118 annexed to Recommendation XIV-5 (1987) shall cease to be effective.

Management Plan for Antarctic Specially Protected Area No 118

SUMMIT OF MOUNT MELBOURNE, VICTORIA LAND

1. Description of values to be protected

An area of 6km^2 on the summit of Mount Melbourne was originally designated in Recommendations XVI-5 (1987, SSSI No 24, Summit of Mount Melbourne) and XVI-8 (1991 SPA No 22, Cryptogam Ridge, Mount Melbourne) after proposals by New Zealand and Italy on the grounds that these areas contain geothermal soils that support a unique and diverse biological community. The warmest areas of ground created by fumaroles support patches of moss, liverwort and algae along with one species of invertebrate protozoan. ASPA No 118a (SPA No 22) was originally enclosed within ASPA No 118b (SSSI No 24) in order to provide more stringent access conditions to this part of the Mt Melbourne summit area. ASPA 118a and 118b have now been merged in the current plan, and Prohibited and Restricted zones provide for more stringent access conditions within the former SPA. The outer boundaries of the Area follow the original SSSI No 24 designation.

The biotic communities of the closest documented fumarolic ground, 400km to the south on Tramway Ridge, Mt Erebus and on Mt Rittman, in the Mountaineer Range over 180km to the north, are considered significantly different to that on Mt Melbourne. Mount Melbourne has the only known leafy example of the moss *Campylopus pyriformis* on the Antarctic continent (the moss is present on Mt Erebus only in the protonema stage). A new species of moss *Pohlia nutans* (very genetically similar to another species found on Mt Rittman) was discovered in 2002 in small mosses in the fumeroles on the NW slope of Mt Melbourne. The algae *Stigonema ocellatum* and *Chlorella* cf. *reniformis* are the only Antarctic records. Several other algal species are not recorded elsewhere in Antarctica, apart from Mt Erebus. An entirely new species of thermophilic bacteria, *Bacillus thermoantarcticus*, has also been discovered on the summit (Manca *et al* 1996; Lama *et al* 1996, 2001; Nicolaus *et al* 2000, 2001, 2002), and some enzymes have been isolated from these microorganisms (Lama *et al* 2001, 2004, 2005; Nicolaus *et al* 2002, 2004). Biochemical and microbiological studies have also been carried out on hot substrata in the area (Bargagli *et al* 2004; Pepi *et al* 2005).

The total cover of vegetation within the Area is hard to assess due to largely permanent snow cover, but is estimated at 100-200 m^2. Despite this relatively small area of cover, the uniqueness and fragility of the biological communities and their physical environment are such that the Area is of high scientific and conservation value and vulnerable to human disturbance. The dangers of introducing new organisms and disturbance by trampling and sampling are great and justify this site being given long-term special protection. Extensive ice-free geothermal areas at high altitude, supporting a unique community of flora and microbiota and accumulations of organic matter, make this Area of exceptional scientific interest.

2. Aims and objectives

Management at Mount Melbourne aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance;

- allow scientific research on the ecosystem in the Area, in particular on the plants, liverworts, algae and invertebrates, while ensuring protection from oversampling;
- allow other scientific research provided it is for compelling scientific reasons which cannot be served elsewhere;
- minimise the possibility of introduction of alien soils, plants, animals and microbes into the Area;
- preserve a part of the natural ecosystem of the Area, which is declared a Prohibited Zone, as a reference site for the purpose of future comparative studies;
- allow visits for the purposes of installation and maintenance of essential communications equipment that does not compromise the values of the Area;
- allow visits for management purposes in support of the aims of the Management Plan.

3. Management activities

The following management activities are to be undertaken to protect the values of the Area:

- Information showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently, and a copy of this Management Plan shall be kept available, in all of the research hut facilities located within 25km of the Area, and in the radio repeater equipment box on the summit of Mt Melbourne.
- Markers, signs or structures erected within the area for scientific or management purposes shall be secured and maintained in a good condition.
- Visits shall be made as necessary to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate.
- National Antarctic Programmes operating in the region are encouraged to consult together with a view to ensuring these steps are carried out.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

- Map A: Mount Melbourne, location map. Map specifications: Projection: Lambert conformal conic; Standard parallels: 1st 72°40’0.000"S; 2nd 75°20’0.000"S; Central Meridain: 165°0’0.000"E; Latitude of Origin 74°0’49.2"S; Scale approx. 1:350,000. Spheroid: WGS84.
- Map B: Mount Melbourne, site map. Map specifications: Projection: Lambert conformal conic; Standard parallels: 1st 72°40’0.000"S; 2nd 75°20’0.000"S; Central Meridain: 165°0’0.000"E; Latitude of Origin 74°0’49.2"S; Scale approx. 1:16,000. Spheroid: WGS84. Photography USGS/DoSLI (SN7851) 22 November 1993.

6. Description of the Area

6(i) Geographical coordinates, boundary markers and natural features

Mount Melbourne (2733m, 74º21'S 164º42'E) in northern Victoria Land, is situated between Wood Bay and Terra Nova Bay, on the western side of the Ross Sea, and Campbell Glacier, about 10km to the west (see Map A). The Area encompasses all terrain above the 2200m contour surrounding the main crater of Mt Melbourne. Boundary markers are not installed at points on the 2200m contour, due to access being predominantly via helicopter to the summit of the mountain, making assessment of altitude straightforward.

Mount Melbourne is part of the McMurdo volcanics, which are a line of dormant and extinct volcanoes running along the coast of Victoria Land. The Mt Melbourne area is thought to be late Quaternary in age and the most recent eruption may have been as little as 150 years ago. The volcanic rocks have been detailed as trachyte to trachyandesite on the mountain itself, with basalt at its base.

Mount Melbourne is an almost perfect low-angle volcanic cone with extensive areas of hot ground, fumaroles, and ice towers prominent around the summit crater and on some upper parts of the mountain. The summit caldera is about 1km in diameter and forms the névé for a westward flowing glacier. Several smaller basaltic cones and mounds occur near the base and on the flanks of the mountain. The summit also contains the most extensive areas of warm ground, marked by snow-free warm or steaming ground, fumaroles and ice towers or pinnacles. Surface soil (0-2cm depth) temperatures of up to 42ºC, areas of cooler ground where activity is discontinuous, and zones of geothermal activity are marked by ice and snow hummocks up to a metre in height.

There are three main areas exhibiting thermal activity (see Map B); two situated on the edge of the caldera, and a third about 250m lower on the northern slopes. However, areas of surface activity extend at least as low as 2400m on the north-west side of the mountain. These geothermal areas support a unique biological assemblage of species otherwise restricted to low altitudes. The species are not of a local provenance and must have been dispersed over long distances to reach the Area. The total cover of vegetation at the site is small, perhaps only 100-200 m^2 with plant life only possible through the occurrence of small water droplets formed by the condensation of steam keeping the soils moist. Known sites of vegetation are marked as A-E on Map B. Site D is known to have been disturbed and possibly contaminated by human activity.

Mount Melbourne exhibits high biodiversity relative to other geothermal sites in the Antarctic, both maritime and high altitude. Biota includes algal crusts and felts (11 species) that coat small stones, gravel and finer substrata, bryophytes (one species of moss and one of liverwort), a protozoan, and a range of microflora. A lichen association has been observed as a component of black crusts over small areas of warm soil. The warmest areas of ground support yellowish-green patches of the moss *Campylopus pyriformis,* along with the liverwort *Cephaloziella varians* and brownish crusts of algae. The unusual occurrence of shallow peat is evidence of bryophyte growth over at least several decades. The amoeboid protozoan *Corythion dubium* was observed as empty shells in both mineral substrates and amongst bryophytes. The species is not common in continental Antarctica, and only found at one other site in Victoria Land.

6(ii) Prohibited, restricted and managed zones within the Area

Prohibited and Restricted Zones - Cryptogam Ridge

An area on the southern rim of the main summit crater (known as Cryptogam Ridge) is designated as a Prohibited Zone and a Restricted Zone (see Map B) in order to protect the most extensive stand of vegetation and preserve part of the Area as a reference site for future comparative study. The

remainder of the Area, similar in biology, features, and character, is available for research programmes and controlled sample collection.

The zones consist of areas of snow-covered cool ground, warm snow-free ground, and ice-hummocks covering steam emissions and extend 40m in all directions from the ridge line. Most of Cryptogam Ridge is incorporated within the Restricted Zone, which may be accessed by permit for essential scientific reasons which cannot be met elsewhere in the Area. The western most 100m of the Cryptogam Ridge is a Prohibited Zone, to which access is strictly prohibited until such time it is agreed by management plan review that access should be allowed.

Managed Zones

Two Managed zones (see Map B) have been established within the Area where survey marks used in deformation studies need to be regularly accessed, and a radio repeater is installed and maintained each season. The zones extend 15m around the survey marks and are located as follows:

Summit of Mt Melbourne, containing survey mark No. 600 and radio repeater site; and

south-east of Cryptogam Ridge, containing survey mark No. 601.

6(iii) Structures within and near the Area

A total of six survey marks, consisting of a metal tube set into a concrete base, are located around the summit area (see Map B) and are used in an ongoing Italian scientific programme examining the deformation study on the mountain. A radio repeater to support communications for the Italian Antarctic programme, consisting of an equipment box and aerial, is also installed annually on cool, ice-free ground near the summit.

6(iv) Location of other protected areas within close proximity of the Area

The nearest protected areas are: Edmonson Point ASPA No 165, approximately 13km east of Mt Melbourne; Cape Hallett, Victoria Land ASPA No 106 (SPA No 7), approximately 300km to the north; and, Botany Bay, Cape Geology, Victoria Land ASPA No 164 (SSSI No 37) approximately 300km to the south.

7. Permit conditions

Entry into the Area is prohibited except in accordance with a specific Permit issued by the appropriate national authoritie under Article 3 of Annex II. Permits may be issued for the following purposes:

- For activities outside the Restricted and Managed zones, permits may be issued only for scientific study of the ecosystem, for a compelling scientific or management purpose that cannot be served elsewhere, or for essential management purposes consistent with the plan objectives such as inspection, monitoring or review.
- Permits to access to the Restricted Zone may only be issued for essential scientific or management purposes that cannot be met elsewhere in the Area.
- Permits to enter only the Managed Zones may be issued for essential operational or scientific purposes consistent with the objectives of the Management Plan, such as to access survey marks and radio repeater sites.

Conditions for issuing a Permit to enter the Area are that:

- the actions permitted are not likely to jeopardise the natural ecological system or scientific values of the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with all requirements of the Management Plan;
- a Permit, or a copy, shall be carried within the Area, including a copy of all relevant maps from the Management Plan;
- a visit report shall be supplied to the authority named on the permit; and
- any Permit shall be issued for a stated period.

7(i) Access to and movement within the Area

The following restrictions apply within the Area:

- land vehicles are prohibited within the Area;
- helicopters may only land at the established survey marks within the two Managed Zones (see Map B), unless specifically allowed by Permit for purposes consistent with the aims of this plan;
- use of helicopter smoke grenades within the Area is prohibited;
- any overflight of the Prohibited or Restricted Zone must be more than 50m above the ground level; and
- hovering over any part of the Area is not permitted lower than 50m, and ice-free areas should be avoided unless absolutely necessary for access to the Area.

Visitors must avoid walking on areas of visible vegetation or moist soil, both on ice-free ground and among ice hummocks, and should not interfere with any ice structures unless specified in the permit. Pedestrian traffic should be kept to the absolute minimum necessary consistent with the objectives of any permitted activities and every reasonable effort should be made to minimise effects.

7(ii) Activities that are or may be conducted in the Area, including restrictions on time or place

As outlined above, permitted activities within the Area may include:

- scientific research that will not jeopardise the ecosystem of the Area and cannot be conducted elsewhere;
- essential management activities, including monitoring and inspection; and
- essential operational activities, such as access to survey marks and radio repeater sites.

7(iii) Installation, modification or removal of structures

No structures are to be erected within the Area except as specified in a Permit. All scientific equipment installed in the Area must be approved by Permit and clearly identified by country, name of the principal investigator, and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area. Removal of specific equipment for which the Permit has expired shall be a condition of the Permit.

7(iv) Location of field camps

Camping is permitted only in the ice-filled summit of the caldera or outside the Area (i.e. below the 2200m contour).

7(v) Restrictions on materials and organisms which can be brought into the Area

To avoid compromising the values of the ecosystem for which the Area is protected, the following restrictions apply to all activities in the Area:

- no living animals, plant material or microorganisms shall be deliberately introduced into the Area and precautions shall be taken against accidental introductions;
- chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the Permit, shall be removed from the Area at or before the conclusion of the activity for which the Permit was granted;
- fuel is not to be stored in the Area, unless required for essential purposes connected with the activity for which the Permit has been granted and shall not be stored on ice free areas; and
- all materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimised.

7(vi) Taking or harmful interference with native flora or fauna

Any removal or disturbance of the vegetation or invertebrates is prohibited, except in accordance with a Permit issued under Article 3 of Annex II by the appropriate national authority specifically for that purpose. Any sampling is to be kept to the absolute minimum required for scientific or management purposes, and carried out using techniques which minimise disturbance to the surrounding soil, ice structures and biota. Any sampling or experimental sites should be photographed and the location recorded in detail and reported to the Permitting authority.

7(vii) Collection or removal of anything not brought into the Area by the Permit holder

Material may be collected or removed from the Area only in accordance with a Permit issued under Article 3 of Annex II by the appropriate national authority specifically for that purpose and should be limited to the minimum necessary to meet scientific or management needs. Sampling is to be carried out using techniques which minimise disturbance to the surrounding soil and biota. Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the Permit holder or otherwise authorised, may be removed from any part of the Area, including the Restricted Zone, unless the impact of removal is likely to be greater than leaving the material *in situ*: if this is the case the appropriate authority should be notified.

7(viii) Disposal of waste

All wastes, including all human wastes, shall be removed from the Area.

7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

Permits may be granted to enter the Area to carry out biological monitoring and site inspection activities, which may involve the collection of small samples for analysis, or for protective measures and other essential management activities.

Any specific sites of long-term monitoring shall be appropriately marked (as in 7iii above).

To help maintain the ecological and scientific values derived from the isolation and relatively low level of human impact at the Area, visitors shall take special precautions against introductions, especially when visiting several thermal regions in a season. Of particular concern are microbial or vegetation introductions sourced from:

- thermal areas, both Antarctic and non-Antarctic;
- soils at any other Antarctic sites, including those near stations;
- soils from regions outside Antarctica.

To this end, visitors shall take the following measures to minimise the risk of introductions:

- Any sampling equipment or markers brought into the Area shall be sterilised and maintained in a sterile condition before being used within the Area. To the maximum extent practicable, footwear and other equipment used or brought into the Area (including backpacks or carry-bags) shall be thoroughly cleaned or sterilised and maintained in this condition before entering the Area;
- Sterilisation should be by an acceptable method, such as by UV light, autoclave, or by washing surfaces in 70 percent ethanol solution in water.
- Sterile protective overclothing shall be worn. The overclothing shall be suitable for working at temperatures of -20°C or below and comprise at a minimum sterile overalls to cover arms, legs and body and sterile gloves suitable for placing over the top of cold-weather gloves. Disposable sterile/protective foot coverings are not suitable for the scoria surface and should not be used. Instead, all footwear should be thoroughly brushed to remove soil particles and wipes with 70 percent ethanol.
- Both the interior and exterior of helicopters should be cleaned as far as practicable before landing within Area.

7(x) Requirements for reports

Parties shall ensure that the principal holder for each Permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report Form suggested by SCAR. Under item 10 of this form (mode of transport to/from the area), particular note should be made of where any helicopter used took off from and which landing site was used.

Parties shall maintain a record of such activities and, in the Annual Exchange of Information, shall provide summary descriptions of activities conducted by persons subject to their jurisdiction, in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such reports in a publicly accessible archive to maintain a record of usage, to be used both for review of the Management Plan and in organising the scientific use of the site.

8. Bibliography

Bargagli R., Skotnicki M.L., Marri L., Pepi M., Mackenzie A., Agnorelli C., 2004. New record of moss and thermophilic bacteria species and physico-chemical properties of geothermal soils on the north-west slope of Mt. Melbourne (Antarctica). Polar Biol. 27: (2004) 423-431.

Broady, Paul A, Given, David R.; Greenfield, Laurence G.; Thompson, Keith., 1987. The biota and environment of fumaroles on Mt Melbourne, Northern Victoria Land.Polar Biology, 1987, 7(2): 97-113.

Lama L., Nicolaus B., Calandrella V., Esposito E., Gambacorta A., 1996. Xylanase Produced by *Bacillus thermoantarcticus*, a new thermophilic bacillus. Enzyme Engineering XIII, 799, 285-289.

Lama L., Nicolaus B., Calandrella V., Basile R. and Gambacorta A., 2001. Purification and characterization of thermostable xylose (glucose) isomerase from Bacillus thermoantarcticus. J. Ind. Microbiol. Biotechnol 27, 234-240

Lama L., Calandrella V., Gambacorta A., Nicolaus B., 2004. Purification and characterization of thermostable xylanase and beta-xylosidase by the thermophilic bacterium Bacillus thermantarcticus. Res Microbiol. 155, 283-289

Lama L., Nicolaus B., Gambacorta A., 2005. Thermozymes from Antarctica bacteria Biocatalysis: Chemistry and Biology, 111-125. Antonio trincone ed. Research Signpost, trivandrum 695 023 Kerala, India

Manca M.C., Lama L., Esposito E. Improta R. Gambacorta A. and Nicolaus B., 1996. Chemical Composition of Two Exopolysaccharides from *Bacillus thermoantarcticus* Appl. Env. Microbiol. 62 (9), 3265-3269

Nicolaus, B. Lama, L. Esposito, E. Manca, M.C. Di Prisco, G. Gambacorta, A., 1996. *Bacillus thermoantarcticus* sp. nov., from Mount Melbourne, Antarctica: a novel thermophilic species. Polar Biology. 16(2). pp.101-104.

Nicolaus B., Lama L., Esposito E, Bellitti M.R., Improta R., Panico A., and Gambacorta A., 2000. Extremophiles in Antarctica. Ital. J. Zool. 1, 169-174

Nicolaus B., Manca M.C., Lama L., Esposito E., and Gambacorta A., 2001. Lipid modulation by environmental stresses in two models of extremophiles isolated from Antarctica. Polar Biol. 24, (2001) 1-8

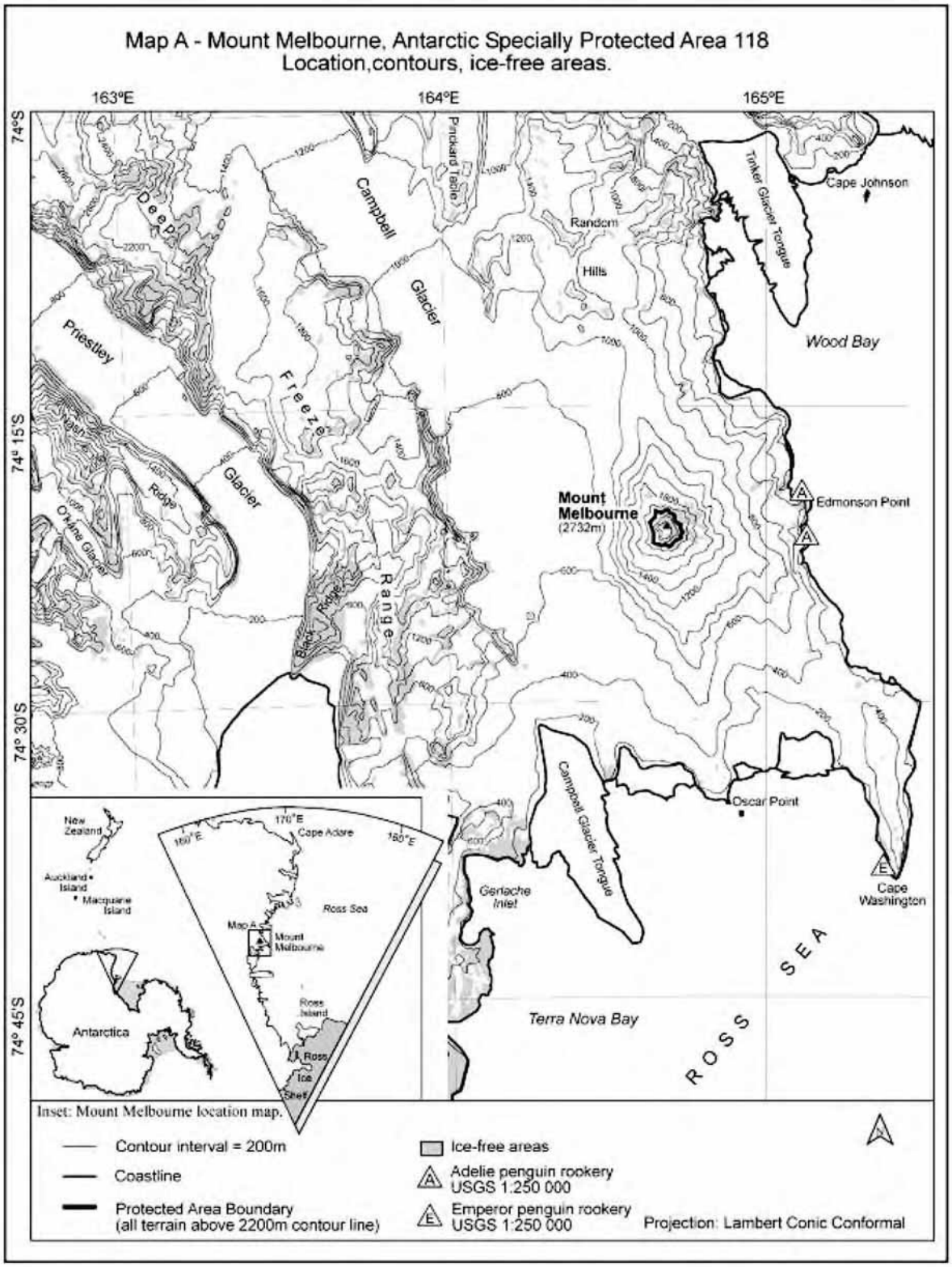
Nicolaus B., Lama L., and Gambacorta A., 2002. Thermophilic *Bacillus* isolates from Antarctic environments. In: Applications and Systematics of *Bacillus* and Relatives (Berkeley R, Heyndrickx M, Logan N, De Vos P, eds) Blackwell Publishing Vol 5, 47-63

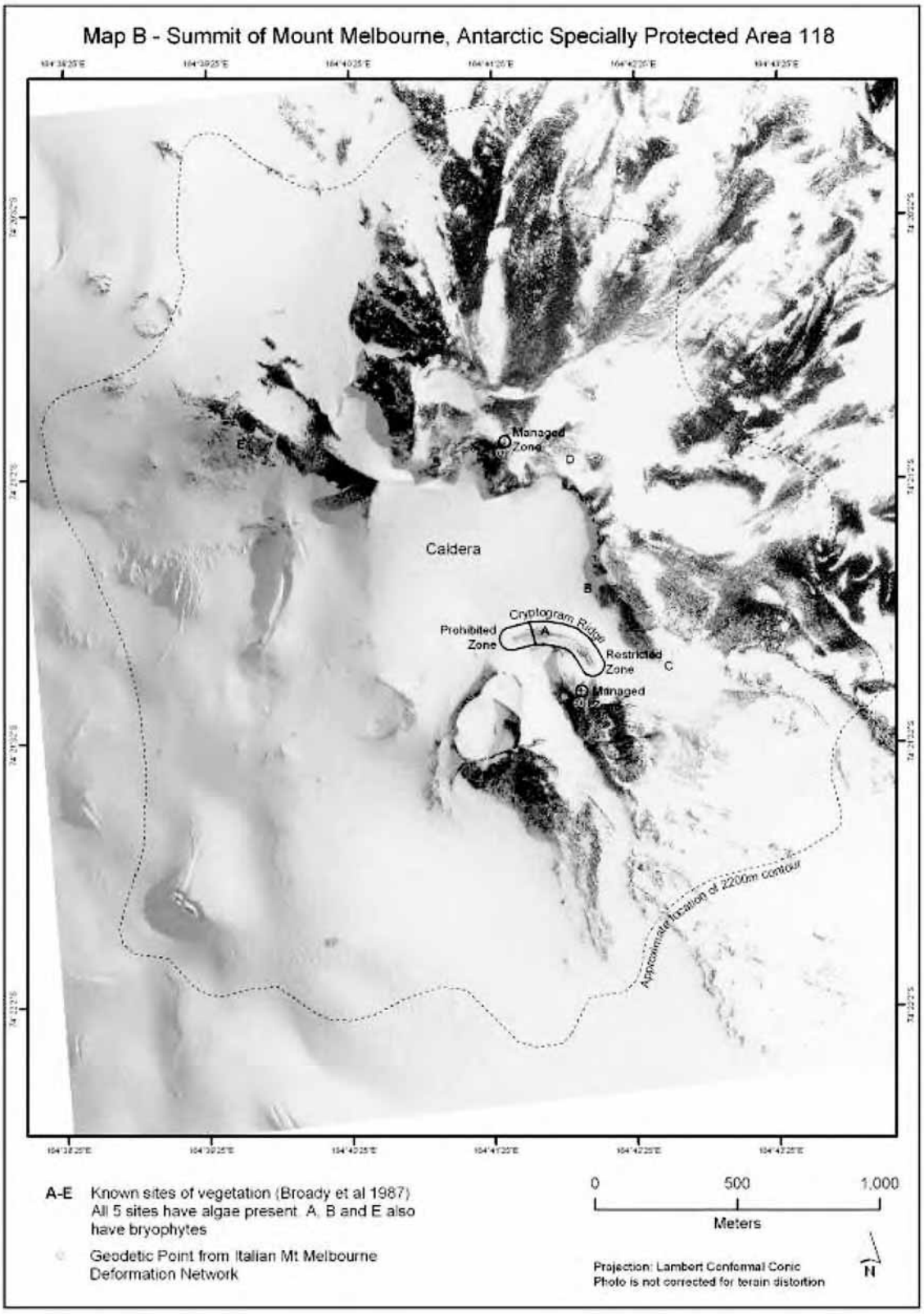
Seppelt R.D., Green T.G.A., 1998. A bryophyte flora from southern Victoria Land. New Zealand Journal of Botany. Vol 36. pp 53-59.

Seppelt, R.D., 1983. *Cephaloziella exiliflora* (Tayl.) Steph. from the Windmill Islands, continental Antarctica. In: (Ed.). *Lindbergia.* Vol 9. pp 27-28.

Skotnicki, M.L, Selkirk, P.M., Broady, P. Adam, K.D. and Ninham, J.A., 2001. Dispersal of the moss *Campylopus pyriformis* on geothermal ground near the summit of Mount Erebus and Mount Melbourne, Victoria Land, Antarctica. Antarctic Science 13 (3). pp 280-285.

Smith, G.H., 1992. Distribution and ecology of the testate rhizopod fauna of the continental Antarctic zone. Polar Biology. Vol 12. pp 629-634.


Map A - Mount Melbourne, Antarctic Specially Protected Area 118
Location,contours, ice-free areas.
163°E
164°E
165°E
74°S
74° 15'S
74° 30'S
74° 45'S
Deep Glacier
Priestley Glacier
Campbell Glacier
Pinckard Table
Random Hills
Freeze Glacier
Priestley Ridge
O'Kane Glacier
Black Ridge
Range
Mount Melbourne (2732m)
Tinker Glacier Tongue
Cape Johnson
Wood Bay
Edmonson Point
Campbell Glacier Tongue
Oscar Point
Gerlache Inlet
Cape Washington
Terra Nova Bay
ROSS SEA
New Zealand
Auckland Island
Macquarie Island
Antarctica
170°E
Cape Adare
180°E
Ross Sea
Map A
Mount Melbourne
Ross Island
Ross Ice Shelf
Inset: Mount Melbourne location map.
Contour interval = 200m
Coastline
Protected Area Boundary
(all terrain above 2200m contour line)
Ice-free areas
Adelie penguin rookery
USGS 1:250 000
Emperor penguin rookery
USGS 1:250 000
Projection: Lambert Conic Conformal


Map B - Summit of Mount Melbourne, Antarctic Specially Protected Area 118
Managed Zone
E
D
Caldera
B
Cryptogram Ridge
Prohibited Zone
A
Restricted Zone
C
Managed Zone
Approximate location of 2200m contour
A-E Known sites of vegetation (Broady et al 1987) All 5 sites have algae present. A, B and E also have bryophytes
Geodetic Point from Italian Mt Melbourne Deformation Network
0
500
1,000
Meters
Projection: Lambert Conformal Conic
Photo is not corrected for terain distortion
N

Measure 6 (2008)

Antarctic Specially Protected Area No 123 (Barwick and Balham Valleys, Southern Victoria Land): Revised Management Plan

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas ("ASPA") and approval of Management Plans for those Areas;

Recalling

- Recommendation VIII-4 (1975), which designated the Barwick Valley, Victoria Land as Site of Special Scientific Interest ("SSSI") No 3 and annexed a Management Plan for the Site;
- Recommendation X-6 (1979), which extended the expiry date of SSSI 3 from 30 June 1981 to 30 June 1985;
- Recommendation XII-5 (1983), which extended the expiry date of SSSI 3 from 30 June 1985 to 31 December 1985;
- Recommendation XIII-7 (1985), which extended the expiry date of SSSI 3 from 31 December 1985 to 31 December 1995;
- Resolution 7 (1995), which extended the expiry date of SSSI 3 from 31 December 1995 to 31 December 2000;
- Measure 2 (2000), which extended the expiry date of SSSI 3 from 31 December 2000 to 31 December 2005;
- Decision 1 (2002), which renamed and renumbered SSSI 3 as Antarctic Specially Protected Area No 123;
- Measure 1 (2002), which annexed a revised Management Plan for ASPA 123;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 123;

Desiring to replace the existing Management Plan for ASPA 123 with the revised Management Plan;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) the revised Management Plan for Antarctic Specially Protected Area No 123: Barwick and Balham Valleys, Southern Victoria Land, which is annexed to this Measure, be approved; and

2) all prior management plans for ASPA 123, namely those annexed to:

    a) Recommendation VIII-4 (1975); and

    b) Measure 1 (2002);

    shall cease to be effective.

Management Plan for Antarctic Specially Protected Area No 123

BARWICK AND BALHAM VALLEYS, SOUTHERN VICTORIA LAND

1. Description of values to be protected

An area of 325km^2 at Barwick Valley, including part of adjacent Balham Valley, was originally designated in Recommendation VIII-4 (1975, SSSI No 3) after a proposal by the United States of America on the grounds that it was "one of the least disturbed and contaminated of the Dry Valleys of Victoria Land" and was important as a reference base against which to measure changes in comparable ecosystems of the other Dry Valleys where scientific investigations were being regularly conducted. The site remains distant from field stations and has not been subjected to intensive visitation or research. The Barwick Valley was first visited in 1958 and several subsequent expeditions were conducted in the 1960s through to 1975, after which time visits have been few because of the designation of the SSSI. Although some human impacts from these early expeditions were visible within the region in 1993-94, Barwick and Balham Valleys are believed to remain one of the least impacted areas in the Victoria Land Dry Valleys region of Antarctica.

The boundaries of the original Area were enlarged in 2002 (Measure 1) to include more of the Balham Valley catchment, and rationalized to exclude the Victoria Upper Glacier catchment which was previously within the Area, resulting in a total area of 480km^2. The current Management Plan has been updated to include additional provisions to reduce the risk of microbial and vegetation introductions from soils at other Antarctic sites, or from regions outside Antarctica.

The Victoria Land Dry Valleys have a unique and extreme polar desert ecosystem. The Area contains examples of a wide variety of the environments found in this ecosystem, including desert pavements, sand dunes, patterned ground, glacial and moraine features, streams, freshwater and saline lakes, valleys and high-altitude ice-free ground. Some of the best examples of ventifact pavements and weathering-pitted dolerites are found on the valley floors, along with examples of chasmolithic lichens, layered communities of endolithic lichens, fungi, algae and associated bacteria, and populations of soil and lake microflora. Special protection of the Area provides the opportunity to conserve a relatively pristine example of this ecosystem as a baseline for future reference. Protection on a catchment basis serves to provide greater representation of the ecosystem features, and also facilitates management of the Area as a geographically distinct and integrated ecological system. The high ecological values, as well as the scientific, aesthetic and wilderness values derived from the isolation and relatively low level of human impact are important reasons for special protection at Barwick and Balham Valleys.

2. Aims and objectives

Management at Barwick and Balham Valleys aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- conserve the natural ecosystem as a reference area largely undisturbed by direct human activities;
- allow scientific research on the natural ecosystem and physical environment in the Area provided it is for compelling reasons which cannot be served elsewhere;

- minimize human disturbance to the Area by preventing unnecessary sampling;
- minimize the possibility of introduction of alien plants, animals and microbes to the Area;
- allow visits for management purposes in support of the protection of the values and features of the Area.

3. Management activities

- Copies of this management plan, including maps, shall be kept available in the principal research hut facilities in the vicinity of the Area and at McMurdo Station and Scott Base;
- Visits shall be made as necessary to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate;
- National Antarctic Programs operating in the region shall consult together for the purpose of ensuring that the above provisions are implemented.

4. Period of designation

Designated for an indefinite period.

5. Maps

Map 1: ASPA No 123 Barwick and Balham Valleys, Topography and boundary. Map specifications: Projection: Lambert conformal conic; Standard parallels: 1st 77° 15' S; 2nd 77° 25' S; Central Meridian: 161° 10' E; Latitude of Origin: 78° 00' S; Spheroid: WGS84 approximation; Datum: 'Camp Area' Local.

- Inset 1: Ross Sea region, showing the location of the McMurdo Dry Valleys and Inset 2.
- Inset 2: McMurdo Dry Valleys and Ross Island, showing location of McMurdo Station (US) and Scott Base (NZ), Antarctic Specially Managed Area No 2 McMurdo Dry Valleys (ASMA No 2), and the location of other Antarctic Specially Protected Areas in the McMurdo Dry Valleys (ASPA No 131, Canada Glacier, and ASPA No 138, Linnaeus Terrace).

6. Description of the Area

6(i) Geographical coordinates, boundary markers and natural features

Barwick Valley (161° E, 77° 20' S) is situated about 65km inland from the Ross Sea coast of southern Victoria Land (Map and Insets). The Area includes Barwick and Balham Valleys and their respective catchments and is bordered on the south, west and north by the McKelvey Valley, the Willet Range and the divide between the Victoria and Barwick Valleys, respectively.

The boundary of the Area extends from its eastern extremity in the lower Barwick Valley (around the confluence of the Barwick, Victoria and McKelvey Valleys) several kilometers south towards the ridge leading SW to the summit of Mount Insel (1345m), from where the boundary follows the high points of the ridge of the Insel Range for 5km before descending to a low pass between the McKelvey and Balham Valleys at the location of Bullseye Lake. The boundary crosses the lake before ascending the ridge to a further high point on the Insel Range (approximately 1250m), and continues towards the upper reaches of the Balham Valley. As the terrain becomes gentler in the

upper Balham and approximately 7km east of the summit of Shapeless Mountain (2736m), the boundary extends northward at an elevation of approximately 1800m towards Apocalypse Peaks. The boundary extends NW from the Apocalypse Peaks for approximately 9km towards a prominent ridge leading to the summit of Mount Bastion (2477m, 160°29'E, 77°19'S). This ridge is followed in a northerly direction to Skew Peak (2535m, 160°41'E, 77°13'30'S), located at the head of the Barwick Valley. The boundary then descends along the east ridge of Skew Peak above Webb Glacier, before following the catchment boundary in a more southerly direction toward Parker Mesa. From Parker Mesa the boundary descends further to follow the dividing ridge between the catchments of the Victoria Upper Glacier and the Barwick Valley. The boundary extends east along this ridge for 13km to Sponsors Peak (1454m, 161°24'E, 77°18'S). The boundary descends the SW ridge of Sponsors Peak and Nickell Peak (approximately 1400m) to the lower Barwick to the eastern extremity of the Area, which is about 4km north-west of Lake Vida, Victoria Valley.

An extensive névé south of Skew Peak feeds the Webb Glacier in the upper Barwick Valley. Very little ice from the Polar Plateau flows over the scarp into the Barwick Valley, as flow vectors and debris cover patterns on the Webb Glacier in this location indicate that this part of the glacier is almost stationary. The Barwick and Balham Valleys merge in the south-east of the Area, 9km from where the Barwick joins the Victoria Valley. A series of lakes occupy the Barwick Valley, the largest being Webb Lake (approximate elevation 650m) at the snout of Webb Glacier. Lake Vashka (approximate elevation 507m), partially filling an unusually deep circular depression, is the second largest and 5.7km down-valley from Webb Lake. Hourglass Lake (approximate elevation 625m), the next largest, is approximately half way between Webb Lake and Lake Vashka. An intermittent stream connecting this series of lakes terminates at Lake Vashka, which has a level well below its overflow threshold. Early observations of the smooth surfaces of Lakes Webb and Vashka suggested that they are 'ice-block' lakes that contain no significant liquid water. However, liquid water up to several meters in depth was observed at the perimeter of Lake Vashka in December 1993. Recent studies on the physical features of any of the Barwick Valley lakes have not been made. Lake Balham, a small lake in a depression (<700m elevation) below Apocalypse Peaks, is the only lake in Balham Valley (generally around 800m in elevation).

Multiple glaciations, mainly between 13 Ma and 3.5 Ma ago, have resulted in a thick ground moraine on both valley floors. These deposits are mantled by solifluction sheets at the head of Balham Valley. In addition the valleys bear a small number of fresh and saline lakes on the drift surfaces. In many cases the lakes have evaporated to leave extensive salt deposits. The walls of Barwick and Balham Valleys display remnants of glacial benches at about 800m and 1,200-1,500m altitude. The soils near Lake Vashka consist of moraine debris derived largely from dolerite and sandstone, but granites, gneiss and schist make up as much as 35% of boulders locally. Weathering is often indicated by deep red staining due to oxidation of iron compounds, usually eroded by wind-driven sand on the boulders' windward side. The valley floors are extensively covered with patterned ground of sand-wedge polygons, typical of permafrost areas in the Dry Valleys. The majority is old (high centered), with young (hollow centered) polygons found in recent stream channels, and both typically measure 20m across.

No invertebrates have been found in the dry soils of the Barwick Valley and there is little obvious vegetation. Algal crusts and mats fringe the lakes and streams but the flora reported is essentially microbial: chasmolithic lichens are present in jagged screes of the Apocalypse Range and dense layered communities of endolithic lichens, fungi, algae and associated bacteria are occasionally found in boulders of Beacon Sandstone. Black lichen growth is reported to be well developed in areas of sandstone on the valley floor of Balham Valley. Significant heterotrophic bacterial populations have been reported in sandy samples from Barwick Valley. The population contained lactose-fermenters, nitrate-reducers, nitrogen-fixers, yeasts and algae but no detectable filamentous fungi or Protozoa.

While the Barwick and Balham Valleys are one of the most remote areas of the Dry Valleys, south polar skuas (*Catharacta maccormicki*) are known to visit the Area, with about 40 carcasses found at Lake Vashka in 1959-60. The mummified carcasses of two seals have been found near the snout of Webb Glacier, and seven more, mainly crabeaters (*Lobodon carcinophagus*) were found near the Balham/Barwick Valley junction.

Inspection of the Barwick and Balham Valleys in December 1993 from Bullseye Lake to Lake Vashka revealed evidence of prior human activity, particularly around Lake Vashka where field camps had been in use for scientific research in the 1960s. Impacts observed in the Lake Vashka vicinity included stone circles for tents at old camp sites, soil pits and a trench, remains of a wooden crate, a wooden box containing rocks and a paper poster, and a broken food cache partially submerged in the lake. Bamboo poles are situated near the snout of Webb Glacier and at Vashka Crag. Dynamite charges have been used in the vicinity of Lake Vashka and at least one other unknown location in the Barwick Valley. Remediation of the site was carried out in 1995/96 by a New Zealand team. Recent visits have recorded no evidence of human activities or disturbance.

6(ii) Restricted and managed zones within the Area

None.

6(iii) Structures within and near the Area

None.

6(iv) Location of other protected areas within close proximity of the Area

Barwick and Balham Valleys lie within Antarctic Specially Managed Area (ASMA) No 2, McMurdo Dry Valleys. Within the ASMA, the nearest Special Features include the Sand Dune Field in the Lower Victoria Valley, Argo Gully, Boulder Pavement and Prospect Mesa in the Wright Valley, and Don Juan Pond in the Upper Wright Valley. The nearest protected areas to Barwick and Balham Valleys are Linnaeus Terrace (ASPA No 138) 35km south in the Wright Valley, and Canada Glacier (ASPA No 131) 50km SE in the Taylor Valley (Inset 2, Map 1).

7. Permit conditions

Entry into the Area is prohibited except in accordance with a permit issued by an appropriate national authority. Conditions for issuing a permit to enter the Area are that:

- it is issued for compelling scientific reasons that cannot be served elsewhere, or for essential management purposes consistent with plan objectives such as inspection or review;
- the actions permitted will not jeopardize the physical, ecological, scientific or aesthetic and wilderness values of the Area, nor the pristine value of the Area and its potential as a largely undisturbed reference site;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- the permit, or a copy, shall be carried within the Area;
- a visit report shall be supplied to the authority named in the permit;
- permits shall be issued for a stated period.

7(i) Access to and movement within the Area

- Access to and movement within the Area shall be on foot. Vehicles are prohibited within the Area;
- Landing of aircraft and overflight below 750m (~2500 ft) is prohibited within the Area, except for scientific or management purposes specifically authorized by permit;
- Use of smoke grenades is prohibited within the Area and discouraged within 1km of the Area;
- No special restrictions apply to the air or land routes used to move to and from the Area. Scientists are encouraged to access the Area at a practicable point closest to their site of study to minimize the amount of the Area that is traversed;
- Pedestrian routes should avoid lakes, ponds, stream beds, areas of damp ground and areas of soft sediments or dunes;
- Pedestrian traffic should be kept to the minimum necessary consistent with the objectives of any permitted activities and every reasonable effort should be made to minimize effects.

7(ii) Activities that may be conducted in the Area

Activities that may be conducted within the Area include:

- scientific research that will not jeopardize the scientific or ecosystem values of the Area, or its pristine value and potential as a reference site, and which cannot be served elsewhere;
- essential management activities, including monitoring.

7(iii) Installation, modification or removal of structures

- No structures are to be erected within the Area except as specified in a permit;
- Permanent structures are prohibited;
- All scientific equipment installed in the Area must be approved by permit and clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area;
- Removal of specific equipment for which the permit has expired shall be the responsibility of the authority which granted the original Permit, and shall be a condition of the Permit.

7(iv) Location of field camps

Camping should generally be avoided within the Area, and two campsites outside of, but close to, the east and south boundaries are identified for access into the Area. One of these is at the confluence of the lower Barwick and Victoria Valleys (161° 41' 15" E, 77° 21' 45" S), while the other is close to Bullseye Lake in the McKelvey Valley (161° 13' 08" E, 77° 25' 40" S) (see Map 1). If deemed to be essential, camping should be at previously impacted sites, preferably on snow or ice-covered ground if available. Researchers should consult with the appropriate national authority to obtain up-to-date information on any sites where camping may be preferred.

7(v) Restrictions on materials and organisms that can be brought into the Area

- No living animals, plant material or microorganisms shall be deliberately introduced into the Area, and the precautions listed below shall be taken against accidental introductions;
- To help maintain the ecological and scientific values of the isolation and relatively low level of human impact at the Area visitors shall take special precautions against the introduction of animals, plant material and microorganisms. Of particular concern are microbial and vegetation introductions from soils at other Antarctic sites, including stations,

or from regions outside Antarctica. To minimize the risk of introductions, visitors shall thoroughly clean footwear and any equipment to be used in the area – particularly sampling equipment and markers – before entering the Area;

- To reduce the risk of microbial contamination, the exposed surfaces of footwear, sampling equipment and markers should, to the greatest extent practical, be sterilized before use within the Area. Sterilization should be by an acceptable method, such as by washing in 70% ethanol solution in water or in a commercially available solution such as 'Virkon';
- No herbicides or pesticides shall be brought into the Area;
- Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the permit, shall be removed from the Area at or before the conclusion of the activity for which the permit was granted;
- Fuel is not to be brought into the Area, unless specifically authorized by permit for specific scientific or management purposes;
- All materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimized;
- If release occurs which is likely to compromise the values of the Area, removal is encouraged only where the impact of removal is not likely to be greater than that of leaving the material *in situ*.

7(vi) Taking or harmful interference with native flora or fauna

Taking or harmful interference of native flora and fauna is prohibited, except in accordance with a separate permit issued under Article 3 of Annex II by the appropriate national authority specifically for that purpose.

7(vii) Collection or removal of anything not introduced by a visitor

- Material may be collected or removed from the Area only in accordance with a permit and should be limited to the minimum necessary to meet scientific or management needs. Permits shall not be granted if there is a reasonable concern that the sampling proposed would take, remove or damage such quantities of soil, native flora or fauna that their distribution or abundance within the Area would be significantly affected;
- Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the permit holder or otherwise authorized, may be removed unless the impact of removal is likely to be greater than leaving the material *in situ*. If this is the case the appropriate authority should be notified.

7(viii) Disposal of waste

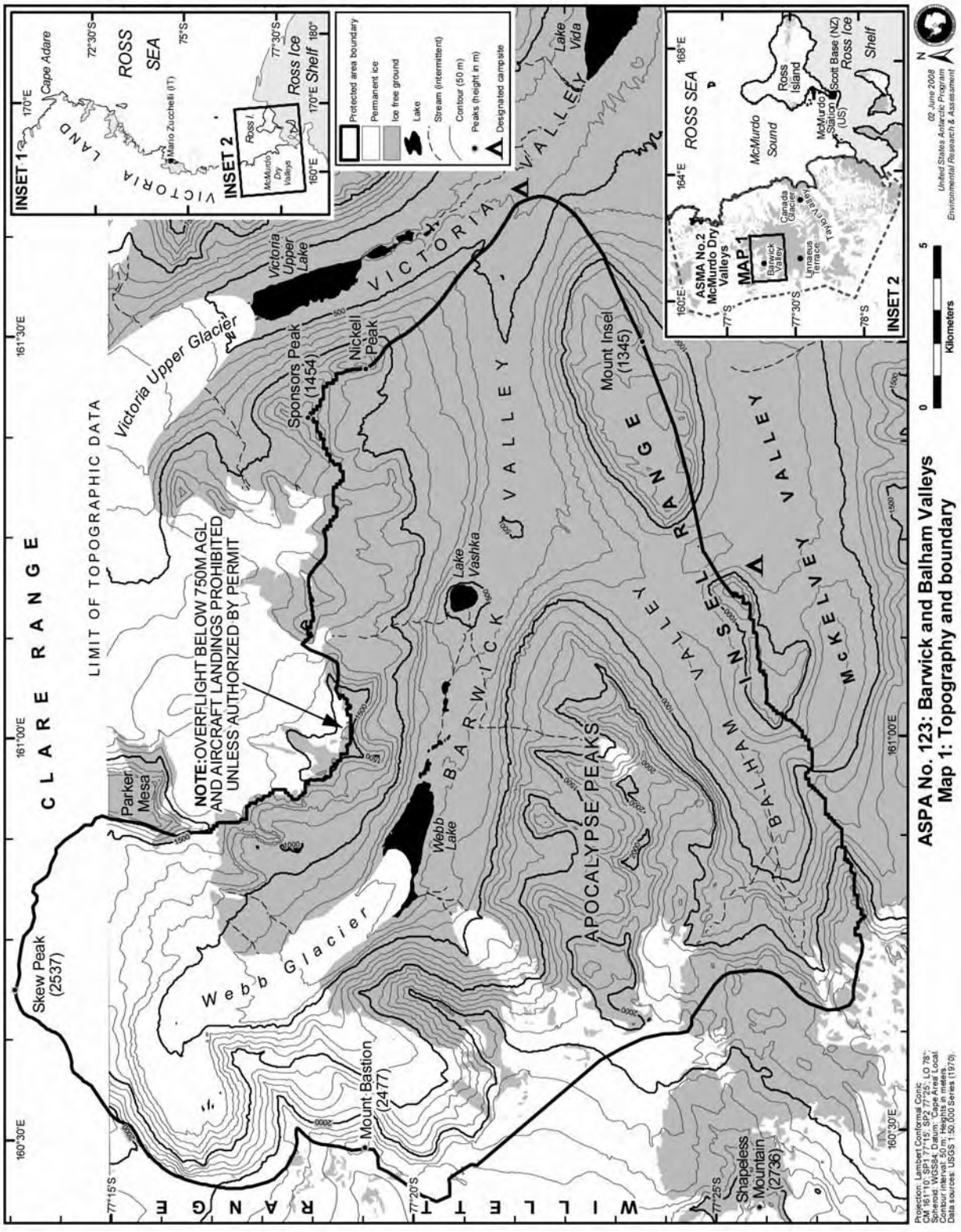
All wastes, including water used for any human purpose and including all human wastes, shall be removed from the Area. Individuals or groups shall carry appropriate containers for human waste and gray water so they may be safely transported and removed from the Area.

7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

- Visitors should consult and apply where appropriate the comprehensive Code of Conduct and *Guidelines for Conduct of Scientific Research* developed for use within the McMurdo Dry Valleys (ASMA No 2).
- Any specific sites of long-term monitoring should be appropriately marked;

7(x) Requirements for reports

- Parties should ensure that the principal holder for each permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report form contained in Appendix 4 of Resolution 2 (1998)(CEP I).
- Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, which should be in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the Management Plan and in organizing the scientific use of the Area.
- The appropriate authority should be notified of any activities/measures undertaken, and / or of any materials released and not removed, that were not included in the authorized Permit.


ASPA No. 123: Barwick and Balham Valleys
Map 1: Topography and boundary
CLARE RANGE
LIMIT OF TOPOGRAPHIC DATA
NOTE: OVERFLIGHT BELOW 750M AGL AND AIRCRAFT LANDINGS PROHIBITED UNLESS AUTHORIZED BY PERMIT
Victoria Upper Glacier
Victoria Upper Lake
Sponsors Peak (1454)
Nickell Peak
Parker Mesa
Skew Peak (2537)
Webb Glacier
Webb Lake
Lake Vashka
BARWICK VALLEY
APOCALYPSE PEAKS
Mount Bastion (2477)
Shapeless Mountain (2736)
RANGE
WILLETT
Mount Insel (1345)
BALHAM VALLEY
INSEL
McKELVEY VALLEY
VICTORIA VALLEY
Lake Vida
INSET 1
INSET 2
Cape Adare
LAND
VICTORIA
ROSS SEA
Mario Zucchelli (IT)
Ross I.
McMurdo Dry Valleys
Ross Ice Shelf
Protected area boundary
Permanent ice
Ice free ground
Lake
Stream (intermittent)
Contour (50 m)
Peaks (height in m)
Designated campsite
ASMA No.2 McMurdo Dry Valleys
MAP 1
Barwick Valley
Lyrnaeus Terrace
Canada Glacier
Taylor Valley
McMurdo Sound
Ross Island
McMurdo Station (US)
Scott Base (NZ)
Kilometers
02 June 2008
United States Antarctic Program
Environmental Research & Assessment

Measure 7 (2008)

Antarctic Specially Protected Area No 124 (Cape Crozier, Ross Island): Revised Management Plan

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas ("ASPA") and approval of Management Plans for those Areas;

Recalling

- Recommendation IV-6 (1966), which designated Cape Crozier, Ross Island, as Specially Protected Area ("SPA") No 6;
- Recommendation VIII-2 (1975), which terminated Recommendation IV-6;
- Recommendation VIII-4 (1975), which renamed and renumbered SPA 6 as Site of Special Scientific Interest ("SSSI") No 4 and annexed a Management Plan for the Site;
- Recommendation X-6 (1979), which extended the expiry date of SSSI 4 from 30 June 1981 to 30 June 1985;
- Recommendation XII-5 (1983), which extended the expiry date of SSSI 4 from 30 June 1985 to 31 December 1985;
- Recommendation XIII-7 (1985), which extended the expiry date of SSSI 4 from 31 December 1985 to 31 December 1991;
- Recommendation XVI-7 (1991), which extended the expiry date of SSSI 4 from 31 December 1991 to 31 December 2001;
- Measure 3 (2001), which extended the expiry date of SSSI 4 from 31 December 2001 until 31 December 2005;
- Decision 1 (2002), which renamed and renumbered SSSI 4 as Antarctic Specially Protected Area No 124;
- Measure 1 (2002), which annexed a revised Management Plan for ASPA 124;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 124;

Desiring to replace the existing Management Plan for ASPA 124 with the revised Management Plan;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) the revised Management Plan for Antarctic Specially Protected Area No 124, Cape Crozier, Ross Island, which is annexed to this Measure, be approved;
2) all prior Management Plans for ASPA 124, namely those annexed to:
    a) Recommendation VIII-4 (1975); and
    b) Measure 1 (2002);

    shall cease to be effective.

Management Plan for Antarctic Specially Protected Area No 124

CAPE CROZIER, ROSS ISLAND

1. Description of values to be protected

An area at Cape Crozier was originally designated as Specially Protected Area No 6 by Recommendation IV-6 (1966) after a proposal by the United States of America on the grounds that the region supports a rich bird and mammal fauna as well as microfauna and microflora, and that the ecosystem depends on a substantial mixing of marine and terrestrial elements of outstanding scientific interest. With adoption by Antarctic Treaty Parties of the Site of Special Scientific Interest (SSSI) category of protection in 1972, Cape Crozier's designation as an SPA was terminated by Recommendation VIII-2 (1975) and the site was re-designated as SSSI No 4 by Recommendation VIII-4 (1975). The reason for designation of SSSI No 4 was to protect long-term studies of the population dynamics and social behaviour of emperor (*Aptenodytes forsteri*) and Adélie (*Pygoscelis adeliae*) penguin colonies in the region. Information gathered since the designation of SSSI No 4 supported the inclusion of skua populations and vegetation assemblages as important values to be protected at Cape Crozier. In 2002 (Measure 1) the boundaries were extended south to Igloo Spur to protect the range of vegetation assemblages representative of the Cape Crozier region. The western boundary of the Area has been modified in the current plan to follow a simple line of longitude because visitors found the previous boundary hard to follow.

The emperor penguin colony at Cape Crozier was first recorded by members of the British National Antarctic Expedition in 1902. The colony is the most southerly known and has the longest record of study on an emperor penguin population. The colony breeds on fast ice that forms between large cracks, which develop where the Ross Ice Shelf abuts Cape Crozier. The positions of these cracks shift with movement of the ice shelf, and the colony itself is known to move around different parts of the cracks during the breeding season. The boundaries of the Area have been designed to include fast-ice areas consistently occupied by breeding birds.

Cape Crozier has a large Adélie penguin (*Pygoscelis adeliae*) population numbering around 150,000 breeding pairs, making it one of the largest Adélie colonies in Antarctica. The colony is divided into two main groups 1km apart known as East and West Colonies (Maps 1 and 2). In addition, well-preserved ancient Adélie penguin remains found within the Area have particular scientific value for genetic studies. Associated with the penguin colonies is a large south polar skua (*Catharacta maccormicki*) colony, estimated at 1000 breeding pairs.

Weddell seals (*Leptonychotes weddellii*) breed within the Area, while leopard seals (*Leptonyx hydrurga*) are frequent visitors and crabeater seals (*Lobodon carcinophagus*) are commonly seen at sea and on ice floes. Orca are also frequently seen close off shore within the Area. While the mammal species recorded at Cape Crozier are not unique to the Area nor known to be outstanding in this context, they form an integral and representative part of the local ecosystem.

There are moss, algae and lichen assemblages in the Area. Expanses of snow algae at Cape Crozier cover an area of more than 4 ha adjacent to the skua and penguin colonies. Growths as extensive as those at Cape Crozier have been remarked on only once before in the Continental Antarctic Zone, on the Wilkes Land Coast, and Cape Crozier has one of the most southerly records of snow algae. Lichens are also abundant, with large areas of bright orange encrusting (crustose) lichens on rocks

and stones on the slopes above the Adélie colony, and rich growths of foliose and fruticose lichens in the vicinity of Wilson's Stone Igloo.

A message post from Scott's National Antarctic Expedition (1901-04) is situated in West Colony (169°16'14"E, 77°27'15"S) and was designated as Historic Site and Monument (HSM) No 69 in Measure 4 (1995). Wilson's Stone Igloo (169°18'E, 77°51'S), designated as HSM No 21 in Recommendation VII-9 (1972), is situated in the south of the Area. The rock shelter was constructed in July 1911 by members of the 1910-1913 British Antarctic Expedition during their winter journey to Cape Crozier to collect emperor penguin eggs.

The high scientific, ecological and historic values of this area along with its vulnerability to disturbance through trampling, sampling, pollution or alien introduction, are such that this Area requires long-term special protection.

2. Aims and objectives

Management at Cape Crozier aims to:

- avoid degradation of, or substantial risk to, the values of the Area, and in particular the avifauna and vegetation assemblages within the Area;
- allow scientific research, especially of the avifauna and vegetation assemblages, in the Area while ensuring it is protected from oversampling or other possible scientific impacts;
- allow other scientific research provided it will not jeopardize the values of the Area;
- minimize the possibility of introduction of alien plants, animals and microbes into the Area;
- allow visits to the historic sites, but under strict control by permit;
- allow visits for management purposes in support of the aims of the Management Plan.

3. Management activities

- Durable wind direction indicators should be erected close to the primary designated helicopter landing site whenever it is anticipated there will be a number of landings at the site in a given season. These should be replaced as needed and removed when no longer required.
- Brightly colored markers, which should be clearly visible from the air and pose no significant threat to the environment, should be placed to mark the primary and secondary designated helicopter landing sites adjacent to the field hut.
- Signs showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently, and a copy of this management plan shall be kept available, in the research hut facility at Cape Crozier.
- Markers, signs or structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition, and removed when no longer necessary.
- Visits shall be made as necessary (no less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate.
- National Antarctic Programs operating in the region shall consult together for the purpose of ensuring that the above provisions are carried out.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

- Map 1: ASPA No 124 Cape Crozier: Topography and boundary. Map specifications: Projection: Lambert conformal conic; Standard parallels: 1st 77° 27' S; 2nd 77° 32' S; Central meridian: 169° 15' E; Latitude of Origin: 77° S; Spheroid: WGS84; Datum: McMurdo Sound Geodetic Control Network 1992.

  Inset 1: Ross Sea region, showing location of Inset 2.

  Inset 2: Ross Island region, showing the location of Map 1 and McMurdo Station (US) and Scott Base (NZ).

- Map 2: ASPA No 124 Cape Crozier: Access, facilities and wildlife. Map specifications are the same as those for Map 1.

6. Description of the Area

6(i) Geographical co-ordinates, boundary markers and natural features

Cape Crozier (169° 21' 30" E, 77° 30' 30" S) is at the eastern extremity of Ross Island, where an ice-free area comprises the lower eastern slopes of Mount Terror. The designated area is situated in the vicinity of Post Office Hill (407 m), extending to encompass the adjacent Ross Ice Shelf where large cracks in the shelf are covered by fast-ice which is occupied annually by breeding emperor penguins.

The Area includes a terrestrial region and ice shelf above the mean high water mark as well as the adjacent fast-ice within the boundaries occupied by breeding emperor penguins. The north boundary of the Area extends 6.5km along the 77° 26' 00" S line of latitude from 169° 11' 30" E to 169° 28' 00" E. The west boundary extends 1.5km south from the northern boundary to the coast, thence in a SW direction following a low ice-free ridge that passes 30m west of the hut and helicopter pad. The boundary then follows this ridge in a southerly direction to the saddle SW of the summit of Post Office Hill at 169° 11' 30" E 77° 28' 00" S, before following the 169° 11' 30" E line of longitude south to a point at 169° 11' 30" E 77° 31' 00" S, which is close to the summit of Bomb Peak (740m). The boundary extends down the SE ridge of Bomb Peak to Igloo Spur at 169° 20' 00" E 77° 32' 00" S, from where it extends due east along latitude 77° 32' 00" S to the east boundary at 169° 28' 00" E.

The ice-free ground at Cape Crozier is of recent volcanic origin, with numerous small cones and craters evident among gentle slopes of scoria and fine-grained basalt lava. Several of these hills, including Post Office Hill, shelter the penguin colonies from south-westerly winds. On the surface are many volcanic bombs and other evidence of small-scale volcanic explosions. To the south of the Area coastal cliffs adjacent to the ice shelf are up to 150m high. The cliff faces show bedded lava and brown palagomite tuffs with several lenticular patches of columnar basalt towards the base. Large rocks of continental origin transported by glacial action can be found on the northern side of Cape Crozier. Prevailing winds tend to be from between the south-west and west, with temperatures generally about 8° colder than those at McMurdo Sound.

The emperor penguin (*Aptenodytes forsteri*) colony at Cape Crozier was discovered in October 1902 by R.S. Skelton, a member of Scott's Discovery Expedition. The presence of the colony depends on fast-ice locked between cracks in the Ross Ice Shelf where it abuts Cape Crozier. The size of the

colony is limited by the area and condition of the fast ice, which also affects the availability of breeding sites sheltered from the strong katabatic winds that descend from Mount Terror. The location of the colony varies from year to year and the colony moves within a breeding season, beginning the season near to shore and moving off shore as fledging approaches. The breeding population has fluctuated widely since the turn of the century, for example with 400 adults recorded in 1902, 100 in 1911, and 1,300 in 1969. The number of chicks fledged and the fledging success of the colony has also been variable (Table 1).

Table 1. Cape Crozier emperor penguin live chick counts 1983–2006

Year	Chicks	Year	Chicks	Year	Chicks	Year	Chicks
1983	78	1993	?	1998	1108	2003	333 (a)
1986	?	1994	645	1999	798	2004	475
1989	?	1995	623	2000	1201	2005	0
1990	324	1996	859	2001	0	2006	339 (b)
1992	374	1997	821	2002	247		

Source: Barber-Meyer, Kooyman & Ponganis 2008.

a) All chicks not counted due to rugged ice conditions and thus one chick assumed per adult counted.

b) G. Kooyman, *pers. comm.*, Nov. 2007.

In 2000, a section of the Ross Ice Shelf calved to form an iceberg 295km long and 40km wide. A fragmented section of this iceberg, known as B15A, together with another iceberg (C16) lodged near Ross Island in 2001. These icebergs had a major effect on sea ice distribution and primary production, and impeded the arrival of emperor penguins. In 2001 and several subsequent years, icebergs C16 and B15A affected the breeding success and colony locations of emperor and Adélie penguins by blocking access to foraging areas and destroying nesting habitat. In 2005, the emperor colony remained well below its pre-2000 size, with no sign of breeding (Kooyman *et al*. 2007). However, in 2006 the colony had returned to its pre-iceberg location and 339 chicks were produced (G. Kooyman, *pers. comm.*, Nov. 2007; Table 1).

A comprehensive population study of Adélie penguins occurred at Cape Crozier from 1961-62 through the 1981-82 austral summers, with 2000 to 5000 chicks banded yearly. There are two Adélie penguin (*Pygoscelis adeliae*) colonies at Cape Crozier, known as East and West Colonies. These are about 1km apart, separated by a 45-m high ridge and a sloping ice field across which the birds do not travel. A coastline of 1.6km with three beaches separated by rock outcrops provides penguins with access to West Colony. By contrast, East Colony has one 50-m wide rocky beach and 550m of sea cliffs. The population of the two colonies has increased substantially over the last 50 years, numbering 65,000 breeding pairs in 1958, 102,500 in 1966 and 177,083 in 1987. Numbers fell to 136,249 in 1989 and 106,184 in 1994. In 2000, the number of breeding pairs was estimated to be 118,772 (based on a projection from counts of selected subcolonies) (Ainley *et al*., 2004). The combined population of the East and West Colonies at Cape Crozier make it one of the largest Adélie colonies in Antarctica. The presence of the B15A and C16 icebergs from 2001 to 2005 had a significant effect on the Adélie penguin colony at Cape Crozier (Arrigo *et al*., 2002).

Approximately 1000 pairs of south polar skuas (*Catharacta maccormicki*) breed on ice-free ground surrounding the Adélie penguin colony. A demographic study of this colony began in 1961-62 and was still continuing in 1996-97. Chinstrap penguins (*Pygoscelis antarctica*), Wilson's storm petrels (*Oceanites oceanicus*), snow petrels (*Pagadroma nivea*), Antarctic petrels (*Thalassoica antarctica*), southern fulmars (*Fulmaris glacialoides*), southern giant petrels (*Macronectes giganteus*), black-backed gulls (*Larus dominicanus*), and south polar skuas from more northerly breeding sites, have been recorded as visitors to Cape Crozier.

Weddell seals (*Leptonychotes weddellii*) breed within the Area, with approximately 20 pups being recorded in recent years. Leopard seals (*Leptonyx hydrurga*) frequent the Area, with approximately 12 individuals recognized as regular visitors, while crabeater seals (*Lobodon carcinophagus*) are commonly seen at sea and on ice floes in the vicinity. Other mammals frequently observed within the Area include killer whales (*Orcinus orca*), of which several distinct types have been recognized.

Algae can be found throughout the Area on large patches of snow and on soils and stones, often below the soil surface layer. Large areas of green snow algae, covering more than 4 ha, can be found in the north of the Area in snowfields around the periphery of the Adélie penguin colony and skua nesting areas (Broady 1989). Particularly large patches have been reported in the snow-filled valley between the two coastal hills at the northern end of the Adélie colony, with snow-tinted green over at least one hectare. However, the extent of snow algae is not always obvious, with the green color often not revealed until a surface crust of white ice is broken away. Snow algae samples are dominated by a species of *Chlamydomonas*, and associated with occasional *Ulothrix*-like filaments and diatoms. Growth requires percolating meltwater during summer and nutrients derived from the bird colonies.

Prasiola crispa grows in slow water flows in the vicinity of the penguin colonies and ribbon-like growths of *P. calophylla* are found where water percolates over stones on the tallus slopes. Numerous small ponds are found throughout the Area, from small pools 1-m in diameter to a lake 150-m in diameter situated immediately south of The Knoll. The four ponds in the penguin colonies contain abundant phytoplankton populations of *Chlamydomonas* cf. *snowiae*, while ponds elsewhere support growths of red-brown to dark blue-green benthic felts dominated by Oscillatoriaceae. Occasional epilithic algae (dominated by *Gloeocapsa*, *Nostoc* and *Scytonema*) are found as blackish crusts coating rock surfaces where meltwater percolates.

Mosses are sparse and scattered in their distribution with most occurrences being of one or a small number of isolated cushions no larger than 10cm in diameter. Richer growths than this occur up to 0.5km NE of the hut on north and NW facing slopes and on slopes immediately above the coastal cliffs about 1km south of the penguin colonies. The moss species occurring at Cape Crozier have yet to be identified.

Encrusting orange lichens are present in shallow hollows, on rock outcrops, boulders and encrusting bryophytes on the slopes above the penguin colonies. Also present adjacent to Wilson's Stone Igloo is the fruticose lichen *Usnea* and the foliose lichen *Umbilicaria*, both duller in color but structurally more complex. Green algal crusts are found throughout the Area.

6(ii) Restricted and managed zones within the Area

None.

6(iii) Structures within and near the Area

The Cape Crozier hut (US) (169° 11' 14" E, 77° 27' 39" S) is situated on the NW side of a low peak (locally known as 'Pat's Peak') (Maps 1 and 2). A radio communications repeater is installed above the hut on a seasonal basis (Map 2). An observation hide dating from research programs in the 1960–80 period is located at the base of the north side of Post Office Hill. An old 'Jamesway' hut was built on a small terrace approximately 1km NE of the present hut (Map 2), although this was destroyed by fire and all hut debris has since been removed. Some materials such as nails, screws and hinges remain at the site.

A historic message post, designated as HSM No 69 under Measure 4 (1995), is situated in the West Colony on the NE coast of the Area (169° 16' 14" E, 77° 27' 15" S). The post was used by the 1901–04 British National Antarctic Expedition to provide information to the expedition's relief ships. An

historic rock hut known as Wilson's Stone Igloo (HSM No 21) (169° 17' 48" E, 77° 31' 48" S) is located on Igloo Spur (Map 1).

6(iv) Location of other protected areas within close proximity of the Area

The nearest protected areas to Cape Crozier are on Ross Island: Lewis Bay (ASPA No 156), the site of the 1979 DC-10 passenger aircraft crash is the closest and 45km west; Tramway Ridge (ASPA No 130) near the summit of Mt. Erebus is 55km west; Discovery Hut on the Hut Point Peninsula (ASPA No 158 and HSM No 18); Arrival Heights (ASPA No 122) is 70km to the SW adjacent to McMurdo Station; Cape Royds (ASPA No 121), Backdoor Bay (ASPA No 157 and HSM No 15) and Cape Evans (ASPA No 155) are 75km west; and New College Valley (ASPA No 116) are 75km NW at Cape Bird.

7. Permit conditions

Entry into the Area is prohibited except in accordance with a permit issued by an appropriate national authority. Conditions for issuing a permit to enter the Area are that:

- it is issued for scientific research, and in particular for research on the bird fauna as well as on the vegetation assemblages in the Area, or for essential management or educational purposes;
- access to the historic sites may be permitted for scientific, management, educational or historical purposes on the condition that movement within the Area be restricted to accessing the historic sites;
- the actions permitted will not jeopardize the ecological, scientific or historic values of the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- the permit, or a copy, shall be carried within the Area;
- a visit report shall be supplied to the authority named in the permit;
- permits shall be issued for a stated period.

7(i) Access to and movement within the Area

Access into the Area is permitted by foot or by helicopter. Use of land vehicles within the Area is prohibited.

Aircraft may operate and land within the Area according to strict observance of the following conditions:

- All overflight of the Area for purposes other than access shall be at a height greater than 2500 ft (~750m) Above Ground Level, except when specifically permitted for scientific purposes.
- The primary designated helicopter landing site preferred for most access to the Area is located at 169° 11' 25" E, 77° 27' 42" S (elevation 240m) (Map 2). This landing site is below and 150m north-west of the Cape Crozier field hut (US) and is marked by a circle of bright orange painted rocks. An alternative, secondary, landing site is located 150m above the hut, which may also be used when necessary.
- A third designated helicopter landing site is located above and 350m north-west of Wilson's Stone Igloo (Map 1) in an area of relatively flat terrain.

- When required for scientific, educational or management purposes, landings may be made elsewhere within the Area provided this is specifically authorized by permit.
- To minimize the risks of inadvertent overflight of bird colonies, helicopter pilots accessing the Area for the first time should be accompanied by another pilot with previous experience of flying into the Area.
- Use of helicopter smoke grenades is prohibited unless absolutely necessary for safety, and all grenades should be retrieved.
- When transporting permitted visitors, pilots, air crew, or passengers en route elsewhere on helicopters are prohibited from moving on foot beyond the immediate vicinity of the designated landing site and field hut unless specifically authorized by a Permit.
- Pedestrian traffic should be kept to the minimum necessary consistent with the objectives of any permitted activities and every reasonable effort should be made to minimize effects.
- Permitted visitors should keep to natural penguin tracks when walking through bird colonies and should not approach occupied nests except as required for scientific or management purposes. Care should be taken to avoid trampling nests when moving through skua territories.
- Visitors should avoid walking on visible vegetation and care should be exercised walking in areas of moist ground, where foot traffic can easily damage sensitive soils, plant and algal communities and degrade water quality.

7(ii) Activities that are or may be conducted in the Area, including restrictions on time or place

Activities that may be conducted within the Area include:

- scientific research or educational visits that will not jeopardize the ecosystem of the Area;
- essential management activities, including monitoring;
- visits to historic sites for scientific, management, educational or historical reasons subject to the conditions described within this plan;
- activities with the aim of preserving or protecting the historic resources within the Area.

7(iii) Installation, modification or removal of structures

- No structures are to be erected within the Area except as specified in a permit;
- All scientific equipment installed in the Area must be authorized by permit and clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area;
- Removal of specific equipment for which the permit has expired shall be the responsibility of the authority which granted the original Permit, and shall be a condition of the permit.

7(iv) Location of field camps

Camping within the Area should be within a 100-m radius of the hut (169° 11' 14" E, 77° 27' 39" S). Camping is permitted outside of the hut vicinity where access is required to distant parts of the Area. Such camping should preferably be at sites that have been previously used, are not vegetated or occupied by breeding birds, and should be on snow or ice-covered ground if available. Researchers should consult with the appropriate national authority to obtain up-to-date information on any sites where camping may be preferred.

7(v) Restrictions on materials and organisms that can be brought into the Area

- No living animals, plant material, microorganisms or soils shall be deliberately introduced into the Area, and the precautions listed below shall be taken against accidental introductions;
- To help maintain the ecological and scientific values of the Area visitors shall take special precautions against introductions. Of particular concern are microbial, invertebrate and vegetation introductions from soils at other Antarctic sites, including stations, or from regions outside Antarctica. To minimize the risk of introductions, visitors should thoroughly clean footwear and any equipment to be used in the area – particularly sampling equipment and markers – before entering the Area.
- In view of the presence of breeding bird colonies at Cape Crozier, no poultry products, including products containing uncooked dried eggs, including wastes from such products, shall be released into the Area;
- No herbicides or pesticides shall be brought into the Area;
- Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the permit, shall be removed from the Area at or before the conclusion of the activity for which the permit was granted;
- Fuel, food, and other materials are not to be stored in the Area, unless required for essential purposes connected with the activity for which the permit has been granted or are contained within an emergency cache authorized by an appropriate authority;
- All materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimized;
- If release occurs which is likely to compromise the values of the Area, removal is encouraged only where the impact of removal is not likely to be greater than that of leaving the material *in situ*.

7(vi) Taking or harmful interference with native flora or fauna

Taking or harmful interference of native flora and fauna is prohibited, except in accordance with a permit issued under Article 3 of Annex II by the appropriate national authority specifically for that purpose.

7(vii) Collection or removal of anything not brought into the Area by the permit holder

- Material may be collected or removed from the Area only in accordance with a permit and should be limited to the minimum necessary to meet scientific or management needs.
- Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the permit holder or otherwise authorized, may be removed from any part of the Area, unless the impact of removal is likely to be greater than leaving the material *in situ.* If this is the case the appropriate authority should be notified.
- Unless specifically authorized by permit, visitors are prohibited from interfering with or attempting restoration of Wilson's Stone Igloo in any way, or from handling, taking or damaging any artifacts. Evidence of recent changes, damage or new artifacts observed should be notified to the appropriate national authority. Relocation or removal of artifacts for the purposes of preservation, protection, or to re-establish historical accuracy is allowable by permit.

7(viii) Disposal of waste

All wastes, including all human wastes, shall be removed from the Area.

7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

- Any specific sites of long-term monitoring shall be appropriately marked.

7(x) Requirements for reports

- Parties should ensure that the principal holder of each permit issued submit to the appropriate authority a report describing the activities undertaken. Such report should include, as appropriate, the information identified in the Visit Report form contained in Appendix 4 of Resolution 2 (1998)(CEP I).
- Parties should maintain a record of such activities, and, in the annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the Management Plan and in organizing the scientific use of the Area.
- The appropriate authority should be notified of any activities/measures undertaken, and / or of any materials released and not removed, that were not included in the authorized permit.

8. Selected references

Ainley, D.G., C.A. Ribic, G. Ballard, S. Heath, I. Gaffney, B.J. Karl, K.J. Barton, P.R. Wilson, & S. Webb. 2004. Geographic structure of Adélie penguin populations: overlap in colony-specific foraging areas *Ecological Monographs* **74**(1):159–78.

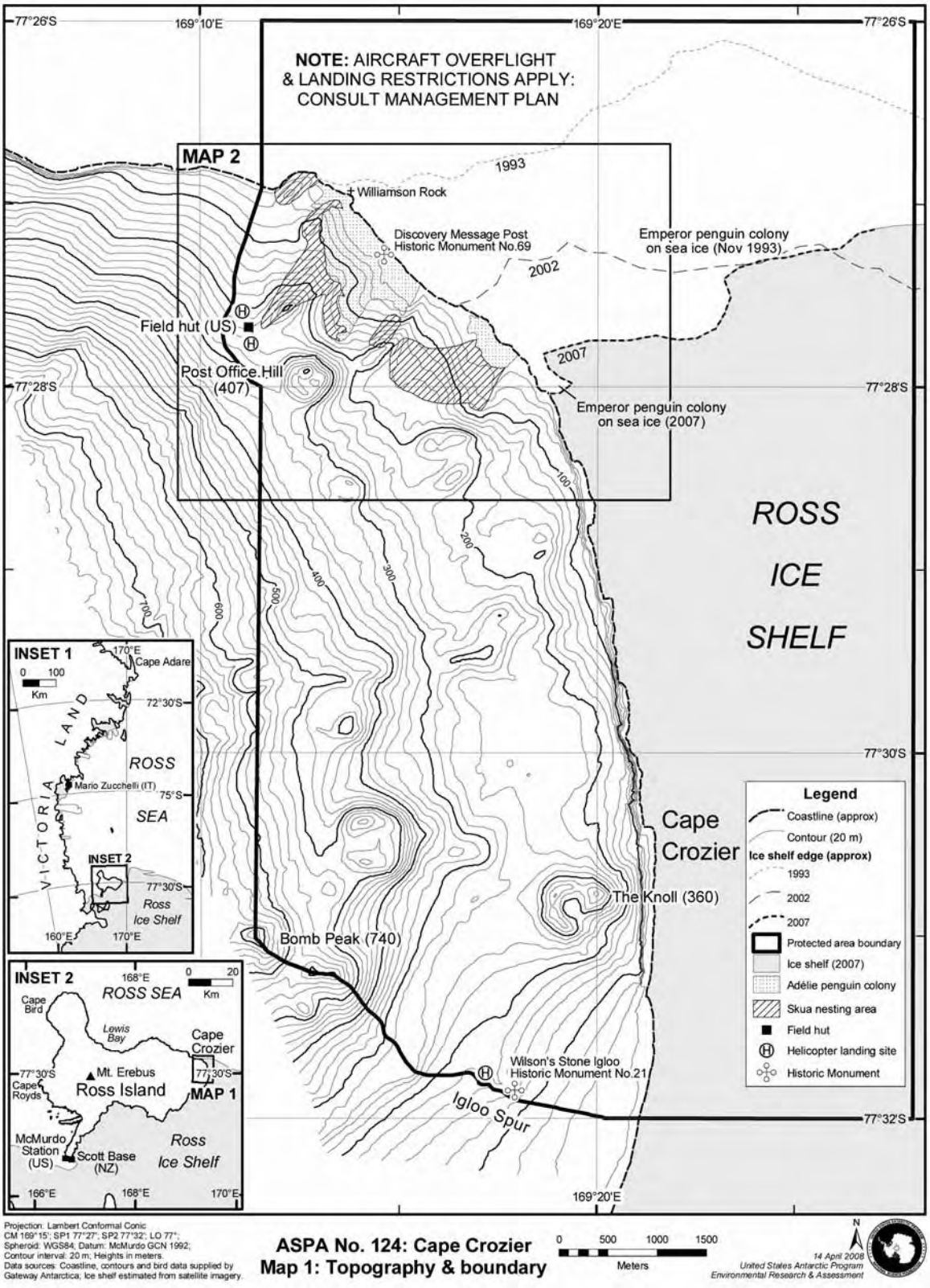
Arrigo, K. R., G.L. van Dijken, D.G. Ainley, M.A. Fahnestock, & T. Markus. 2002. Ecological impact of a large Antarctic iceberg. *Geophysical Research Letters* **29**(7): 1104.

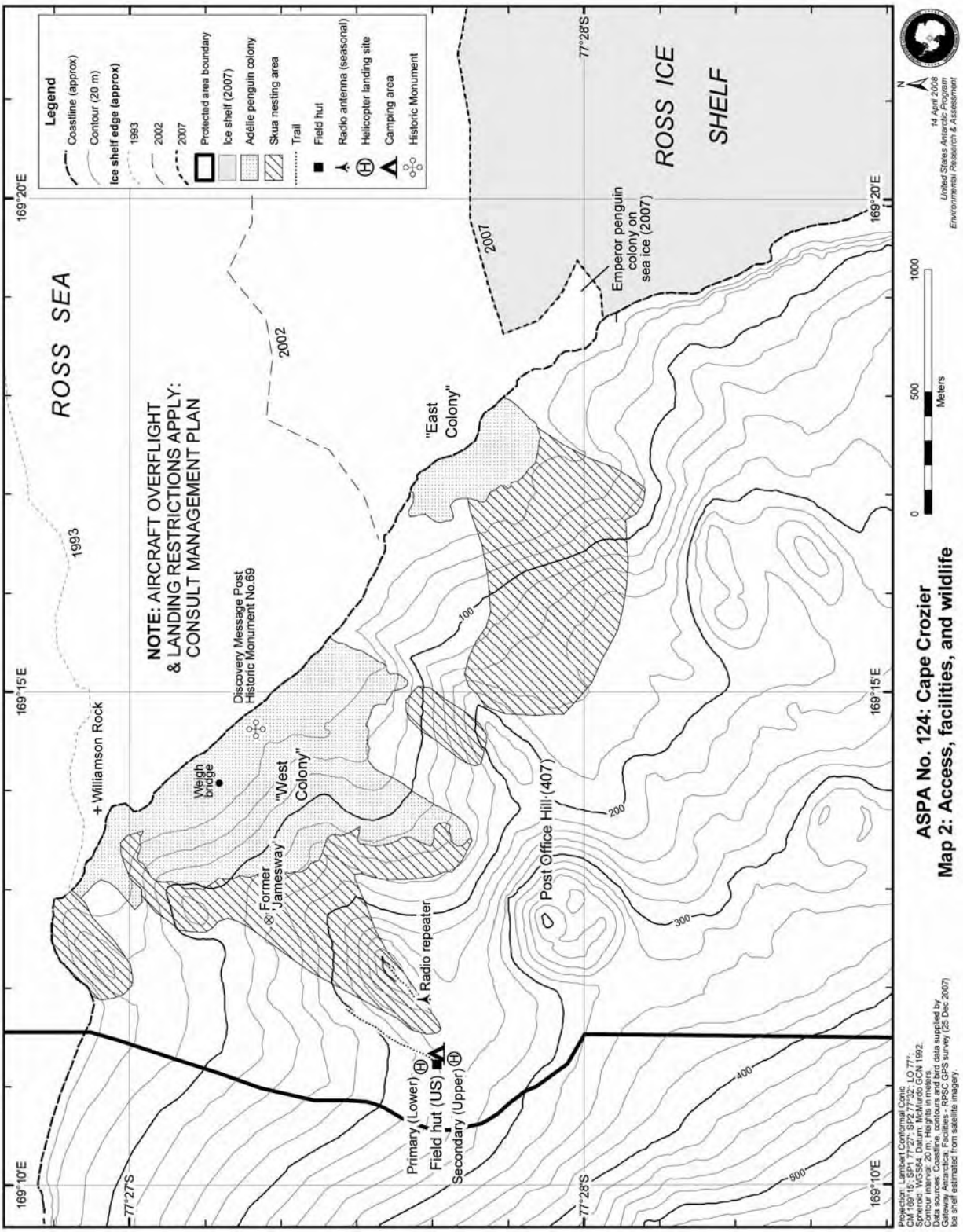
Barber-Meyer, S.M., G.L. Kooyman, & P.J. Ponganis. 2008. Trends in western Ross Sea emperor penguin chick abundances and their relationships to climate. *Antarctic Science* **20** (1), 3–11.

Broady, P.A. 1989. Broadscale patterns in the distribution of aquatic and terrestrial vegetation at three ice-free regions on Ross Island, Antarctica. *Hydrobiologia* **172**: 77-95.

Kooyman, G.L. 1993. Breeding habitats of emperor penguins in the western Ross Sea. *Antarctic Science* **5**(2): 143-48.

Kooyman, G.L., D.G. Ainley, G. Ballard, & P.J. Ponganis. 2007. Effects of giant icebergs on two emperor penguin colonies in the Ross Sea, Antarctica. *Antarctic Science* **19**(1): 31-38.


77°26'S
169°10'E
169°20'E
NOTE: AIRCRAFT OVERFLIGHT
& LANDING RESTRICTIONS APPLY:
CONSULT MANAGEMENT PLAN
MAP 2
1993
Williamson Rock
Discovery Message Post
Historic Monument No.69
Emperor penguin colony
on sea ice (Nov 1993)
2002
Field hut (US)
2007
Post Office Hill
(407)
77°28'S
Emperor penguin colony
on sea ice (2007)
100
200
300
400
500
600
700
ROSS
ICE
SHELF
77°30'S
INSET 1
170°E
Cape Adare
0 100
Km
72°30'S
VICTORIA LAND
ROSS
SEA
Mario Zucchelli (IT)
75°S
INSET 2
77°30'S
Ross
Ice Shelf
160°E
170°E
Cape
Crozier
The Knoll (360)
Bomb Peak (740)
Legend
Coastline (approx)
Contour (20 m)
Ice shelf edge (approx)
1993
2002
2007
Protected area boundary
Ice shelf (2007)
Adélie penguin colony
Skua nesting area
Field hut
Helicopter landing site
Historic Monument
INSET 2
168°E
0 20
Km
ROSS SEA
Cape
Bird
Lewis
Bay
Cape
Crozier
77°30'S
Mt. Erebus
Ross Island
MAP 1
Cape
Royds
McMurdo
Station
(US)
Scott Base
(NZ)
Ross
Ice Shelf
166°E
168°E
170°E
Wilson's Stone Igloo
Historic Monument No.21
Igloo Spur
77°32'S
169°20'E
Projection: Lambert Conformal Conic
CM 169°15'; SP1 77°27'; SP2 77°32'; LO 77°;
Spheroid: WGS84; Datum: McMurdo GCN 1992;
Contour interval: 20 m; Heights in meters.
Data sources: Coastline, contours and bird data supplied by
Gateway Antarctica; Ice shelf estimated from satellite imagery.
ASPA No. 124: Cape Crozier
Map 1: Topography & boundary
0 500 1000 1500
Meters
N
14 April 2008
United States Antarctic Program
Environmental Research & Assessment


Legend
Coastline (approx)
Contour (20 m)
Ice shelf edge (approx)
1993
2002
2007
Protected area boundary
Ice shelf (2007)
Adélie penguin colony
Skua nesting area
Trail
Field hut
Radio antenna (seasonal)
Helicopter landing site
Camping area
Historic Monument
ROSS SEA
ROSS ICE SHELF
NOTE: AIRCRAFT OVERFLIGHT & LANDING RESTRICTIONS APPLY: CONSULT MANAGEMENT PLAN
+ Williamson Rock
Discovery Message Post Historic Monument No.69
Weigh bridge
"West Colony"
Former Jamesway
Radio repeater
Primary (Lower)
Field hut (US)
Secondary (Upper)
"East Colony"
Post Office Hill (407)
Emperor penguin colony on sea ice (2007)
169°10'E
169°15'E
169°20'E
77°27'S
77°28'S
100
200
300
400
500
0
500
1000
Meters
N
14 April 2008
United States Antarctic Program
Environmental Research & Assessment
ASPA No. 124: Cape Crozier
Map 2: Access, facilities, and wildlife
Projection: Lambert Conformal Conic
CM 169° 15'; SP1 77° 27'; SP2 77° 32'; LO 77°;
Spheroid: WGS84; Datum: McMurdo GCN 1992.
Contour interval: 20 m; Heights in meters
Data sources: Coastline, contour and ice shelf data supplied by Gateway Antarctica: Facilities - RPSC GPS survey (25 Dec 2007)
Ice shelf estimated from satellite imagery.

II. Measures

Measure 8 (2008)

Antarctic Specially Protected Area No 135 (North-East Bailey Peninsula, Budd Coast, Wilkes Land): Revised Management Plan

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas ("ASPA") and approval of Management Plans for those Areas;

Recalling

- Recommendation XIII-8 (1985), which designated Bailey Peninsula, Budd Coast, Wilkes Land as Site of Special Scientific Interest ("SSSI") No 16 and annexed a Management Plan for the Site;
- Resolution 7 (1995), which extended the expiry date of SSSI 16 from 31 December 1995 to 31 December 2000;
- Measure 2 (2000), which extended the expiry date of SSSI 16 from 31 December 2000 until 31 December 2005;
- Decision 1 (2002), which renamed and renumbered SSSI 16 as Antarctic Specially Protected Area No 135;
- Measure 2 (2003), which annexed a revised Management Plan for ASPA 135;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 135;

Desiring to replace the existing Management Plan for ASPA 135 with the revised Management Plan;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) the revised Management Plan for Antarctic Specially Protected Area No 135: North-East Bailey Peninsula, Budd Coast, Wilkes Land, which is annexed to this Measure, be approved; and

2) all prior Management Plans for ASPA 135, namely those annexed to:

    - Recommendation XIII-8 (1985), and

    - Measure 2 (2003);

    shall cease to be effective.

Management Plan for Antarctic Specially Protected Area No 135

NORTH-EAST BAILEY PENINSULA, BUDD COAST, WILKES LAND

Introduction

North-east Bailey Peninsula was designated in 1985 as Site of Special Scientific Interest (SSSI) No 16 through Recommendation XIII-8, after a proposal by Australia. In accordance with Resolution 5 (1996) the site was redesignated and renumbered as Antarctic Specially Protected Area (ASPA) No 135. The ASPA is designated primarily as a scientific reference site which, since the early 1980s, has supported a range of studies into the diverse assemblage of vegetation found in the area. The site is located in close proximity to Australia's Casey station, which allows ease of access for field research but also creates the potential for disturbance of study areas.

1. Description of values to be protected

Windmill Islands Region

Outside the Antarctic Peninsula, the Windmill Islands region supports some of the most extensive and best-developed plant communities on continental Antarctica. The region is floristically diverse with rich associations of macrolichens and bryophytes that occupy very specific ecological niches. The flora of the Windmill Islands region comprises at least 36 species of lichen, 6 bryophytes (5 mosses and 1 liverwort), 150 non-marine algae and at least 120 fungal taxa. An ascomycete mycorrhizal fungus has been shown in the liverwort *Cephaloziella varians*.

Lichens constitute the largest part of the Windmill Islands region flora, with bryophytes being dominant in moister areas. At least 11 cryptogamic community types have been identified. These vegetation groupings exist within a continuum of ecological variation along environmental gradients influenced by soil moisture, soil chemistry, and microclimate. On the peninsulas in the region, the major community types are distinguished by the dominance of three bipolar lichens, *Usnea sphacelata, Pseudephebe minuscula* and *Umbilicaria decussata*. Vegetation communities on the islands are dominated by algal species such as *Prasiola crispa*, with moss and lichen being considerably poorer developed than on the peninsulas. Mosses and lichens are all but absent in eutrophic sites near bird colonies with a prevalence of *Prasiola crispa, Prasiococcus calcareus* and *Desmococcus olivaceus* chlorophyte algae occurring.

North-east Bailey Peninsula Protected Area

The North-east Bailey Peninsula Antarctic Specially Protected Area (the Area) is representative of a diverse assemblage of the Windmill Islands region flora. As such, the Area has intrinsic ecological value and scientific importance, particularly to botanists, microbiologists, soil scientists and glacial geomorphologists.

The Area contains three extensive and contrasting moss fields that have been the subject of taxonomic, ecological and physiological studies since the summer of 1982/83. Additional studies have included population ecology of invertebrates associated with the vegetation, and soil/water chemistry. Permanent lichen growth monitoring sites are established, as are sites monitoring annual growth increments in mosses. Other floral studies have concentrated on the determination of biodiversity,

physiological and biochemical attributes, component interactions, impact of anthropogenic pollutants, and potential effects of global climate change.

Global change studies have included a multi-season investigation into the impact of water and nutrients on various components of the vegetation, associated studies into the tolerance of mosses to both submergence and desiccation, and examination of the tolerance of three moss species to increased UV-B as a result of ozone depletion. Fine-scale analysis of genetic diversity of one cosmopolitan moss species *Ceratodon purpureus* has been compared for this location and others in the region. Dating of long cores of mosses has been achieved using ^{14}C released during atmospheric atomic bomb testing in the 1950s and 1960s.

The Area is included within the geographic coverage of an Australian Antarctic programme state of the environment indicator "Windmill Islands terrestrial vegetation dynamics", which involves quantitative analysis of a series of permanent transects across selected vegetation, with the aim of monitoring the effects of climate change on Antarctic cryptogamic communities.

Moss and lichen communities are used to monitor environmental impacts of Casey station. The Area provides baseline data with which to compare changes in similar plant communities in the immediate surroundings of Casey station. The Area also serves as a valuable comparative site for similar plant communities in ASPA 136 Clark Peninsula, which are subject to less environmental stress and disturbance.

2. Aims and objectives

Management of the Area aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance and sampling in the Area;
- preserve a part of the natural ecosystem as a reference Area for the purpose of future comparative studies and to assess direct and indirect effects of Casey station;
- provide for compelling scientific research which cannot be served elsewhere;
- minimise the possibility of introduction of alien plants, animals and microbes to the Area; and
- allow for the continued maintenance of the Tandem Delta antenna communications installation and associated facilities without degradation of the Area's values.

3. Management activities

The following management activities shall be undertaken to protect the values of the Area:

- place signs illustrating the location and boundaries, with clear statements of entry restrictions at appropriate locations at the boundaries of the Area to help avoid inadvertent entry;
- display prominently information on the location of the Area (stating special restrictions that apply) and a copy of this Management Plan at Casey station and provide copies of this information to ships visiting the vicinity;
- secure and maintain in good condition markers, signs and structures erected within the Area for scientific or management purposes and remove them when no longer required;
- remove abandoned equipment or materials to the maximum extent possible provided this does not adversely impact on the values of the Area;

- detailed mapping of ongoing scientific experimental sites to ensure they are not disturbed;
- visit the Area as necessary (no less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure that management activities are adequate; and
- review the Management Plan at least every five years and update as required.

4. Period of designation

Designated for an indefinite period.

5. Maps

- Map A: Windmill Island, showing location of the North-east Bailey Peninsula ASPA No 135 and other protected areas within the region.
  Map specifications:
  Projection: Lambert Conformal Conic
  Horizontal Datum: WGS84
- Map B: North-east Bailey Peninsula, Antarctic Specially Protected Areas No 135: Topography, vegetation, birds, roads and structures.
  Map specifications:
  Projection: UTM Zone 49
  Horizontal Datum: WGS84.
  Contour Interval: 10m.
- Map C: North-east Bailey Peninsula, Antarctic Specially Protected Areas No 135: Vegetation
  Map specifications:
  Projection: UTM Zone 49
  Horizontal Datum: WGS84.
- Map D: North-east Bailey Peninsula, Antarctic Specially Protected Areas No 135. Geology.
  Map specifications:
  Projection: UTM Zone 49
  Horizontal Datum: WGS84.
- Map E: North-east Bailey Peninsula, Antarctic Specially Protected Areas No 135: Showing buildings, structures and vegetation.
  Map specifications:
  Projection: UTM Zone 49
  Horizontal Datum: WGS84.

6. Description of the Area

6(i) Geographical co-ordinates, boundary markers and natural features

General description

The Area is located on Bailey Peninsula in the Windmill Islands region of Budd Coast, Wilkes Land, East Antarctica (Map A). Bailey Peninsula is an area of rock exposures and permanent snow and ice fields lying between Newcomb Bay and O'Brien Bay, two kilometres south of Clark Peninsula.

The Area is located in the north-east of Bailey Peninsula, approximately 200m east of Casey station (66°16'59.9"S, 110°31'59.9"E), and covers an area of approximately 0.28km^2. The boundary is irregular, extending in the north to within approximately 70m south of Brown Bay. Boundary coordinates for the Area are shown in Appendix 1.

Topographically, Bailey Peninsula comprises low lying, rounded ice-free rocky outcrops (maximum altitude approximately 40 m), and, rising from the coast to the Løken Moraines (altitude approximately 130 m) approximately three kilometres to the east. Intervening valleys are filled with permanent snow or ice, or glacial moraine and exfoliated debris, and contain water catchment areas. The topography of Bailey Peninsula is shown at Map B.

Climate

The climate of the Windmill Islands region is frigid-Antarctic. Climate records from nearby Casey station (altitude 32 m) show mean temperatures for the warmest and coldest months of 2.2 and -11.4°C respectively, extreme temperatures ranging from 9.2 to -34°C, and mean annual maximum and minimum temperatures of –5.9°C and –12.5°C respectively. The climate is dry with a mean annual snowfall of 219 mm year (rainfall equivalent), precipitation as rain has been recorded in the summer.

There is an annual average wind speed of 25km per hour. Gale winds are predominantly from the east, off the polar ice cap. Blizzards may occur very suddenly and are a frequent occurrence especially during winter. Snowfall is common during the winter, but the extremely strong winds scour the snow off exposed areas of the Peninsula. On most hill crests on Bailey Peninsula snow gathers in the lee of rock outcrops and in depressions in the substratum. Further down the slopes snow forms deeper drifts.

Geology and soils

WINDMILL ISLANDS REGION

The Windmill Islands region represents one of the eastern-most outcrops of a Mesoproterozoic low-pressure granulite facies terrain that extends west to the Bunger Hills and further to the Archaean complexes in Princess Elizabeth Land, to minor exposures in the east in the Dumont d'Urville area and in Commonwealth Bay. The total outcrop areas do not exceed more than a few square kilometres. The Mesoproterozoic outcrop of the Windmill Islands and the Archaean complexes of Princess Elizabeth Land are two of the few major areas in East Antarctica that can be directly correlated with an Australian equivalent in a Gondwana reconstruction. The Mesoproterozoic facies terrain comprises a series of migmatitic metapelites and metapsammites interlayered with mafic to ultramafic and felsic sequences with rare calc-silicates, large partial melt bodies (Windmill Island supacrustals), undeformed granite, charnockite, gabbro, pegmatite, aplites and cut by easterly-trending late dolerite dykes.

BAILEY PENINSULA

Bailey Peninsula is part of the northern gradation of a metamorphic grade transition which separates the northern part of the Windmill Islands region from the southern part. The metamorpohic grade ranges from amphibolite facies, sillimanite-biotite-orthoclase in the north at Clark Peninsula, through biotite-cordierite-almandine granulite, to hornblende-orthopyroxene granulite at Browning Peninsula in the south. The Ardery Charnockite of the south is prone to deep weathering and crumbles readily because of its mineral assemblage, whereas the metamorphic sequences of the northerly parts of the region have a much more stable mineral assemblage and crystalline structure. This difference has a significant influence on the distribution of vegetation in the Windmill Islands region with the northern rock types providing a more suitable substrate for slow growing lichens.

The leucocratic granite gneiss, which constitutes the main outcrop on Bailey Peninsula, may be subdivided into leucogneiss and two different types of garnet-bearing gneiss. The outcrop on Bailey Peninsula is characterised as a garnet-bearing gneiss type 1 which is white, medium grained and foliated. The foliation is defined by the alignment of an early biotite generation that is tight to openly folded, with a garnet and a later biotite generation that overgrows the fabric. Unmetamorphosed and undeformed dolerite dykes occur over Bailey Peninsula such as at "Penguin Pass" (66°17’18"S, 110°33’16"E), to the south of the Area. Small outcrops of metapelite, metapsammite and leuco- gneisses occur on the Peninsula. Recent geochronology of the rocks of the Windmill Islands region suggest two major phases of metamorphism, the first at c. 1400-1310 Ma, an upper amphibolite facies event, followed by a granulite facies overprint c. 1210-1180 Ma. The geology of Bailey Peninsula is shown at Map D.

GLACIATION

The Windmill Islands region was glaciated during the Late Pleistocene. The southern region of the Windmill Islands was deglaciated by 8000 corr. yr B.P., and the northern region, including Bailey Peninsula deglaciated by 5500 corr. yr B.P. Isostatic uplift has occurred at a rate of between 0.5 and 0.6 m/100 yr, with the upper mean marine limit, featured as ice-pushed ridges, being observed on Bailey Peninsula at approximately 30m where they extend in continuous rows from the present sea-level.

SOILS

Soils on Bailey Peninsula are derived from weathered gneiss, moraine deposits and outwash gravels stemming from glacial episodes. Seabirds have a large impact on soil formation in the entire landscape. Soils are frozen much of the year during summer, the upper 30-60 cm thaws with the few top centimetres, refreezing at night. Soils are mainly formed by cryoturbation and cryoclastic weathering. In the vicinity of Casey station most soils are classified by Blume, Kuhn and Bölter (2002) as cryosols with lithic, leptic, skeletal, turbic and stagnic subunits. Other soils in the Area are gelic subunits of histosols, podzols, and regosols, boulder and rock outcrops with ecto- and endolithic flora are classified as Lithosols.

Lakes

Cold monomictic lakes and ponds occur throughout the Windmill Islands region in bedrock depressions and are usually ice-free during January and February. Nutrient rich lakes are found near the coast, in close proximity to penguin colonies or abandoned colonies, sterile lakes are located further inland and are fed by meltwater and local precipitation. A number of these lakes and ponds occur across Bailey Peninsula with two large lakes located 500m to the west of the Area. Two ponds occur within the protected Area, the largest being approximately 75m by 50m and the smaller approximately 25m diameter. The distribution of lakes and ponds on Bailey Peninsula is shown at Map B.

Vegetation

The vegetation of Bailey Peninsula is exceptionally well developed and diverse and the Area represents one of the most important botanical sites on continental Antarctica. Within the relatively complex plant communities and contrasting habitats found on Bailey Peninsula, are found at least 23 lichens, three mosses, and a liverwort. There are expansive dense stands of macrolichens and in the more moist and sheltered areas bryophytes form closed stands of 25-50 m^2 with turf up to 30 cm in depth. Together with the lichens *Umbilicaria decussata, Pseudephebe minuscula* and *Usnea sphacelata* mixed bryophytes dominate the vegetation cover of most of the ice-free areas. This is particularly so on the north-east and centre of the Peninsula where there are dense communities similar to those found on Clark Peninsula. The most complex bryophyte communities are restricted to small locally moist hollows adjacent to melt pools and streams in the central north-east and central parts of the Peninsula. Vegetation is absent or poorly developed on the ice-free areas of the Peninsula's southern coast. Appendix 2 provides a list of bryophytes and lichens identified in the Area. In many areas mosses appear to becoming increasingly moribund and are being out-competed or overgrown by lichens.

Two principal cryptogamic subformations are recognised; a lichen-dominated association occupying a variety of windswept substrata ranging from bedrock to gravel, and, a short cushion and turf moss subformation comprising four moss dominated sociations. The vegetation of Bailey Peninsula is shown at Maps C and E.

At least 150 taxa of non-marine algae and cyanobacteria have been isolated; these include 50 cyanobacteria, 70 chlorophytes and 23 chromophytes. The taxa have been found in snow and ice, soil, rocks, ephemeral ponds, tarns and lakes; 24 cyanobacterial and algal species occur in the snow. Snow algae are abundant and widespread in the icy corridors between the rocky outcrops and in semi-permanent snow drifts. A list of cyanobacterial and algal species from the Area, Bailey Peninsula, and the Windmill Islands region is shown in Appendix 3.

The vegetated soils of Bailey Peninsula contain fungal hyphae, yeasts, fungal propagules, an assortment of algae, cyanobacteria, protozoa, and provide a significant habitat for soil microfauna such as nematodes, mites, rotifers and tardigrades. There is relatively low fungal diversity in the Windmill Islands region, with 35 taxa representing 22 genera of fungi being isolated from soils, mosses, algae and lichens. Thirty fungal taxa have been detected in soils in the vicinity of Casey station with 12 of these taxa restricted to anthropogenically influenced soils around the station, *Penicillium* species dominate in these sites. Within the Windmill Islands region, 21 fungal taxa have been isolated the mosses, with 12 taxa isolated from algae and 6 from lichens. A number of fungi have also been found associated with animals of the region. Appendix 4 provides detail of the taxa and their source.

Birds

Four species of birds are known to nest in the vicinity of Bailey Peninsula. These include Adélie penguin *Pygoscelis adeliae*, the most abundant bird species in the Area. The nearest breeding colony is on Shirley Island about 1.5km west of Casey station. Snow petrels *Pagodroma nivea* are seen all year round and breed throughout the Windmill Islands region including Reeve Hill about 750m west of the Area and Budnick Hill, 600m to the north-west. Wilson's storm petrels *Oceanites oceanicus* breed throughout the Windmill Islands region and nest in the Area. The Antarctic skua *Catharacta maccormicki* breeds throughout the Windmill Islands region at widely dispersed nests, mostly near Adélie penguin colonies.

Other birds that breed in the Windmill Islands region but not in the immediate vicinity of Bailey Peninsula include southern giant petrel *Macronectes giganteus*, cape petrel *Daption capense*, southern

fulmar *Fulmarus glacialoides* and Antarctic petrel *Thalassoica antarctica*. The emperor penguin *Aptenodytes forsteri* is a common visitor to the Windmill Islands region and a breeding colony of approximately 2000 pairs is established in the area of Peterson Bank.

Terrestrial invertebrates and microbial communities

The Antarctic flea *Glaciopsyllus antarcticus* has been found in the nests of southern fulmars. The anopluran louse *Antarctophthirus ogmorhini* is found on the Weddell seal *Leptonychotes weddellii* A number of species of mallophagan lice have also been found on birds.

The mite *Nanorchestes antarcticus* has been found on Bailey Peninsula at sites characterised as having sandy or gravelly soils, free of extensive moss or lichen cover, and moist but not water-logged.

Five species of tardigrades have been collected on Bailey Peninsula: *Pseudechiniscus suillus, Macrobiotus* sp.*, Hypsibius antarcticus, Ramajendas frigidus* and *Diphascon chilenense.* Significant positive associations between bryophytes and the most common species of tardigrades *P. suillus, H. antarcticus* and *D. chilenense*, have been found, and strong negative associations between those species and algae and lichens have been established. No systematic or ecological accounts of nematodes have yet been published for the Windmill Islands region.

Protozoa have been studied at a number of sites on Bailey Peninsula and in the Area ciliates and testate amoebae are active. Twenty seven ciliate species and six testacean species have been found (see Appendix 5).

6(ii) Special zones within the Area

There are no special zones within the Area.

6(iii) Location of structures within and adjacent to the Area

Casey station (Australia) is located approximately 200m west of the Area. Prior to the designation of the Area in 1986 an array of radio transmitters had been progressively established at the site since 1964. During the 2001/2002 and 2007/2008 summers redundant aerials and some other infrastructure were removed. A number of structures remain within the Area, including a small storage rack in the north-west, the transmitter building (which can also be used as an emergency refuge), a 45m high tandem delta antenna mast and a non-directional beacon antenna located in the south-east (Map E). Another 35m high mast is located approximately 100m south of the Area.

6(iv) Location of other Protected Areas in the vicinity

ASPA No 136, Clark Peninsula, is located 2.5km to the north-east, across Newcomb Bay.

ASPA No 103, Ardery and Odbert Islands, is located approximately 11km to the south, west of Robinson Ridge.

ASPA No 160, Frazier Islands, is located in the eastern part of Vincennes Bay approximately 16km to the west-north-west.

7. Permit conditions

Entry into the Area is prohibited except in accordance with a Permit issued by an appropriate national authority. A Permit to enter the Area may only be issued for compelling scientific research, maintenance of the Tandem Delta antenna communications installation and associated facilities, or

for essential management purposes consistent with the Management Plan's objectives and provisions, and providing that the actions permitted will not jeopardise the ecological or scientific values of the Area or interfere with existing scientific studies. Conditions that must be included in the Permit are that the Permit or an authorised copy shall be carried within the Area, and that the Permit specify the period for specific activities. Additional conditions, consistent with the Management Plan's objectives and provisions, may be included by the issuing Authority.

7(i) Access to and movement within or over the Area

Helicopters are prohibited from landing within the Area.

Vehicles are prohibited from entering the Area, except for the purpose of conducting ongoing maintenance of the transmitter building, associated buildings and antennas. Access to the transmitter building near the south-east end of the Area should be via the over-snow access route to Law Dome, several kilometres to the south. Within the Area, vehicles should follow the most direct practicable route between the Area boundary and the communications facilities, avoiding vegetation and cables. Vehicle use in the Area shall be kept to a minimum.

The Area is accessible on foot. Casey station is located approximately 200m west of the north west boundary of the Area. Visitors should avoid walking on visible vegetation. Care should be exercised when walking in areas of moist ground, where foot traffic can easily damage sensitive soils, plant or algae communities, and degrade water quality. Pedestrian traffic should be kept to the minimum necessary to undertake permitted activities and every reasonable effort should be made to walk around such areas, keeping to ice-covered areas or bare rock where it is practicable and safe to do so.

7(ii) Activities which are or may be conducted within the Area, including restrictions on time and place

Compelling scientific research which cannot be undertaken elsewhere and which will not jeopardise the ecosystem of the Area.

Essential management activities, including monitoring.

Sampling, but this should be the minimum required for the approved research programs.

Maintenance and activities associated with the antennas and transmitter facility.

7(iii) Installation, modification or removal of structures

Any structures erected or installed within the Area are to be specified in a Permit. Scientific markers and equipment must be secured and maintained in good condition, clearly identifying the permitting country, name of principal investigator and year of installation. All such items should be made of materials that pose minimum risk of contamination of the Area. Removal of equipment associated with scientific research, before the Permit for that research expires, shall be a condition of the Permit. Details of markers and equipment left in situ should be reported to the permitting Authority. Such details should include a description, expected "use by date", and accurate GPS location with longitude and latitude in decimal degrees to 6 decimal places (where practicable, details should also be given regarding the horizontal datum used, model of GPS, base station details, and horizontal and vertical accuracies).

7(iv) Location of field camps

Camping is prohibited within the Area.

7(v) Restrictions on materials and organisms which may be brought into the Area

- No living animals, plant material or microorganisms shall be deliberately introduced into the Area. To help maintain the ecological and scientific values of the plant communities found in the Area, persons entering the Area shall take special precautions against unintentional introductions. Of particular concern are microbial or vegetation introductions sourced from soils at other Antarctic sites, including stations, or from regions outside Antarctica. To minimise the risk of introductions footwear and any equipment – including carry cases, sampling equipment and markers – to be used in the Area shall be thoroughly cleaned before entering the Area.
- No herbicides or pesticides shall be brought into the Area. Other chemicals may be introduced for scientific or management purposes specified in a Permit and shall be removed from the Area at or before the conclusion of the permitted activity.
- Permanent fuel depots are prohibited. Fuel may be temporarily stored in the Area for essential purposes connected with an activity for which a Permit has been granted. Such fuel shall be stored in sealed and bunded containers.
- Any materials introduced for a stated period shall be removed at or before the conclusion of the stated period, and shall be stored and handled so that the risk of dispersal into the environment is minimised.

7(vi) Taking of or harmful interference with native flora and fauna

Taking of or harmful interference with native flora and fauna is prohibited, except in accordance with a Permit. Where taking of or harmful interference with animals is involved this should, as a minimum standard, be in accordance with the *SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica.*

7(vii) Collection and removal of anything not brought into the Area by the permit holder

Material may only be collected or removed from the Area in accordance with a Permit and should be limited to the minimum necessary to meet scientific or management needs.

Material of human origin likely to compromise the values of the Area, and which was not brought into the Area by the Permit Holder or otherwise authorised, may be removed unless the impact of the removal is likely to be greater than leaving the material *in situ*. In such cases the appropriate national authority must be notified and approval obtained.

7(viii) Disposal of waste

All wastes, including all human wastes, shall be removed from the Area.

7(ix) Measures that may be necessary to ensure that the aims and objectives of the Management Plan can continue to be met

Permits may be granted to enter the Area to carry out the following measures, provided they do not adversely impact on the values of the Area:

- biological monitoring and Area inspection and management activities, which may involve the collection of small samples for analysis or review;
- erect or maintain signposts;
- remove the storage rack, buildings, antenna masts and associated supplies located in the north-west of the Area; and
- other protective measures as required.

7(x) Requirements for reports

The principal Permit Holder for each Permit issued shall submit to the appropriate national authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report form contained in Appendix 4 of the *Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas* appended to Resolution 2 (1998). Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, which should be in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage; to be used both in any review of the Management Plan and in organising the scientific use of the Area.

8. Supporting documentation

Adamson, E., and Seppelt, R. D. (1990) A comparison of airborne alkaline pollution damage in selected lichens and mosses at Casey Station, Wilkes Land, Antarctica. In: Kerry, K. R. and Hempel, G. (eds.) *Antarctic Ecosystems: Ecological Change and Conservation* Springer-Verlag, Berlin, pp. 347-353.

Azmi, O. R., and Seppelt, R. D. (1997) Fungi in the Windmill Islands, continental Antarctica. Effect of temperature, pH and culture media on the growth of selected microfungi. *Polar Biology* **18**: 128-134.

Azmi, O. R., and Seppelt, R. D. (1998) The broad scale distribution of microfungi in the Windmill Islands region, continental Antarctica. *Polar Biology* **19**: 92-100.

Bednarek-Ochyra, H., Váòa, J., Ochyra, R., Lewis Smith, R. I. (2000) *The Liverwort Flora of Antarctica.* Polish Academy of Sciences, Institute of Botany, Cracow.

Beyer, L., (2002) Properties, Formation and Geography of Soils in a Coastal Terrestrial Ecosystem of East Antarctica (Casey Station, Wilkes Land) [www site] [cited 1 May 2002]. Available from internet: *http://aadc-db.aad.gov.au/metadata/cgi-bin/getdif.pl?format=sgml&morph_dic=dif_to_dif-display-html.dic&entry_ids=ASAC_1083&form=gcmdwww&interface=parameters*

Beyer, L., Pingpank, K., Bölter, M. and Seppelt, R. D. (1998) Small-distance variation of carbon and nitrogen storage in mineral Antarctic cryosols near Casey Station (Wilkes Land). *Zeitschrift fur Pflanzenahrung Bodendunde* **161**: 211-220.

Beyer, Lothar, Kristina Pingpank, Manfred Bölter and Rod D. Seppelt (2002): Soil organic matter storage on soil profile and on landscape level in permafrost affected soils in the coastal region of East Antarctica (Casey Station, Wilkes Land). In: Tarnocai et al. (Eds.). *Cryosols - Permafrost-Affected Soils*. Lewis Publishers, Boca Raton (in press).

Blight, D. F. (1975) The Metamorphic Geology of the Windmill Islands Antarctica, Volume 1 and 2, PhD thesis, University of Adelaide.

Blight, D. F. and Oliver, R. L. (1982) Aspects of the Geological history of the Windmill Islands, Antarctica. In: Craddock, C. (Ed.) *Antarctic Geoscience*, University of Wisconsin Press, Madison, WI, pp. 445-454.

Blight, D. F. and Oliver, R. L. (1997) The metamorphic geology of the Windmill Islands Antarctica: a preliminary account. *Journal of the Geological Society of Australia.* **24** (5): 239-262.

Block, W. (1992) *An Annotated Bibliography of Antarctic Invertebrates (Terrestrial and Freshwater*). British Antarctic Survey, Natural Environmental Research Council, Cambridge.

Block, W. (2002) A dataset of Antarctic and sub-Antarctic invertebrates. [www site], [cited 1 May 2002]. Available from internet: *http://aadc-db.aad.gov.au/metadata/cgi-bin/getdif.pl?format=sgml&morph_dic=dif_to_dif-display-html.dic&entry_ids=block_invertebrates&form=gcmdwww&interface=parameters*

Blume, H-P., Kuhn, D. and Bölter, M. (2002) Soils and landscapes. In: Beyer, L. and Bölter, M. (eds.) *Geoecology of Antarctic Ice-Free Coastal Landscapes.* Springer-Verlag, Berlin, pp. 94-98, 105-108.

Bureau of Meteorology (2004) Climate and History, Climate of Casey [www site], [cited 22 June 2004] Available from internet: *http://www.bom.gov.au/weather/ant/casey/climate.shtml*

Clarke, L.J., Robinson, S.A., Ayre, D.J. (2008) Somatic mutation and the Antarctic ozone hole Journal of Ecology 96 378-385. Editor's choice article for March 2008.

Clarke, L.J., Robinson, S.A. Cell wall-bound UV-screening pigments explain the high UV tolerance of the Antarctic moss, Ceratodon purpureus (revised submission to New Phytologist Feb 2008)

Clarke, L.J., Robinson, S.A., Ayre, D.J. Genetic structure of Antarctic populations of the moss Ceratodon purpureus. (revised submission to Antarctic Science Feb 2008)

Cowan, A. N. (1979) Giant petrels at Casey, Antarctica. *Australian Bird Watcher.* **8** (2): 66-67.

Cowan, A. N. (1981). Size variation in the Snow petrel (Pagodroma nivea). *Notornis* **28**: 169-188.

Dunn, J. (2000) Seasonal variation in the pigment content of three species of Antarctic bryophytes Honours thesis University of Wollongong .; [Ref:10167]; AAS Projects 941, 1310

Dunn, J.L., Robinson, S.A. (2006) Ultraviolet B screening potential is higher in two cosmopolitan moss species than in a co-occurring Antarctic endemic moss: implications of continuing ozone depletion. Global Change Biology 12. 2282-2296; [Ref:12830]; AAS Projects 1310, 2542

Dunn, J.L., Robinson, S.A. (2006) UV-B screening potential is higher in two cosmopolitan moss species than in a co-occurring Antarctic endemic moss - implications of continuing ozone depletion Global Change Biology 12 (12). 42pp; [Ref:12867]; AAS Projects 1310, 2542

Giese, M. (1998) Guidelines for people approaching breeding groups of Adélie penguins (Pygoscelis adeliae). *Polar Record.* **34** (191): 287-292.

Goodwin, I. D. (1993) Holocene deglaciation, sea-level change, and the emergence of the Windmill Islands, Budd Coast, Antarctica. *Quaternary Research.* **40**: 70-80.

Hallingbäck, Tomas and Hodgetts, Nick. (Compilers) (2000) *Mosses, Liverworts, and Hornworts: Status Survey and Conservation Action Plan for Bryophytes.* IUCN/SSC Bryophyte Specialist Group.

Heatwole, H., Saenger, P., Spain, A., Kerry, E. and Donelan, J. (1989) Biotic and chemical characteristics of some soils from Wilkes Land Antarctica. *Antarctic Science.* **1**(3): 225-234.

Hovenden, M. J. and Seppelt, R. D. (1995) Exposure and nutrients as delimiters of lichen communities in continental Antarctica. *Lichenologist* **27**(6): 505-516.

Leslie, S. (2003) The Combined Effects of Desiccation and UV-B Radiation on the Accumulation of DNA Damage, Pigment Composition and Photosynthetic Efficiency in three species of Antarctic moss. Thesis. Bachelor of of Biotechnology (Honours) Degree, University of Wollongong. 1-87; [Ref:11456]; AAS Project 1310

Ling, H. U. (1996) Snow algae of the Windmill Islands region, Antarctica. *Hydrobiologia* 336: 99-106.

Ling, H. U. (2001) Snow Algae of the Windmill Islands, Continental Antarctica: *Desmotetra aureospora*, sp. nov. and D. antarctica, comb. nov. (Chlorophyta). *Journal of Phycology* **37**: 160-174.

Ling, H. U. and Seppelt, R.D. (1990) Snow algae of the Windmill Islands, continental Antarctica. Mesotaenium berggrenii (Zygnematales, Chlorophyta) the alga of grey snow. *Antarctic Science* 2(2): 143-148

Ling, H. U. and Seppelt, R.D. (1993) Snow algae of the Windmill Islands, continental Antarctica. 2. Chloromonas rubroleosa sp. nov. (Volvocales, Chlorophyta), an alga of red snow. *European Journal of Phycology* : 77-84.

Ling, H. U. and Seppelt, R.D. (1998) Non-marine algae and cyanobacteria of the Windmill Islands region, Antarctica, with descriptions of two new species. *Archiv für Hydrobiologie Supplement 124, Algological Studies* 89: 49-62.

Ling, H. U. and Seppelt, R.D. (1998) Snow Algae of the Windmill Islands, continental Antarctica 3. Chloromonas polyptera (Volvocales, Chlorophyta) *Polar Biology* 20: 320-324.

Ling, H. U. and Seppelt, R.D. (2000) Snow Algae of the Windmill Islands Region, Adaptations to the Antarctic Environment. Davison, W., Howard-Williams, C., Broady, P. (eds.) *Antarctic Ecosystems: Models for Wider Ecological Understanding.* pp. 171-174.

Longton, R. E. (1988) *Biology of polar bryophytes and lichens.* Cambridge University Press, Cambridge. 307-309.

Lovelock, C.E., Robinson, S.A. (2002) Surface reflectance properties of Antarctic moss and their relationship to plant species, pigment composition and photosynthetic function. Plant, Cell and Environment. 25. 1239-1250; [Ref:10869]; AAS Projects 941, 1310

Melick, D. R., Hovenden, M. J., and Seppelt, R. D. (1994) Phytogeography of bryophyte and lichen vegetation in the Windmill Islands, Wilkes land, Continental Antarctica. *Vegetatio* 111: 71-87.

Melick, D. R., and Seppelt, R. D. (1990) Vegetation patterns in Relation to climatic and endogenous changes in Wilkes Land, continental Antarctica. *Journal of Ecology* 85: 43-56.

Miller, W. R., Miller, J. D. and Heatwole, H. (1996) Tardigrades of the Australian Antarctic Territories: the Windmill Islands, East Antarctica. *Zoological Journal of the Linnean Society* 116: 175-184.

Murray, M. D., and Luders, D. J. (1990) Faunistic studies at the Windmill Islands, Wilkes Land, East Antarctica, 1959-80. *ANARE Research Notes* **73**, Antarctic Division, Kingston.

Orton, M. N. (1963) A Brief Survey of the fauna of the Windmill Islands, Wilkes Land, Antarctica. *The Emu* **63** (1): 14-22.

Øvstedal, D. O. and Lewis Smith, R. I. (2001) *Lichens of Antarctica and South Georgia: A Guide to their Identification and Ecology.* Cambridge University Press, Cambridge.

Paul, E., Stüwe, K., Teasdale, J. and Worley, B. (1995) Structural and metamorpohic geology of the Windmill Islands, East Antarctica: field evidence for repeated tectonothermal activity. *Australian Journal of Earth Sciences* **42**: 453-469.

Petz, P. (1997) Ecology of the active microfauna (Protozoa, Metazoa) of Wilkes Land, East Antarctica. *Polar Biology* 18: 33-44.

Petz, P. and Foissner, W. (1997) Morphology and infraciliature of some ciliates (Protozoa, Ciliophora) from continental Antarctica, with notes on the morphogenesis of *Sterkiella histriomuscorum*. *Polar Record* **33**(187): 307-326.

Robinson, S.A., Wasley, J., Popp, M., Lovelock, C.E. (2000) Desiccation tolerance of three moss species from continental Antarctica. Australian Journal of Plant Physiology 27. 379-388; [Ref:9083]; AAS Projects 941, 1087, 1313

Robinson, S.A., Dunn, J., Turnbull, D., Clarke, L. (2006) UV-B screening potential is higher in two cosmopolitan moss species than in a co-occurring Antarctic endemic ? implications of continuing ozone depletion. Abstracts of the Combio 2006 Conference, Brisbane Sept 24-28th 2006. p. 101; [Ref:12837]; AAS Projects 1310, 2542

Roser, D. J., Melick, D. R., Ling, H. U. and Seppelt, R. D. (1992) Polyol and sugar content of terrestrial plants from continental Antarctica. *Antarctic Science* **4** (4): 413-420.

Roser, D. J., Melick, D. R. and Seppelt, R. D. (1992) Reductions in the polyhydric alcohol content of lichens as an indicator of environmental pollution. *Antarctic Science* **4** (4): 185-189.

Roser, D. J., Seppelt, R. D. and Nordstrom (1994) Soluble carbohydrate and organic content of soils and associated microbiota from the Windmill Islands, Budd Coast, Antarctica. *Antarctic Science* **6**(1): 53-59.

Selkirk, P. M.and Skotnicki, M. L (2007) *Measurement of moss growth in continental Antarctica*, Polar Biology 30(4): pp. 407-413; Springer-Verlag, Berlin, illus. incl. 2 tables; 21 refs.

Seppelt, R. D. (2002) Plant Communities at Wilkes Land. In: Beyer, L. and Bölter, M. (eds.) *Geoecology of Antarctic Ice-Free Coastal Landscapes* Springer-Verlag, Berlin, 233-242.

Seppelt, R. D. (2002) Wilkes Land (Casey Station). In: Beyer, L. and Bölter, M. (eds.) *Geoecology of Antarctic Ice-Free Coastal Landscapes.* Springer-Verlag, Berlin, pp. 41-46.

Seppelt, R. D. (2008) Dr R. Seppelt, Senior Research Scientist, Australian Antarctic Division. Personal communication.

Smith, R. I. L. (1980) *Plant community dynamics in Wilkes Land, Antarctica,* Proceedings NIPR Symposium of polar biology **3**: 229-224.

Smith, R. I. L. (1986) Plant ecological studies in the fellfield ecosystem near Casey Station, Australian Antarctic Territory, 1985-86. *British Antarctic Survey Bulletin.* **72**: 81-91.

Turnbull, J.D., Robinson, S.A. Susceptibility To Ultraviolet Radiation Induced DNA Damage In Three Antarctic Mosses (submitted to Global Change Biology)

Turnbull, J.D., Robinson, S.A., Leslie, S.J., Nikaido, O. Desiccation confers protection from UV – B radiation but an endemic Antarctic moss is more susceptible to DNA damage than co-occurring cosmopolitan species. (in prep)

Wasley, J., Robinson, S.A., Lovelock, C.E., Popp, M. (2006) Climate change manipulations show Antarctic flora is more strongly affected by elevated nutrients than water. Global Change Biology 12. 1800-1812; [Ref:12682]; AAS Project 1087

Wasley, J., Robinson, S.A., Lovelock, C.E., Popp, M. (2006) Some like it wet — biological characteristics underpinning tolerance of extreme water stress events in Antarctic bryophytes. Functional Plant Biology 33. 443-455; [Ref:12318]; AAS Project 1087

Woehler, E. J., Penney, S. M., Creet, S. M. and Burton, H. R. (1994) Impacts of human visitors on breeding success and long-term population trends in Adélie penguins at Casey, Antarctica. *Polar Biology* **14**: 269-274.

Woehler, E. J., Slip, D. J., Robertson, L. M., Fullagar, P. J. and Burton, H. R. (1991) The distribution, abundance and status of Adélie penguins *Pygoscelis adeliae* at the Windmill Islands, Wilkes Land, Antarctica. *Marine Ornithology* **19**(1): 1-18.

Appendix 1: North-east Bailey Peninsula, Antarctic Specially Protected Area No 135, boundary coordinates

Boundary Point	Longitude	Latitude	**Boundary Point**	Longitude	Latitude
1	110°32’56”	66°17’11”	**15**	110°32’16”	66°16’52”
2	110°32’50”	66°17’11”	**16**	110°32’19”	66°16’53”
3	110°32’41”	66°17’10”	**17**	110°32’19”	66°16’55”
4	110°32’22”	66°17’7”	**18**	110°32’24”	66°16’55”
5	110°32’20”	66°17’6”	**19**	110°32’25”	66°16’53”
6	110°32’18”	66°17’2”	**20**	110°32’29”	66°16’53”
7	110°32’18”	66°17’0”	**21**	110°32’44”	66°16’54”
8	110°32’14”	66°17’0”	**22**	110°33’9”	66°17’5”
9	110°32’9”	66°16’56”	**23**	110°33’11”	66°17’6”
10	110°32’8”	66°16’54”	**24**	110°33’10”	66°17’9”
11	110°32’5”	66°16’54”	**25**	110°33’2”	66°17’11”
12	110°32’7”	66°16’52”			
13	110°32’7”	66°16’52”			
14	110°32’12”	66°16’51”			

Appendix 2: Mosses, liverworts and lichens identified from North-east Bailey Peninsula Antarctic Specially Protected Area No 135, (from Mellick 1994, Seppelt pers. comm.)

Mosses
Bryum pseudotriquetrun (Hedw.) Gaertn., Meyer et Scherb.
Ceratodon purpureus (Hedw.) Brid.
Schistidium antarctici Card.
Liverworts
Cephaloziella varians Steph.
Lichens
Acarospora gwynii Dodge & Rudolph
Amandinea petermannii (Hue) Matzer, H. Mayrhofer & Scheid.
Buellia cf. cladocarpiza Lamb?
Buellia frigida Darb.
Buellia grimmiae Filson
Buellia cf. lignoides Filson
Buellia papillata Tuck.
Buellia pycnogonoides Darb.
Buellia soredians Filson
Caloplaca athallina Darb.
Caloplaca citrina (Hoffm.) Th. Fr.
Candelariella flava (C.W. Dodge & Baker) Castello & Nimis
Lecanora expectans Darb.
Lecidea spp.
Lecidea cancriformis Dodge & Baker (=*Lecidea phillipsiana* Filson)
Lecidea andersonii Filson
Lepraria sp.
Pleopsidium chlorophanum (Wahlenb.) Zopf
Rhizocarpon geographicum
Rhizoplaca melanophthalma (Ram.) Leuck. & Poelt
Rinodina olivaceobrunnea Dodge & Baker
Physcia caesia (Hoffm.) Hampe
Umbilicaria aprina Nyl.
Umbilicaria decussata (Vill.) Zahlbr.
Umbilicaria cf. propagulifera (Vainio) Llano
Xanthoria elegans (Link) Th. Fr.
Xanthoria mawsonii Dodge.
Pseudephebe minuscula (Nyl ex Arnold) Brodo & Hawksw.
Usnea antarctica Du Rietz
Usnea sphacelata R. Br.

Appendix 3: Fungi isolated from soils, mosses, lichens and algae from ASPA No 135 and from species of wider distribution in the Windmill Islands region (from Azmi 1998 and Seppelt pers. comm. 2008)

Note: This is only a partial list of the taxa isolated from the Windmill Islands

	ASPA No 135	Bailey Peninsula	Bryum pseudotri-quetrum	Ceratodon purpureus	Grimmia antarctici	Algae	Lichens*
Acremonium sp.					✓		
Acremonium crotociningenum (Schol-Schwarz) W. Gams		✓					✓
Alternaria alternata (Fr.) Keissl.		✓					
Arthrobotrys			✓	✓			
Aspergillus nidulans (Eidam) G. Winter		✓					
Aspergillus sp.						✓	
Botrytis cinerea Pers.		✓					
Chrysosporium sp	✓		✓	✓	✓		
Chrysosporium pannorum (Link.) S. Hughes	✓	✓	✓	✓	✓	✓	✓
Cladosporium sp.		✓					
Diplodia sp.		✓					
Fusarium oxysporum E.F. Sm., & Swingle		✓					
Geomyces sp.		✓	✓	✓		✓	✓
Geotrichum sp.							
Mortierella sp.		✓	✓		✓	✓	✓
Mortierella gamsii Milko		✓	✓				
Mucor pyriformis Scop.		✓	✓		✓		
Mycelia sterilia 1**	✓		✓	✓	✓	✓	✓
Mycelia sterilia 2**	✓		✓	✓	✓	✓	
Mycelia sterilia 3**	✓		✓	✓	✓		
Mycelia sterilia 4**		✓					
Nectria peziza Berk.		✓	✓		✓		
Penicillium chrysogenum Thom	✓		✓		✓	✓	
P. commune Thom		✓					
P. corylophilum Dierckx		✓					
P. expansum Link		✓	✓	✓		✓	

	ASPA No 135	Bailey Peninsula	Bryum pseudotri-quetrum	Ceratodon purpureus	Grimmia antarctici	Algae	Lichens*
P. hirsutum Dierckx		✓					
P. palitans Westling		✓	✓	✓	✓		
P. roqueforti Thom		✓					
Penicillium sp.			✓	✓	✓	✓	
Penicillium sp. 1							
Penicillium sp. 2							
Phialophora malorum (Kidd & Beaumont) McColloch		✓	✓	✓	✓	✓	
Phoma herbarum Westend		✓	✓	✓	✓		
Phoma sp.	✓						
Phoma sp. 1			✓	✓	✓		
Phoma sp. 2				✓	✓		
Rhizopus stolonifer (Ehrenb.) Vuill.		✓				✓	
Sclerotinia sclerotiorum (Lib.) de Bary		✓					
Thelebolus microsporus (Berk. & Broome) Kimbr.	✓	✓	✓	✓	✓	✓	✓
Trichoderma harzianum Rifai		✓					
T. pseudokoningi Rifai		✓					

*Lichens are *Xanthoria mawsonni, Umbilicaria decussata and Usnea sphacelata.*

** Mycelia sterilia is a general term for sterile mycelia. Approximately 45% of all the isolates obtained from the Windmill Islands have not been identified because they remained sterile in culture.

Appendix 4: Cyanobacterial and algal species identified from the Windmill Islands region

The taxa are listed in alphabetical order under each phylum together with their habitats and whether they are maintained in culture. A = Aquatic, T = Terrestrial (from soil), S = Snow or ice and C = Culture. (from Ling 1998 and Seppelt pers. comm. 2008).

Cyanobacteria	
Aphanothece castagnei (Breb.) Rabenh.	A
Aphanocapsa elachista var. irregularis Boye-Pet.	A
Aphanocapsa muscicola (Menegh.) Wille	A
Aphanothece saxicola Nageli	A
Aphanothece sp.	A
Calothrix parietina Thur.	A
Chamaesiphon subglobosus ((Ros-Taf) Lemmerm.	A
Chroococcus dispersus (Keissl.) Lemmerm.	A
Chroococcus minutus (Kutz.) Nageli	A
Chroococcus turgidus (Kutz.) Nageli	A
Dactylococcopsis antarctica F E. Fritsch	A
Dactylococcopsis smithii R. et E.Chodat (= *Rhabdogloea smithii* (R. et E.Chodat)	A
Eucapsis sp.	T
Gloeocapsa dermochroa Nageli	A
G. kuetzingiana Nageli	A
Hammatoidea sp.	A
Homoeothrix sp.	A
Isocystis pallida Woron.	AT
Katagnymene accurata Geitler	AT
Lyngbya attenuata Fritsch	A
Lyngbya martensiana Menegh.	A
Merismopedia tenuissima Lemmerm.	AT
Myxosarcina concinna Printz	A
Nodularia harveyana var. *sphaerocarpa* (Born. et Flah.) Elenkin	A
Nostoc commune Vaucher	ATC
Nostoc sp.	T
Oscillatoria annae Van Gook	A
Oscillatoria fracta Carlson	A
Oscillatoria irrigua Kutz	A
Oscillatoria lemmermannii Wolosz.	A
Oscillatoria proteus Skuja	A
Oscillatoria sp. (Broady 1979a, *Oscillatoria* cf. *limosa* Agardh)	A
Oscillatoria sp. (BROADY 1979a, *Oscillatoria* sp. C)	T
Phormidium autumnale(Agardh) Gomont	T
Phormidium foveolarum Gomont	A
Phormidium frigidum F.E. Fritsch	A
Phormidium subproboscideum (W et G. S. West) Anagnost et Komarek	A
Phormidium sp.	A
Plectonema battersii Gomont	A
Plectonema nostocorum Bornet	A
Pseudanabaena mucicola (Hub.-Pest. et Naum.) Bour.	A
Schizothrix antarctica F E. Fritsch	A
Stigonema mesentericum Geitler f.	T
Stigonema minutum (AGARDH) Hassall	T
Stigonema sp.	T
Synechococcus aeruginosus Nageli	T
Synechococcus maior Schroeter	AT
Tolypothrix byssoidea (Berk.) Kirchner f	A
Tolypothrix distorta var. *penicillata* (Agardh)Lemmerm.(= Tolypothrix penicillata Thuret)	A

Chlorophyta	
Actinotaenium cucurbita (Breb.) Teiling	AC
Apodochloris irregularis Ling et Seppelt	AC
Asterococcus superbus (Cienk.) Scherff.	AC
Binuclearia tatrana Wittr.	AC
Binuclearia tectorum (KÜTZ.) Beger	AC
Chlamydomonas pseudopulsatilla Gerloff	S
Chlamydomonas sphagnicola (F.E. Fritsch) F.E. Fritsch et Takeda	TC
Chlamydomonas subcaudata Wille	A
Chlamydomonas sp. l	A
Chlamydomonas sp. 2	A
Chlorella vulgaris Beij.	AT
Chloromonas brevispina Hoham, Roemer et Mullet	S
Chloromonas polyptera (F.E. Fritsch) Hoham, Mullet et Roemer	SC
Chloromonas rubroleosa Ling et Seppelt	SC
Chloromonas sp. l	SC
Chloromonas sp. 2	A
Coenochloris sp.	T
Desmococcus olivaceus (Pers. ex Ach.) Laundon	ATC
Desmotetra sp. 1	SC
Desmotetra sp. 2	SC
Dictyosphaerium dichotomum Ling et Seppelt	T
Fernandinella alpina Chodat	AC
Geminella terricola Boye-Pet.	T
Gloeocystis polydermatica (Kutz.) Hindak	T
Gloeocystis vesiculosa Nageli	T
Gongrosira terricola Bristol	AC
Gonium sociale (Dujard.) Warm.	AC
Hormotila sp.	SC
Kentrosphaera bristolae G.M.Smith	A
Klebsormidium dissectum var. 1(Broady 1979a, *Chlorhormidium dissectum* var. A)	T
Klebsormidium subtilissimum (Rabenh.) Silva, Mattox et Blackwell	A
Klebsormidium sp. (BROADY 1981, *Klebsormidium* sp. A)	SC
Lobococcus sp.?	T
Lobosphaera tirolensis Reisigl	TC
Macrochloris multinucleate (Reisigl) Ettl et Gartner	ATC
Mesotaenium berggrenii (Wittr.) Lagerh. f.	S
Monoraphidium contortum (Thur.) Komark.-Legn.	A
Monoraphidium sp.	S
Myrmecia bisecta Reisigl	T
Palmella sp. 1	TC
Palmella sp. 2	A
Palmellopsis sp.	SC
Prasiococcus calcarius (Boye-Pet.) Vischer	ATSC
Prasiola calophylla (Carmich.) Menegh.	TC
Prasiola crispa (Lightf.) Menegh.	ATSC
Prasiola sp.?	A
Pseudochlorella subsphaerica Reisigl	T
Pseudococcomyxa simplex (Mainx) Fott	T
Pyramimonas gelidfcola McFadden, Moestrup et Wetherbee	A
Pyramimonas sp.	A
Raphidonema helvetica Kol	S
Raphidonema nivale Lagerh.	S
Raphidonema sempervirens Chodat	TC
Raphidonema tatrae Kol	S
Schizogonium murale Kutz.	ATC
Schizogonium sp.	AT
Staurastrum sp.	A
Stichococcus bacillaris Nageli	TSC
Stichococcus fragilis (A. Braun) Gay	A

Stichococcus minutus Grintzesco et Peterfi	S
Tetracystis sp. 1	TC
Tetracystis sp. 2	TC
Trebouxia sp.	TC
Trichosarcina mucosa (B Broady) Chappell et O'Kelly	TC
Trochiscia sp. (Broady 1979x,	A
Trochiscia sp. A)	
Ulothrix implexa (Kutz.) Kutz. A	
Ulothrix zonata (Weber et Mohr) Kutz	
Ulothrix sp. 1	A
Ulothrix sp. 2	S
Uronema sp.	S
Xanthophyta	
Botrydiopsis sp.	TC
Bumilleriopsis sp.	TC
Ellipsoidion sp.?	S
Fremya sp.	ATC
Gloeobotrys sp.	A
Heterococcus filiformis Pitschm.	TC
*Heterococcu*s sp.	TC
Heterothrix debilis Vischer	TC
Tribonema microchloron Ettl	A
Chrysophyta	
Chrysococcus sp.	S
Chroomonas lacustris Pascher et Ruttner	A
Dinophyta	
Gymnodinium sp.	A
Bacillariophyta	
**Achnanthes coarctata* var. *elliptica* Krasske	S
Amphora veneta Kutz.	A
**Cocconeis imperatrix* A. Schmidt	S
**Diploneis subcincta* (A. Schmidt) Cleve	S
**Eucampia balaustium* Castray	S
Fragilaria sp.	A
Fragilariopsis antarctica (Castray) Hust.	A
Hantzschia amphioxys (Ehrenb.) Grun.	A
Navicula atomus (Nag.) Grun.	A
Navicula murrayi W. et G. S. West	A
Navicula muticopsis Van Heurck	AT
Navicula sp.	A
Nitzschia palea (Kutz.) W. S M.	AT
Pinnularia borealis Ehrenb.	AT
Torpedoes laevissima W et G. S. West	A

*Believed to be marine diatoms from wind-borne sea spray.

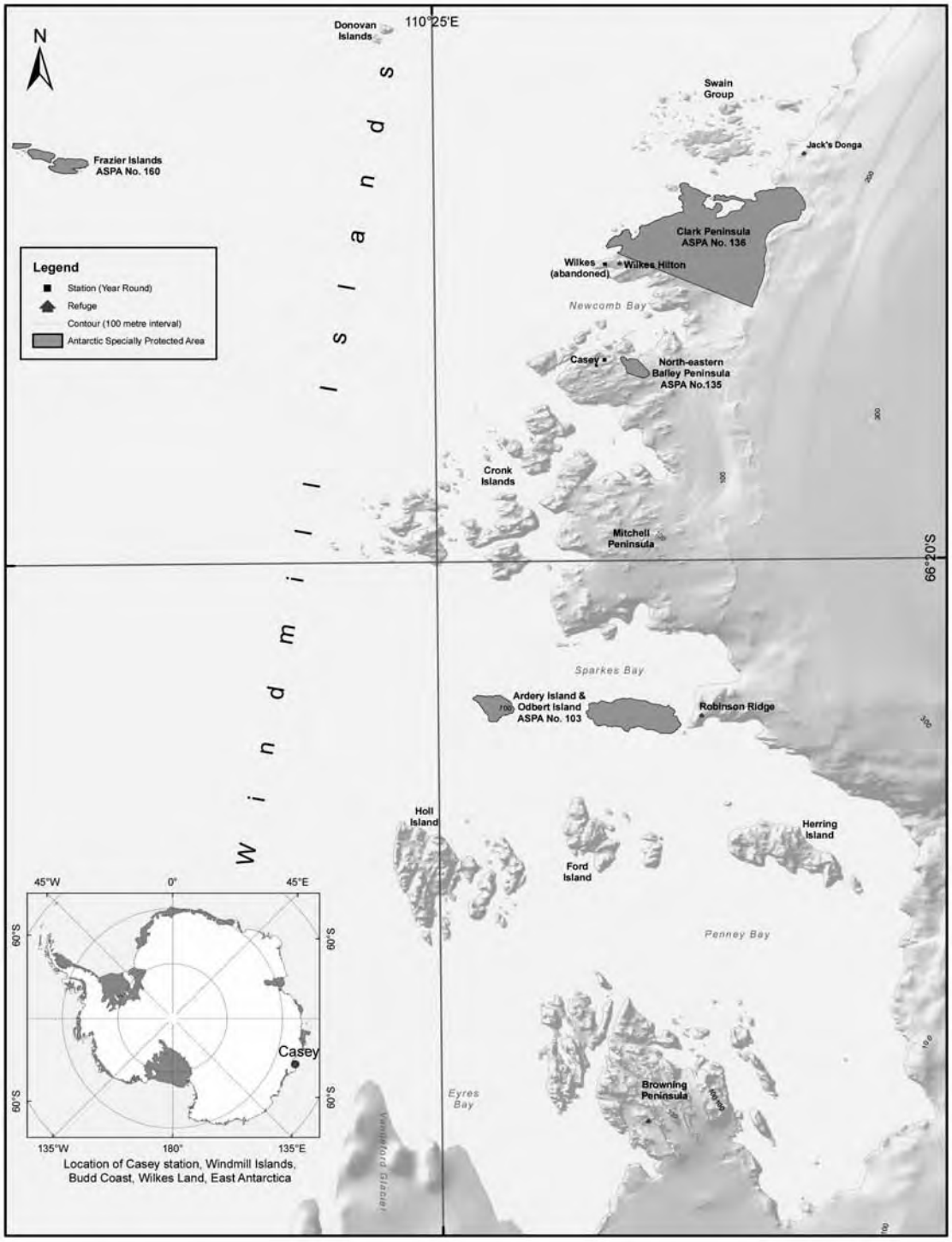
Appendix 5: Ciliates and testate amoebae active in the vicinity of Casey Station on Bailey Peninsula

(Modified from Petz and Foissner 1997)

Ciliates
Bryometopus sp
Bryophyllum cf. loxophylliforme
Colpoda cucullus (Mueller, 1773)
Colpoda inflata (Stokes, 1884)
Colpoda maupasi Enriques, 1908
Cyclidium muscicola Kahl, 1931
Cyrtolophosis elongata (Schewiakoff, 1892)
Euplotes sp.
Fuscheria terricola Berger and others, 1983
Gastronauta derouxi Blatterer and Foissner, 1992
Halteria grandinella (Mueller, 1773)
Holosticha sigmoidea Foissner, 1982
Leptopharynx costatus Mermod, 1914
Odontochlamys wisconsinensis (Kahl, 1931)
Oxytricha opisthomuscorum Foissner and others, 1991
Parafurgasonia sp.
Paraholosticha muscicola (Kahl, 1932)
Platyophrya vorax Kahl, 1926
Pseudocohnilembus sp.
Pseudoplatyophrya nana (Kahl, 1926)
Pseudoplatyophrya cf. saltans
Sathrophilus muscorum (Kahl, 1931)
Sterkiella histriomuscorum (Foissner and others, 1991)
Sterkiella thompsoni Foissner, 1996
Trithigmostoma sp.
Vorticella astyliformis Foissner, 1981
Vorticella infusionum Dujardin, 1 841
Testate amoebae
Assulina muscorum Greeff, 1888
Corythion dubium Taranek, 1881
Euglypha rotunda Wailes and Penard, 1911
Pseudodifflugia gracilis var. *terricola* Bonnet and Thomas, 1960
Schoenbornia viscicula Schoenborn, 1964
Trachelocorythion pulchellum (Penard, 1890)

Australian Government
Department of the Environment, Water, Heritage and the Arts
Australian Antarctic Division

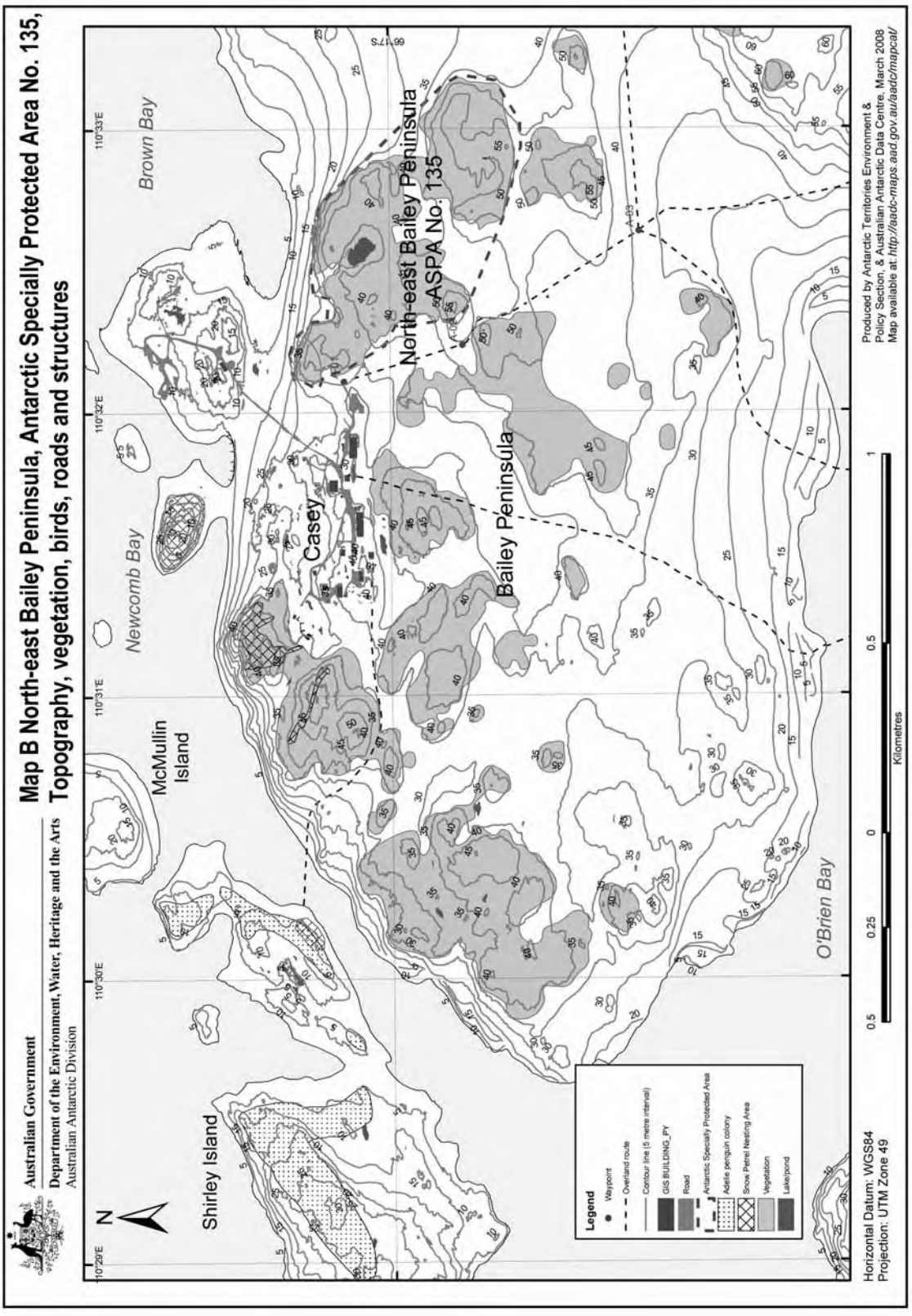
Map A: Windmill Islands, showing location of the North-east Bailey Peninsula ASPA No. 135 and protected areas within the region

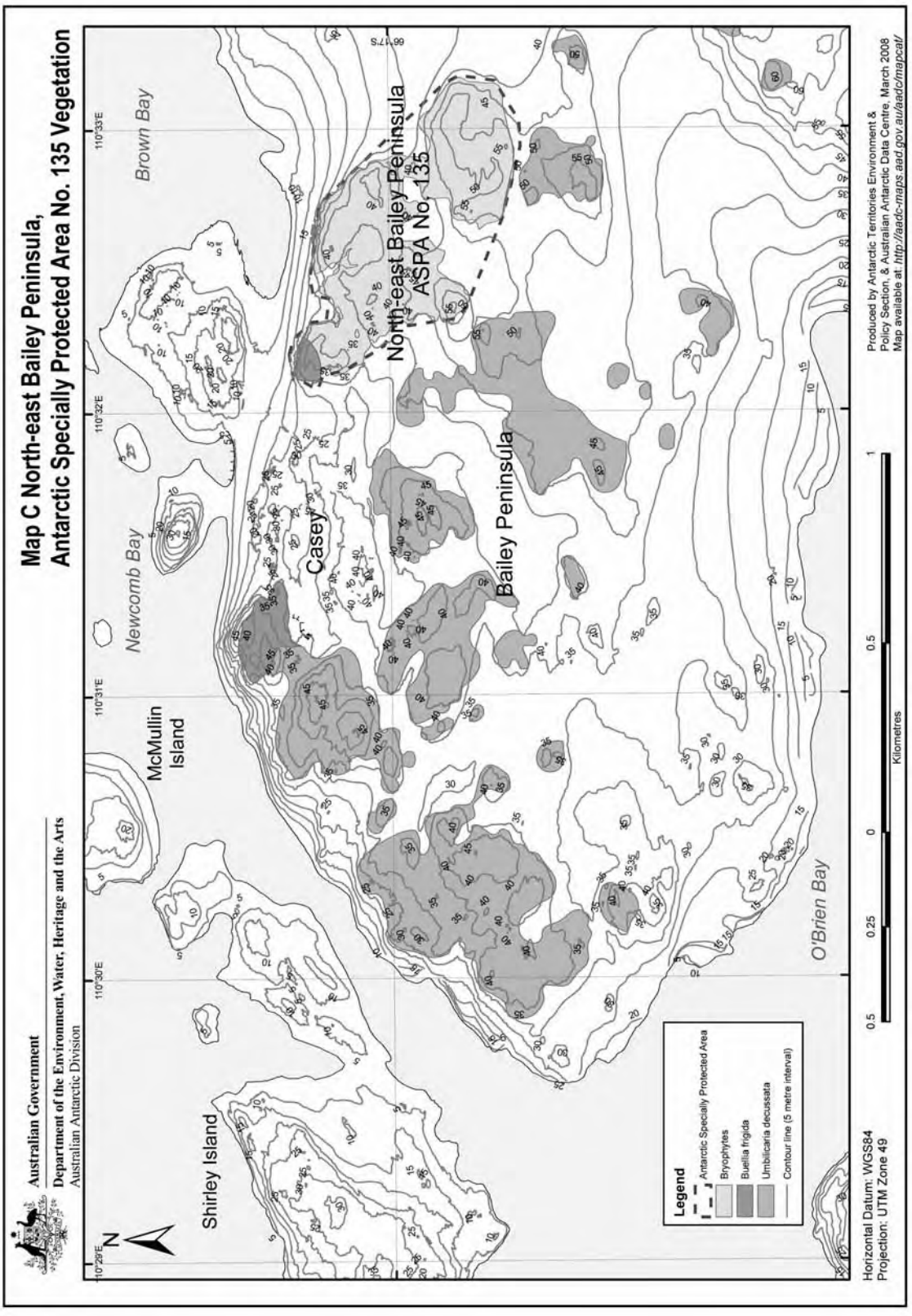


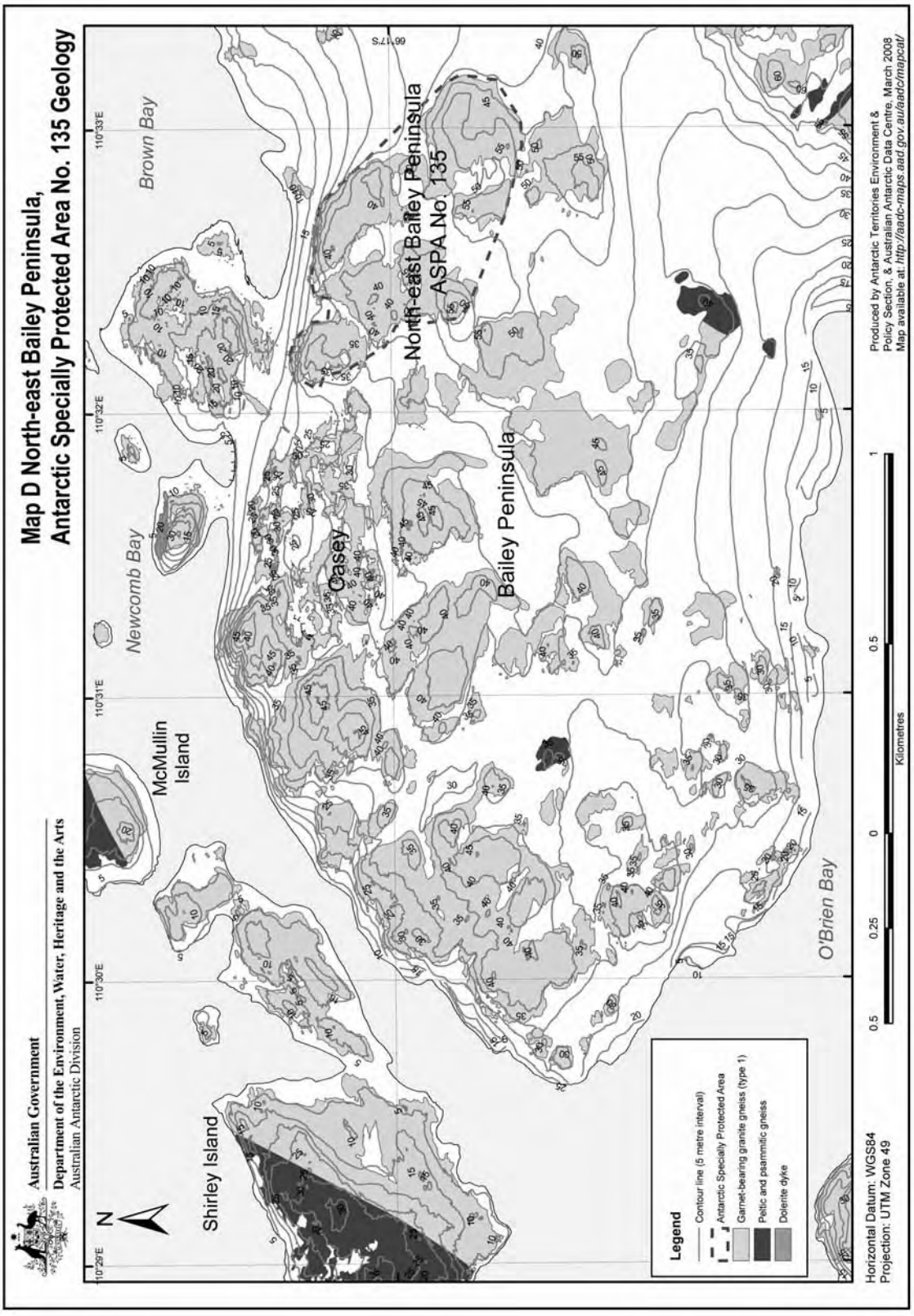
Horizontal Datum: WGS84
Projection: Lambert Conformal Conic

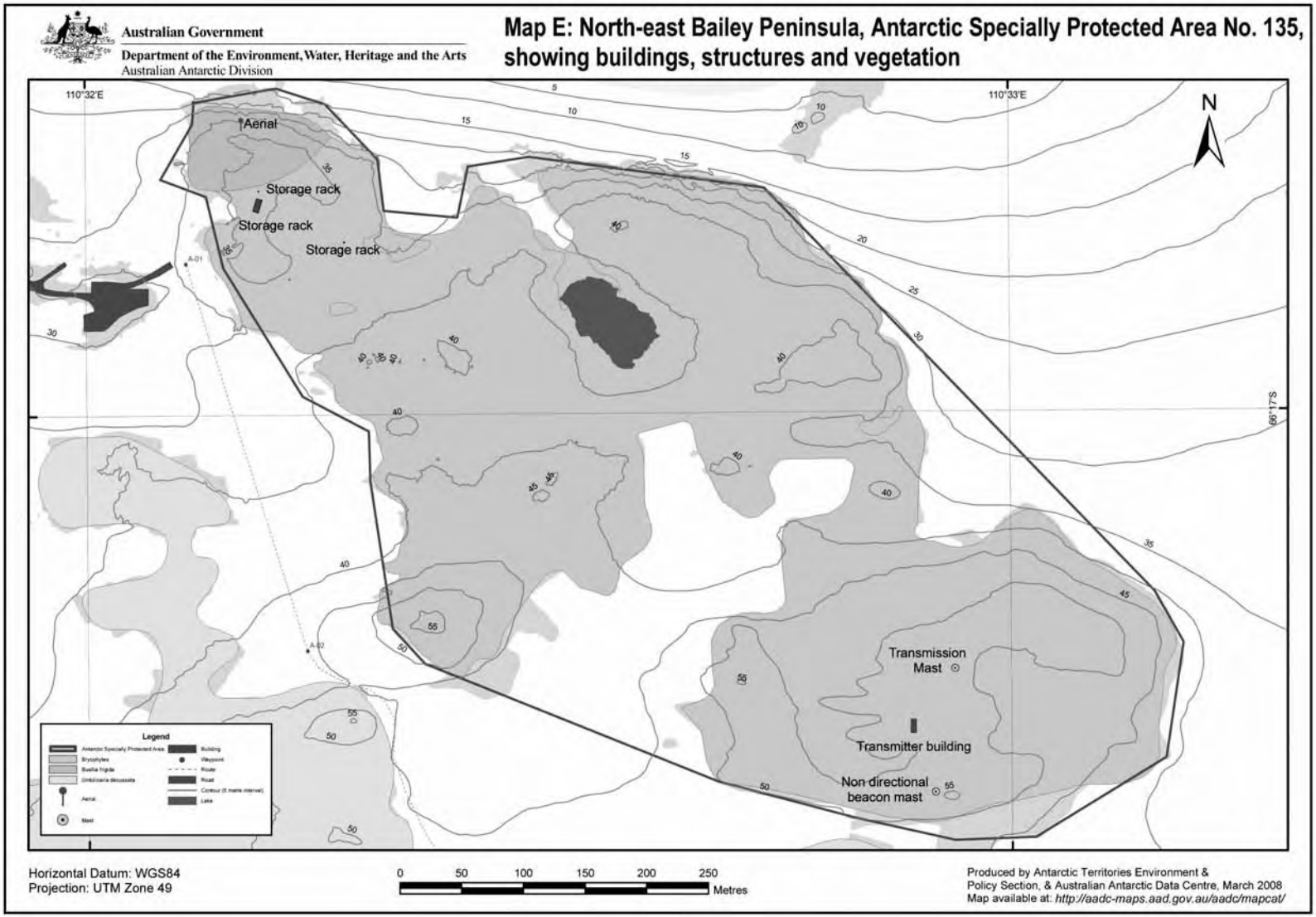
1 0.5 0 1 2 3 4 5
Kilometres

Produced by Antarctic Territories, Environment & Policy Section, & Australian Antarctic Data Centre. March 2008.
Map available at: http://aadc-maps.aad.gov.au/aadc/mapcat/


Australian Government
Department of the Environment, Water, Heritage and the Arts
Australian Antarctic Division
Map B North-east Bailey Peninsula, Antarctic Specially Protected Area No. 135,
Topography, vegetation, birds, roads and structures
Brown Bay
Newcomb Bay
McMullin Island
Shirley Island
Casey
North-east Bailey Peninsula
ASPA No. 135
Bailey Peninsula
O'Brien Bay
110°29'E
110°30'E
110°31'E
110°32'E
110°33'E
66°17'S
N
Legend
Waypoint
Overland route
Contour line (5 metre interval)
GIS BUILDING_PY
Road
Antarctic Specially Protected Area
Adelie penguin colony
Snow Petrel Nesting Area
Vegetation
Lake/pond
Horizontal Datum: WGS84
Projection: UTM Zone 49
0.5 0.25 0 0.5 1
Kilometres
Produced by Antarctic Territories Environment & Policy Section, & Australian Antarctic Data Centre, March 2008
Map available at: http://aadc-maps.aad.gov.au/aadc/mapcat/


Map C North-east Bailey Peninsula,
Antarctic Specially Protected Area No. 135 Vegetation
Australian Government
Department of the Environment, Water, Heritage and the Arts
Australian Antarctic Division
Brown Bay
Newcomb Bay
McMullin Island
Shirley Island
Casey
North-east Bailey Peninsula
ASPA No. 135
Bailey Peninsula
O'Brien Bay
110°29'E
110°30'E
110°31'E
110°32'E
110°33'E
66°17'S
N
Legend
Antarctic Specially Protected Area
Bryophytes
Buellia frigida
Umbilicaria decussata
Contour line (5 metre interval)
0.5 0.25 0 0.5 1
Kilometres
Horizontal Datum: WGS84
Projection: UTM Zone 49
Produced by Antarctic Territories Environment &
Policy Section, & Australian Antarctic Data Centre, March 2008
Map available at: http://aadc-maps.aad.gov.au/aadc/mapcat/


Map D North-east Bailey Peninsula,
Antarctic Specially Protected Area No. 135 Geology
Australian Government
Department of the Environment, Water, Heritage and the Arts
Australian Antarctic Division
Brown Bay
Newcomb Bay
McMullin Island
Shirley Island
Casey
Bailey Peninsula
North-east Bailey Peninsula
ASPA No. 135
O'Brien Bay
110°29'E
110°30'E
110°31'E
110°32'E
110°33'E
66°17'S
N
Legend
Contour line (5 metre interval)
Antarctic Specially Protected Area
Garnet-bearing granite gneiss (type 1)
Pelitic and psammitic gneiss
Dolerite dyke
Horizontal Datum: WGS84
Projection: UTM Zone 49
0.5 0.25 0 0.5 1
Kilometres
Produced by Antarctic Territories Environment & Policy Section, & Australian Antarctic Data Centre, March 2008
Map available at: http://aadc-maps.aad.gov.au/aadc/mapcat/


Australian Government
Department of the Environment, Water, Heritage and the Arts
Australian Antarctic Division
Map E: North-east Bailey Peninsula, Antarctic Specially Protected Area No. 135, showing buildings, structures and vegetation
110°32'E
110°33'E
66°17'S
N
Aerial
Storage rack
Storage rack
Storage rack
Transmission Mast
Transmitter building
Non directional beacon mast
Legend
Horizontal Datum: WGS84
Projection: UTM Zone 49
0 50 100 150 200 250
Metres
Produced by Antarctic Territories Environment & Policy Section, & Australian Antarctic Data Centre, March 2008
Map available at: http://aadc-maps.aad.gov.au/aadc/mapcat/

II. Measures

Measure 9 (2008)

Antarctic Specially Protected Area No 137 (North-west White Island, McMurdo Sound): Revised Management Plan

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas ("ASPA") and approval of Management Plans for those Areas;

Recalling

- Recommendation XIII-8 (1985), which designated White Island, McMurdo Sound, as Site of Special Scientific Interest ("SSSI") No 18 and annexed a management plan for the site;
- Recommendation XVI-7 (1991), which extended the expiry date of SSSI 18 from 31 December 1991 to December 2001;
- Measure 3 (2001), which extended the expiry date of SSSI 18 December 2001 until 31 December 2005;
- Decision 1 (2002), which renamed and renumbered SSSI 18 as Antarctic Specially Protected Area No 137;
- Measure 1 (2002), which adopted a revised Management Plan for ASPA 137;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 137;

Desiring to replace the existing Management Plan for ASPA 137 with the revised Management Plan;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) the revised Management Plan for Antarctic Specially Protected Area No 137: North-west White Island, McMurdo Sound, which is annexed to this Measure, be approved; and

2) all prior management plans for ASPA 137, namely those annexed to:

    - Recommendation XIII-8 (1985), and

    - Measure 1 (2002);

    shall cease to be effective.

Management Plan for Antarctic Specially Protected Area No 137

NORTH-WEST WHITE ISLAND, McMURDO SOUND

1. Description of values to be protected

An area of 150km^2 of coastal shelf ice on the north-west side of White Island was originally designated by Recommendation XIII-8 (1985, SSSI No 18) after a proposal by the United States of America on the grounds that this locality contains an unusual breeding population of Weddell seals (*Leptonychotes weddellii*) which is the most southerly known, and which has been physically isolated from other populations by advance of the McMurdo Ice Shelf and Ross Ice Shelf (Map 1). The original boundaries were adjusted in 2002 (Measure 1) in light of new data recording the spatial distribution of the seals on the ice shelves. In the south, the boundary of the Area was shifted north and east to exclude the region north of White Strait where no observations of the seals have been recorded. In the north, the Area was extended to encompass an additional part of the Ross Ice Shelf in order to ensure inclusion of more of the region within which the seals may be found. In 2008, the Management Plan was updated to include recent census data on the seal colony, which led to revision of the boundary to include part of the Ross Ice Shelf in the north-east where seals have been observed. The Area is now approximately 142km^2. Additional guidance on aircraft overflight and access has also been included.

The Weddell seal colony appears unable to relocate to another area because of its distance from the open ocean of McMurdo Sound, and as such it is highly vulnerable to any human impacts that might occur in the vicinity. The colony is not thought to have been present in the early 1900s, as there is no mention of seals by naturalists who visited White Island many times during Scott's 1902, 1903 and 1910 expeditions. An ice breakout occurred in the region between 1947 and 1956, and the first two seals were observed near the north-eastern end of the island in 1958 (R. Garrott, *pers. comm.* 2007). Year-round studies have detected no evidence of immigration or emigration of seals from the population, which appears to have grown to around 25 to 30 animals from a population of around 11 in the 1960s. The seals do not have the breathing capacity needed to dive the 20km required to reach the open ocean, and there is only one record of a seal from the colony making the journey over the ice shelf surface.

The seals gain access to the sea below the ice shelf through pressure cracks, which are formed by tidal motion and movement of the McMurdo and Ross ice shelves. Only one crack remains open year-round. The Weddell seals at White Island are on average greater in size and weight than their McMurdo Sound counterparts and have been shown to make more shallow dives. NW White Island is one of very few sites where Weddell seals are known to feed under shelf ice. The population is considered to have exceptional scientific value because of its period of physical isolation from interaction with other seals, thought to be around 60 years, and investigations are being undertaken of the extent to which the group may be considered a genetically distinct population. Genetic techniques have been used to construct a complete pedigree for the NW White Island population, which supports the conclusion that the year in which the colony was founded is likely to have been around 60 years ago, which agrees with historical sightings. NW White Island is relatively accessible by shelf ice from the nearby United States and New Zealand research stations at Hut Point, Ross Island. In addition, a flagged access route between these stations and Black Island traverses within approximately 2km of the Area (Map 1).

The Area requires long-term special protection because of the exceptional importance of the Weddell seal colony, outstanding scientific values and opportunities for research, and the potential vulnerability of the Area to disturbance from scientific and logistic activities in the region.

2. Aims and objectives

Management at NW White Island aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- allow scientific research on the ecosystem, in particular on the Weddell seals, while ensuring protection from excessive disturbance or other possible scientific impacts;
- allow other scientific research provided it will not jeopardize the values of the Area;
- minimize the possibility of introduction of alien animals and microbes into the Area;
- allow visits for management purposes in support of the aims of the Management Plan.

3. Management activities

- Signs showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently, and a copy of this management plan shall be kept available in appropriate places, in particular at McMurdo Station, Scott Base and at the Black Island facilities.
- Markers, signs or structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition, and removed when no longer necessary.
- Visits shall be made as necessary (no less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate.
- National Antarctic Programs operating in the region shall consult together for the purpose of ensuring these steps are carried out.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

- Map 1: NW White Island, ASPA No 137, topographic map.

  Map specifications:

  Projection: Lambert Conformal Conic; Standard parallels: 1st 78° 00' 00" S; 2nd 78° 12' 00"S; Central Meridian: 167° 05' 00" E; Latitude of Origin: 77° 30' 00" S; Spheroid: WGS84.

  Inset 1: Ross Sea region.

  Inset 2: Ross Island region, key features and nearby stations.

Note: Map 1 is derived from the Antarctic Digital Database (Version 5.0, SCAR, 2007). This framework has been identified as positionally inaccurate in the Ross Island / White Island

region. Accurate ground control available for Hut Point Peninsula was used to adjust the geographical position of the framework by approximately +240m (x direction) and +100m (y direction). This shift is considered to improve the accuracy of Map 1, but the result is only an approximation. Global Positioning Systems (GPS, in WGS-84) observations of seals shown on Map 1 are considered accurate to approximately 200m of their true positions.

6. Description of the Area

6(i) Geographical coordinates, boundary markers and natural features

White Island, part of the McMurdo volcanic complex, is situated approximately 20km SE of the edge of the McMurdo Ice Shelf and 25km SE of Hut Point, the location of McMurdo Station (United States) and Scott Base (New Zealand) on Ross Island (Inset 2, Map 1). The roughly triangular island is approximately 30km long and 15km wide at its maximum, and rises to a maximum elevation of 762m in several locations (Map 1). The northern and western shores of White Island descend steeply, with water depths of 600m occurring within 5km of the island. The island is predominantly ice-covered with most of the rock outcrops being in the north, and is completely surrounded by permanent shelf ice, between 10m and 100m in thickness, of the McMurdo Ice Shelf and Ross Ice Shelf. Black Island is situated 2.5km west of White Island, separated by the shelf ice of White Strait. The GPS entry and exit points for the access route to Black Island from McMurdo through White Strait are 78° 12' 00"S, 166° 50' 00"E and 78° 14' 17"S, 166° 45' 30" E, respectively.

The westward movement of the McMurdo Ice Shelf is greatest at the northern end of White Island and movement of ice away from the NW coast ensures open water in cracks in the shelf at this locality is present year-round. The Weddell seal population uses the cracks for access to seawater and feeding grounds under the shelf ice, and inhabits and breeds in the region within approximately 5km of their positions. The cracks occur parallel to and within a few hundred meters of the coast of White Island, and intermittently extend along the coast from the northern extremity of the island up to 15km to the south.

The Area includes 142km^2 of the shelf ice and open-water cracks of both the Ross Ice Shelf and McMurdo Ice Shelf up to 5km offshore north-east, north and west from the White Island coast. The north-eastern boundary extends from the north-eastern coast of Cape Spencer-Smith (167° 32' 42" E, 78° 00' 43" S) 5km due east to 167° 46' 37" E, 78° 00' 43" S. The boundary then extends north-west, and follows a line parallel to and 5km from the coast, around Cape Spencer Smith and then heading south-west to 167° 00' 00" E, 78° 05' 00" S. The boundary then extends due south for 7.8km to 167° 00' 00" E, 78° 09' 12" S, and thence 1.5km east to the southern-most significant outcrop of rock on the western coast of White Island (167° 05' 00" E, 78° 09' 12" S). The boundary then extends northwards, following the coastline around Cape Spencer Smith to the north-eastern limit of the Area. The White Island coast is distinguished by a change in surface slope where the transition between the floating ice-shelf and land occurs: the transition is in some places gradual and indistinct, and the exact position of the coast is not precisely known. For this reason the coastal (generally east) boundary of the Area is considered to follow the line of the coast as evidenced by a surface elevation rise towards the land of two meters above the average elevation of the adjacent McMurdo Ice Shelf.

The Weddell seal population was estimated at around 25 to 30 animals in 1991. A 1981 study estimated "about 30" seals, while 1991 studies estimated 26 seals greater than one year of age. Since 1991, 17 different females have produced pups at White Island. Between 2003 and 2007, 11 females have been sighted at White Island, but only six of these individuals have produced pups. Between two and four live pups were recorded in 1963-1968, 1981, and 1991. Annual censuses

since 1991 recorded between four and ten pups from 1991 to 2000, but lower numbers (between two and four pups each year) from 2000 to 2007. Pup mortality is high, possibly due to inbreeding, and pup production is low in comparison to the population in Erebus Bay.

The seals are physically isolated by the barrier of the shelf ice, and are unable to swim the 20km distance under the ice to reach the seasonally open waters of McMurdo Sound: Weddell seals have been estimated to be capable of swimming a distance of around 4.6km (2.5 nautical miles) on a single breath. The apparent isolation of the colony is substantiated by tag observation data on Weddell seals in McMurdo Sound, where in more than 100,000 tag observations over a 20-year period no tagged seals from White Island have been observed in McMurdo Sound. These data suggest that the White Island seals do not generally traverse the 20km distance to the open ocean over the surface of the shelf ice. However, there is at least one record of a yearling from the White Island colony found to have made the journey across to the Williams airfield close to McMurdo station (G. Kooyman, *pers. comm.* 2007).

Adult female seals begin to appear on the shelf ice in early November, one month later than other pupping areas in the southern Ross Sea. They pup at the NW extremity of the island during which time sub-adults and non-breeding adults can be found up to 15km to the SW near open cracks on the west side of the island. Adult male seals are not observed on the sea-ice during this time, remaining in the water to establish and defend territories. The females remain on the ice until pups are weaned at about 6-8 weeks of age. After December, adults and sub-adults mix in the pupping area and along the cracks formed at the NW corner of the island.

It is thought that the harsh surface conditions confine the seals to the water during the winter months. Winter surface temperatures reach as low as -60°C and it is thought that the seals expend considerable time maintaining an open air hole in the cracks. This is thought to be a key factor limiting the population size, with pups and sub-adults possibly excluded from use of the limited breathing holes by more dominant and aggressive adults. Some pups may be unable to maintain their own breathing holes and may become trapped on the ice surface if dominant seals do not allow them entry into the water.

Studies have suggested that the Weddell seals at White Island have a similar diet to their counterparts at McMurdo Sound. Studies of fish otoliths recovered from Weddell seal fecal samples have revealed a diet comprised primarily of the nototheniid fish *Pleuragramma antarcticum*, also with fish from the genus *Trematomus*. Invertebrates are thought to comprise the remainder of the diet along with a cephalopod belonging to the family Mastogoteuthidae. Consumption of the latter was found to be considerably greater amongst White Island seals than those at McMurdo Sound.

Other aspects of the physiology and behaviour of seals at White Island appear to differ from nearby populations at McMurdo Sound and at Terra Nova Bay: the seals at White Island appear to be significantly fatter, with recorded weights of up to 686 kg (1500 lb.) at White Island compared to no more than 500 kg at McMurdo Sound or Terra Nova Bay. A 1991 study revealed that on average adult female seals are considerably longer than those in McMurdo Sound, and young seals at White Island have been observed to exhibit faster growth rates than their McMurdo counterparts. Average diving depths at White Island are shallower than at McMurdo Sound.

6(ii) Restricted and managed zones within the Area

None.

6(iii) Structures within and near the Area

There are no structures within or near the Area.

6(iv) Location of other protected areas within close proximity of the Area

The nearest protected areas to NW White Island are on Ross Island: Arrival Heights (ASPA No 122) adjacent to McMurdo Station and Discovery Hut (ASPA No 158) on the Hut Point Peninsula are the closest at 20km to the north; Cape Evans (ASPA No 155) and Cape Royds (ASPA No 121) are 47km and 55km north respectively; and Tramway Ridge (ASPA No 130) near the summit of Mt. Erebus is 60km to the north.

7. Permit conditions

Entry into the Area is prohibited except in accordance with a permit issued by appropriate national authorities. Conditions for issuing a permit to enter the Area are that:

- it is issued only for scientific study of the Weddell seal ecosystem, or for scientific reasons or management purposes consistent with plan objectives such as inspection or review;
- the actions permitted will not jeopardize the ecological or scientific values of the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- the Permit, or a copy, shall be carried within the Area;
- a visit report shall be supplied to the authority named in the Permit;
- Permits shall be issued for a stated period.

7(i) Access to and movement within the Area

- Access into the Area is permitted on foot, by vehicle, or by aircraft.
- Aircraft landings and overflight below 750m (~2500 ft) within the Area are prohibited without a permit. Aircraft approach and departure shall avoid overflight of the White Island coastline and tide-cracks within the Area, where the seals are most commonly found. Aircraft shall not land closer than 300m from seals where they can be seen from the air, and shall land at least 300m (~980 ft) away from the coastline of White Island and the tide-crack when seals are not visible.
- Use of helicopter smoke grenades is prohibited unless absolutely necessary for safety, and all grenades should be retrieved.
- Vehicles are strongly discouraged from approaching closer than 50m from seals, and closer approaches should be on foot. Vehicle and pedestrian traffic should be kept to the minimum necessary consistent with the objectives of any permitted activities.

7(ii) Activities that are or may be conducted in the Area, including restrictions on time or place

Activities that may be conducted within the Area include:

- scientific research that will not jeopardize the ecosystem of the Area;
- essential management activities, including monitoring.

7(iii) Installation, modification or removal of structures

- No structures are to be erected within the Area except as specified in a permit;
- All scientific equipment installed in the Area must be authorized by permit and clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area;

- Removal of specific equipment for which the permit has expired shall be the responsibility of the authority which granted the original Permit, and shall be a condition of the permit.

7(iv) Location of field camps

Permanent field camps are prohibited within the Area. Temporary campsites are permitted within the Area. There are no specific restrictions to a precise locality for temporary camp sites within the Area, although sites selected shall be more than 200m from the ice-shelf cracks inhabited by the seals, unless authorized by permit when deemed necessary to the accomplishment of specific research goals.

7(v) Restrictions on materials and organisms that can be brought into the Area

- No living animals, plant material or microorganisms shall be deliberately introduced into the Area and precautions shall be taken against accidental introductions. Of particular concern are microbial and viral introductions from other seal populations. To minimize the risk of introductions, visitors shall ensure that any measuring devices, sampling equipment, markers or personal equipment to be used in the area are clean before entering the Area;
- No herbicides or pesticides shall be brought into the Area;
- Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the permit, shall be removed from the Area to the maximum extent practicable at or before the conclusion of the activity for which the permit was granted;
- Fuel is not to be stored in the Area, unless required for essential purposes connected with the activity for which the permit has been granted;
- All materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimized.

7(vi) Taking or harmful interference with native flora or fauna

Taking or harmful interference with native flora and fauna is prohibited, except in accordance with a separate permit issued under Article 3 of Annex II by the appropriate national authority specifically for this purpose.

7(vii) Collection or removal of anything not brought into the Area by the permit holder

Material may be collected or removed from the Area only in accordance with a permit and should be limited to the minimum necessary to meet scientific or management needs. Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the permit holder or otherwise authorized, may be removed unless the impact of removal is likely to be greater than leaving the material *in situ*: if this is the case the appropriate authority should be notified.

7(viii) Disposal of waste

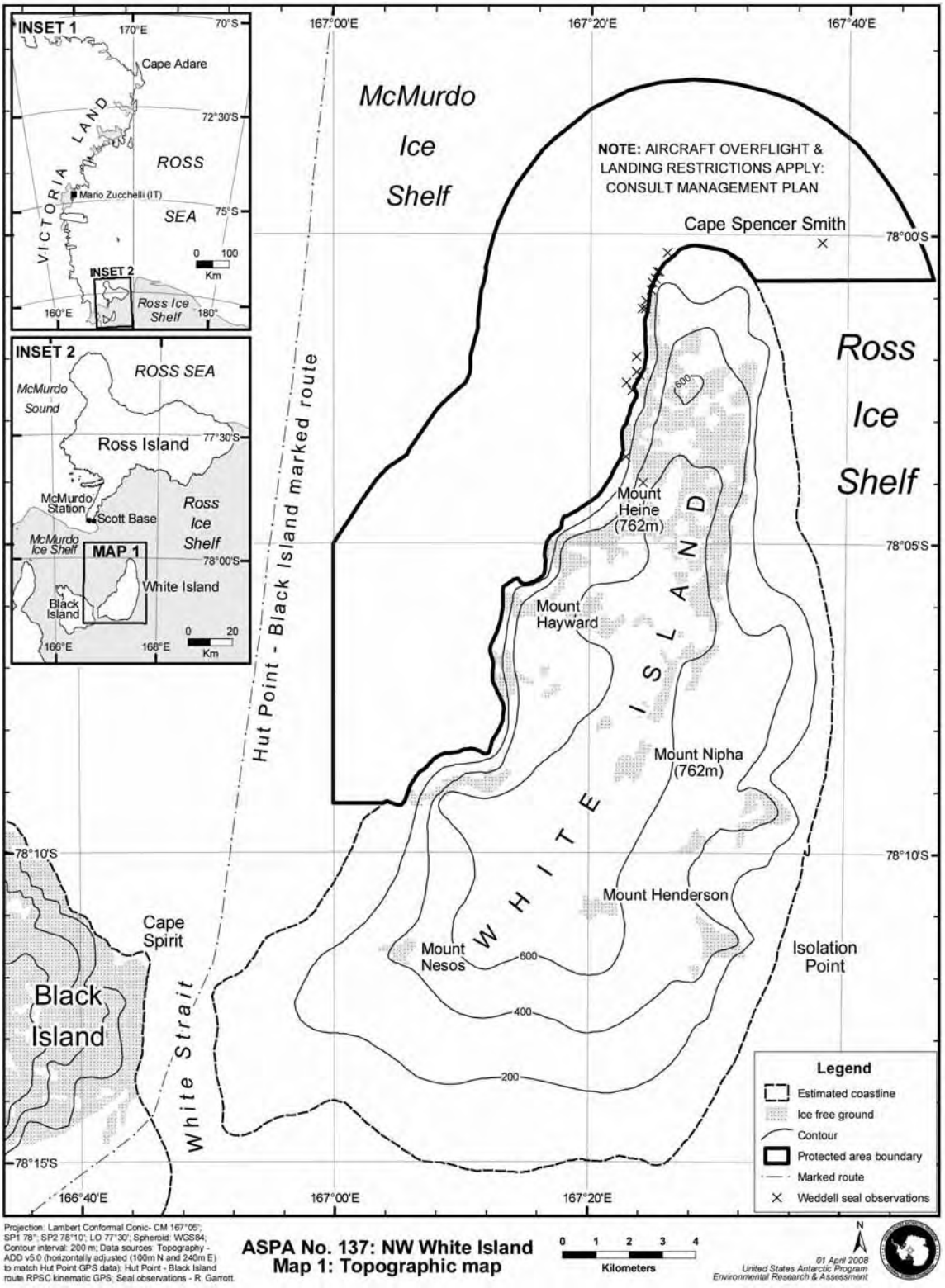
All wastes shall be removed from the Area.

7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

- Any specific sites of long-term monitoring shall be appropriately marked;
- The use of explosives is prohibited within the Area.

7(x) Requirements for reports

- Parties should ensure that the principal holder for each permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report form suggested by SCAR.
- Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, which should be in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the Management Plan and in organizing the scientific use of the Area.


INSET 1
170°E
70°S
Cape Adare
72°30'S
VICTORIA LAND
ROSS
SEA
Mario Zucchelli (IT)
75°S
0 100
Km
INSET 2
160°E
Ross Ice Shelf
180°
INSET 2
ROSS SEA
McMurdo Sound
Ross Island
77°30'S
McMurdo Station
Scott Base
Ross Ice Shelf
McMurdo Ice Shelf
MAP 1
78°00'S
White Island
Black Island
0 20
Km
166°E
168°E
167°00'E
167°20'E
167°40'E
McMurdo Ice Shelf
NOTE: AIRCRAFT OVERFLIGHT & LANDING RESTRICTIONS APPLY: CONSULT MANAGEMENT PLAN
Cape Spencer Smith
78°00'S
Hut Point - Black Island marked route
Ross Ice Shelf
600
Mount Heine (762m)
78°05'S
Mount Hayward
WHITE ISLAND
Mount Nipha (762m)
78°10'S
Mount Henderson
Cape Spirit
Mount Nesos
600
400
200
Isolation Point
Black Island
White Strait
78°15'S
166°40'E
167°00'E
167°20'E
Legend
Estimated coastline
Ice free ground
Contour
Protected area boundary
Marked route
Weddell seal observations
Projection: Lambert Conformal Conic- CM 167°05'; SP1 78°; SP2 78°10'; LO 77°30'; Spheroid: WGS84; Contour interval: 200 m; Data sources: Topography - ADD v5.0 (horizontally adjusted (100m N and 240m E) to match Hut Point GPS data); Hut Point - Black Island route RPSC kinematic GPS; Seal observations - R. Garrott.
ASPA No. 137: NW White Island
Map 1: Topographic map
0 1 2 3 4
Kilometers
N
01 April 2008
United States Antarctic Program
Environmental Research & Assessment

Measure 10 (2008)

Antarctic Specially Protected Area No 138 (Linnaeus Terrace, Asgard Range, Victoria Land): Revised Management Plan

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas ("ASPA") and approval of Management Plans for those Areas;

Recalling

- Recommendation XIII-8 (1985), which designated Linnaeus Terrace, Asgard Range, Victoria Land, as Site of Special Scientific Interest ("SSSI") No 19 and annexed a management plan for the site;
- Resolution 7 (1995), which extended the expiry date of SSSI 19 from 31 December 1995 to 31 December 2000;
- Measure 1 (1996), which adopted a revised Management Plan for SSSI 19;
- Decision 1 (2002), which renamed and renumbered SSSI 19 as Antarctic Specially Protected Area No 138;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 138;

Desiring to replace the existing Management Plan for ASPA 138 with the revised Management Plan;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) the revised Management Plan for Antarctic Specially Protected Area No 138: Linneaus Terrace, Asgard Range, Victoria Land, which is annexed to this Measure, be approved;

2) the Management Plan for ASPA 138 annexed to Recommendation XIII-8 (1985) shall cease to be effective; and

3) Measure 1 (1996), which is not yet effective, be withdrawn.

Management Plan for Antarctic Specially Protected Area No 138

LINNAEUS TERRACE, ASGARD RANGE, VICTORIA LAND

1. Description of values to be protected

Linnaeus Terrace was originally designated in Recommendation XIII-8 (1985, SSSI No 19) after a proposal by the United States of America on the grounds that the Area is one of the richest known localities for the cryptoendolithic communities that colonize the Beacon Sandstone. Exposed surfaces of the Beacon Sandstone are the habitat of cryptoendolithic microorganisms, which may colonize a zone of up to 10 millimeters deep below the surface of the rocks. The sandstones exhibit a range of biological and physical weathering forms, as well as trace fossils, and many of the formations are fragile and vulnerable to disturbance and destruction by trampling and sampling. Cryptoendolithic communities are known to develop over time periods in the order of tens of thousands of years, and damaged rock surfaces would be slow to recolonize. The excellent examples of these communities found at the site are the subject of the original detailed Antarctic cryptoendolithic descriptions. As such, Linnaeus Terrace is considered a type locality with outstanding scientific values related to this ecosystem. These values, as well as the vulnerability of the site to disturbance and destruction, require that it receives long-term special protection. The Management Plan has been updated to include additional provisions to reduce the risk of alien plants, animals or microbes from other Antarctic sites, or from regions outside Antarctica.

2. Aims and objectives

Management at Linnaeus Terrace aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- allow scientific research on the ecosystem, in particular on the cryptoendolithic communities, while ensuring protection from excessive sampling, damage to fragile rock formations, or other possible scientific impacts;
- allow other scientific research provided it will not jeopardize the values of the Area;
- minimize the possibility of introduction of alien plants, animals and microbes into the Area;
- allow visits for management purposes in support of the aims of the Management Plan.

3. Management activities

- A copy of this Management Plan shall be kept available in appropriate places, in particular at McMurdo Station and Scott Base;
- Durable wind direction indicators should be erected close to the designated helicopter landing site whenever it is anticipated there will be a number of landings at the Area in a given season. These should be replaced as needed and removed when no longer required;
- Brightly colored markers, which should be clearly visible from the air and pose no significant threat to the environment, should be placed to mark the designated helicopter landing site;

- Markers or structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition, and removed when no longer necessary;
- Visits shall be made as necessary (preferably no less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate;
- National Antarctic Programmes operating in the region shall consult together for the purpose of ensuring these steps are carried out.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

- Map 1: ASPA No 138 Linnaeus Terrace, Wright and Taylor Valleys.
  Projection: Lambert conformal conic; Standard parallels: 1st 77° 30' S; 2nd 77° 40' S; Central Meridian: 161° 53' E; Latitude of Origin: 78° 00' S; Spheroid: WGS84; Datum: 'Camp Area' Local; Contour interval 250m.
- Map 2: ASPA No 138 Linnaeus Terrace, topography and boundary. Projection: Lambert conformal conic; Standard parallels: 1st 77° 35' S; 2nd 77° 36' S; Central Meridian: 161° 05' E; Latitude of Origin: 78° 00' S; Spheroid and horizontal datum: WGS84; Contour interval 5m. Map derived from an orthophotograph with an estimated positional accuracy of 0.5m.
- Figure 1: Photograph illustrating some of the fragile rock formations and trace fossils found on Linnaeus Terrace.

6. Description of the Area

6(i) Geographical coordinates, boundary markers and natural features

Linnaeus Terrace (161° 05' 00" E, 77° 35' 50" S) is a bench of weathered Beacon Sandstone approximately 1.5km in length and 1km in width at an elevation of about 1600m (Map 1). It is located at the western end of the Asgard Range, 1.5km north of Oliver Peak (161° 02' 30"E, 77° 36' 40" S, 2410 m). The Area overlooks the South Fork of the Wright Valley, is about 4km from Don Juan Pond and 10km from the terminus of the Wright Upper Glacier (Map 1).

The lower (northern) boundary of the Area is characterized by the presence of a predominantly sandstone outcrop of approximately 3m in height which extends for much of the length of the terrace (Map 2). The lower boundary of the Area is defined as the upper edge of this outcrop, and as straight lines adjoining the visible edges where the outcrop is covered by surface talus. The upper (south-western) boundary of the Area is characterized by a line of sandstone outcrop of about 2-5m in height, occurring between the elevations of 1660 - 1700m about 70m above the general elevation of the terrace. The upper boundary of the Area is defined as the uppermost edge of this outcrop, and shall be considered a straight line between the visible edges where the outcrop is covered by surface talus. The western end of the Area is defined as where the terrace narrows and merges with a dolerite talus slope on the flank of the NW ridge of Oliver Peak. The boundary at the west dips steeply from where the upper outcrop disappears, following the border of the dolerite talus with the terrace sandstone down to the westernmost corner. The east boundary is defined as the 1615m

contour, which follows closely the edge of an outcrop which extends much of the width of the terrace (Map 2). At the southernmost corner of the Area the terrace merges with the slopes into the valley to the east: from this point the boundary extends upward to the 1700m contour, from where it follows the line of outcrop defining the south-western boundary.

Winter air temperature at Linnaeus Terrace ranges between -20°C and -45°C, while in January the daily mean is approximately -5°C. Cryptoendolithic microorganisms typically colonize porous Beacon sandstones with a 0.2 - 0.5 mm grain size, with an apparent preference for rocks stained tan or brown by Fe3+ -containing oxyhydroxides. A silicified crust of about 1 mm thickness on many of the rocks probably facilitates colonization by stabilizing the surface and reducing wind erosion. Three of the five described cryptoendolithic microbial communities have been found on Linnaeus Terrace: the Lichen Dominated, Red-Gloeocapsa and Chroococcidiopsis Communities. Linnaeus Terrace is the type locality of the endemic green algal genus *Hemichloris* and of the endemic Xanthophycean algal species *Heterococcus endolithicus*. The Area is unusual in that so many different living and fossil endolithic communities are present within a small area. The main physical and biological features of these communities and their habitat are described in Friedmann, E.I. (ed) 1993 *Antarctic Microbiology*, Wiley-Liss, New York.

Fragile weathered rock formations, such as trace fossils in eroded sandstone and brittle overhanging low rock ledges (ranging from approximately 10 cm up to 1m in height), are present throughout the Area.

A small area (Map 2) has been contaminated by release of the C(14) radioactive isotope. While the contamination poses no significant human or environmental threat, any samples gathered within this area are considered unsuitable for scientific work using C(14) techniques.

6(ii) Restricted zones within the Area

None.

6(iii) Structures within the Area

A number of rocks within the Area have small instruments installed into them for scientific purposes and should not be disturbed.

6 (iv) Location of other protected areas within close proximity of the Area

Linnaeus Terrace lies within Antarctic Specially Managed Area (ASMA) No 2, McMurdo Dry Valleys. Within the ASMA, the nearest Special Feature is Don Juan Pond in the Upper Wright Valley. The nearest protected areas to Linnaeus Terrace are Barwick and Balham Valleys (ASPA No 123), 35km to the north, and Canada Glacier (ASPA No 131), 50km to the east (Map 1).

7. Permit conditions

Entry into the Area is prohibited except in accordance with a permit issued by an appropriate national authority. Conditions for issuing a Permit to enter the Area are that:

- it is issued only for scientific study of the cryptoendolithic ecosystem, or for a compelling scientific or management purpose that cannot be served elsewhere;
- the actions permitted will not jeopardize the natural ecological or scientific values of the Area;
- any management activities are in support of the objectives of the Management Plan;

- the actions permitted are in accordance with the Management Plan;
- the permit, or a copy, shall be carried within the Area;
- a visit report is supplied to the authority named in the Permit;
- permits shall be issued for a stated period.

7(i) Access to and movement within the Area

- Access to the Area is permitted by foot or by helicopter. No special restrictions apply to the routes used to move to and from the Area;
- Helicopters shall land only at the designated site at the west end of the terrace (161° 04' 29" E, 77° 35' 50" S, elevation 1610m: Map 2), except when specifically authorized by Permit otherwise for a compelling scientific or management purpose. Use of helicopter smoke grenades is prohibited unless absolutely necessary for safety, and all grenades should be retrieved;
- When transporting permitted visitors, pilots, air crew, or passengers en route elsewhere on helicopters are prohibited from moving on foot beyond the immediate vicinity of the designated landing and camping sites unless specifically authorized by a Permit;
- Land vehicles are prohibited within the Area;
- Movement within the Area should avoid damage to fragile rock formations: care should be exercised to avoid walking on trace fossils (Figure 1) and brittle overhanging low rock ledges which are easily broken;
- Pedestrian traffic should be kept to the minimum necessary consistent with the objectives of any permitted activities.

7(ii) Activities that are or may be conducted in the Area, including restrictions on time or place

- Scientific research which will not jeopardize the ecosystem of the Area;
- Essential management activities, including monitoring.

7(iii) Installation, modification or removal of structures

- No structures are to be erected within the Area except as specified in a permit;
- Permanent structures are prohibited;
- All scientific equipment installed in the Area must be authorized by permit and clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area;
- Removal of specific equipment for which the permit has expired shall be the responsibility of the authority which granted the original permit, and shall be a condition of the permit.

7(iv) Location of field camps

Camping is permitted within the Area only at the designated site in the immediate vicinity of the helicopter landing site (Map 2).

7(v) Restrictions on materials and organisms which can be brought into the Area

- To avoid compromising the microbial ecosystem for which this site is protected, no living animals, plant material or microorganisms shall be deliberately introduced into the Area and the precautions listed below shall be taken against accidental introductions.

- To help maintain the ecological and scientific values of the Area, visitors shall take special precautions against the introduction of animals, plant material or microorganisms. Of particular concern are microbial and vegetation introductions from soils at other Antarctic sites, including stations, or from regions outside Antarctica. To minimize the risk of introductions, visitors should thoroughly clean footwear and any equipment to be used in the Area – particularly sampling equipment and markers – before entering the Area.
- No herbicides or pesticides shall be brought into the Area.
- Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the permit, shall be removed from the Area at or before the conclusion of the activity for which the Permit was granted.
- Food, fuel, and other materials are not to be stored in the Area, unless required for essential purposes connected with the activity for which the permit has been granted.
- All materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimized.
- If release occurs which is likely to compromise the values of the Area, removal is encouraged only where the impact of removal is not likely to be greater than that of leaving the material *in situ*.

7(vi) Taking or harmful interference with native flora or fauna

Taking or harmful interference with native flora or fauna is prohibited, except in accordance with a separate permit issued under Article 3 of Annex II by an appropriate national authority.

7(vii) Collection or removal of anything not brought into the Area by the Permit holder

- Material may be collected or removed from the Area only in accordance with a permit and should be limited to the minimum necessary to meet management needs;
- Material of human origin, not brought into the Area by the permit holder, but which is likely to compromise the values of the Area may be removed from the Area unless the impact of removal is likely to be greater than leaving the material *in situ*. If this is the case the appropriate authority should be notified.

7(viii) Disposal of waste

All wastes, including all human wastes, shall be removed from the Area.

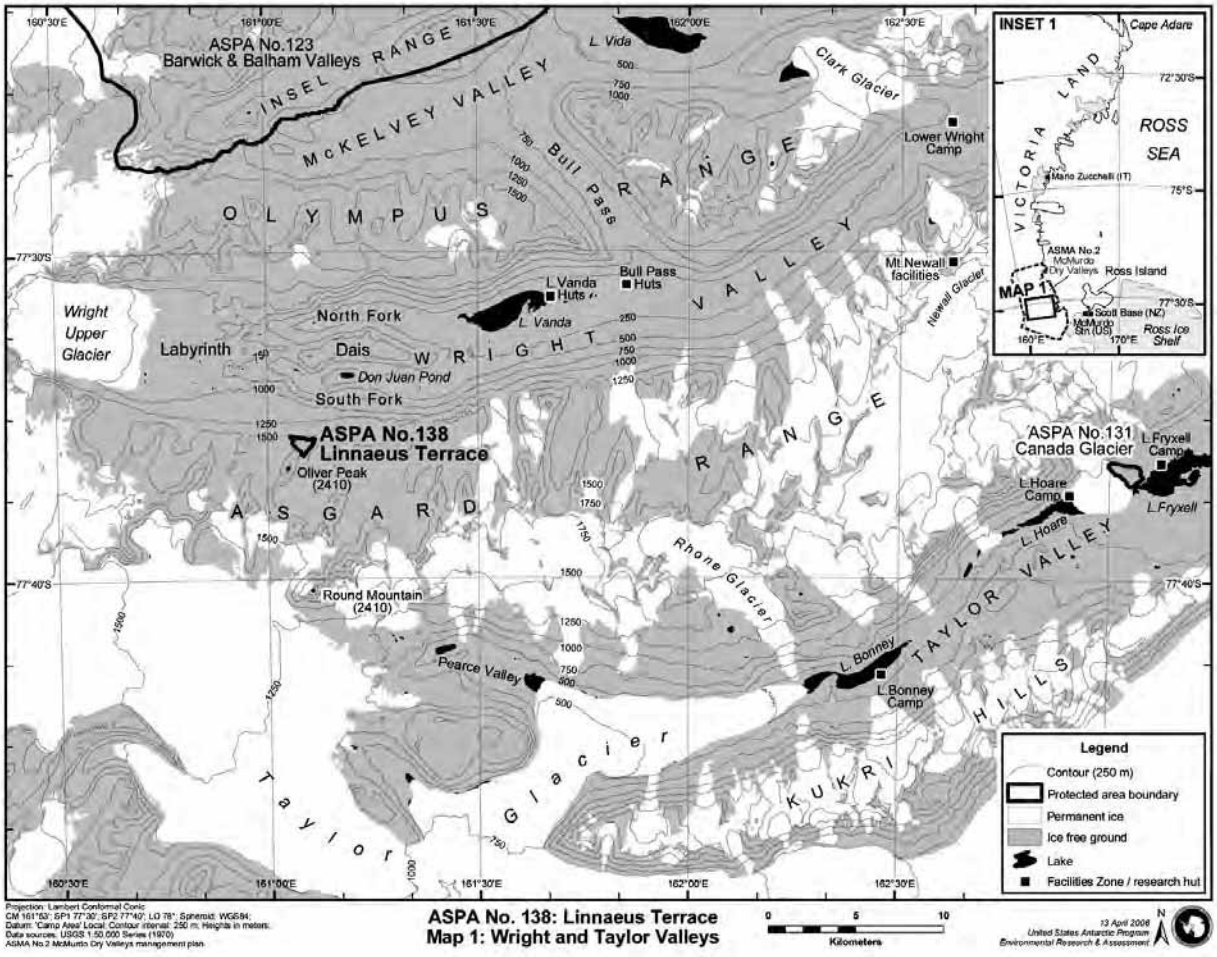
7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

- Visitors should consult and apply where appropriate the comprehensive Code of Conduct and *Guidelines for Conduct of Scientific Research* developed for use within the McMurdo Dry Valleys (ASMA No 2).
- Any specific sites of long-term monitoring should be appropriately marked.

7(x) Requirements for reports

- Parties should ensure that the principal holder of each permit issued submit to the appropriate authority a report describing the activities undertaken. Such report should include, as appropriate, the information identified in the Visit Report form contained in Appendix 4 of Resolution 2 (1998)(CEP I).

- Parties should maintain a record of such activities, and, in the annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the Management Plan and in organizing the scientific use of the Area.
- The appropriate authority should be notified of any activities/measures undertaken, and / or of any materials released and not removed, that were not included in the authorized permit.


ASPA No.123
Barwick & Balham Valleys
INSEL RANGE
McKELVEY VALLEY
OLYMPUS RANGE
Bull Pass
WRIGHT VALLEY
ASGARD RANGE
TAYLOR VALLEY
TAYLOR HILLS
KUKRI
L. Vida
Clark Glacier
Lower Wright Camp
Mt Newall facilities
Newall Glacier
L Vanda Huts
Bull Pass Huts
L. Vanda
North Fork
Wright Upper Glacier
Labyrinth
Dais
Don Juan Pond
South Fork
ASPA No.138
Linnaeus Terrace
Oliver Peak (2410)
Round Mountain (2410)
Pearce Valley
Taylor Glacier
Rhone Glacier
L. Bonney
L Bonney Camp
ASPA No.131
Canada Glacier
L Fryxell Camp
L Fryxell
L Hoare Camp
L Hoare
INSET 1
Cape Adare
VICTORIA LAND
ROSS SEA
Mario Zucchelli (IT)
ASMA No.2
McMurdo Dry Valleys
Ross Island
MAP 1
Scott Base (NZ)
McMurdo Stn (US)
Ross Ice Shelf
Legend
Contour (250 m)
Protected area boundary
Permanent ice
Ice free ground
Lake
Facilities Zone / research hut
ASPA No. 138: Linnaeus Terrace
Map 1: Wright and Taylor Valleys
Kilometers
13 April 2006
United States Antarctic Program
Environmental Research & Assessment

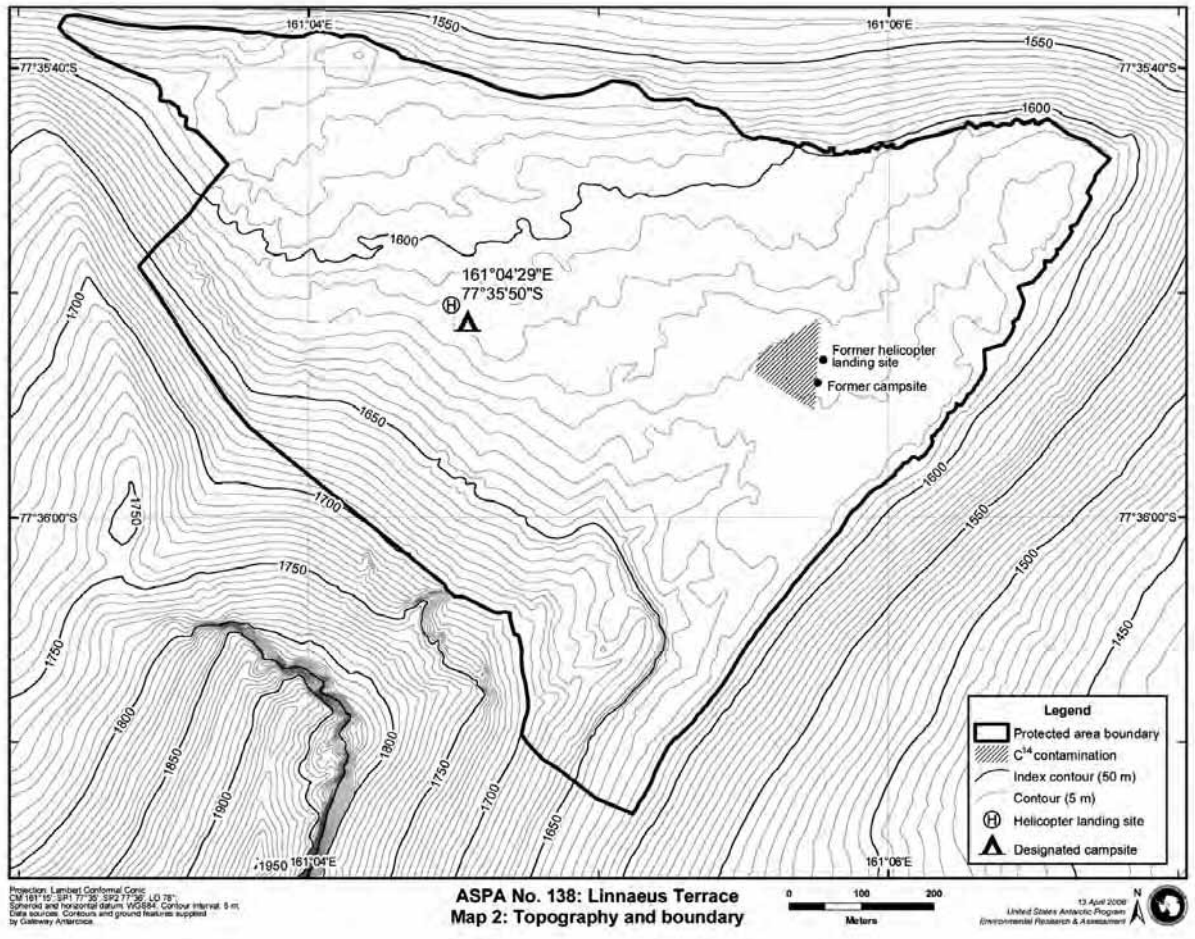
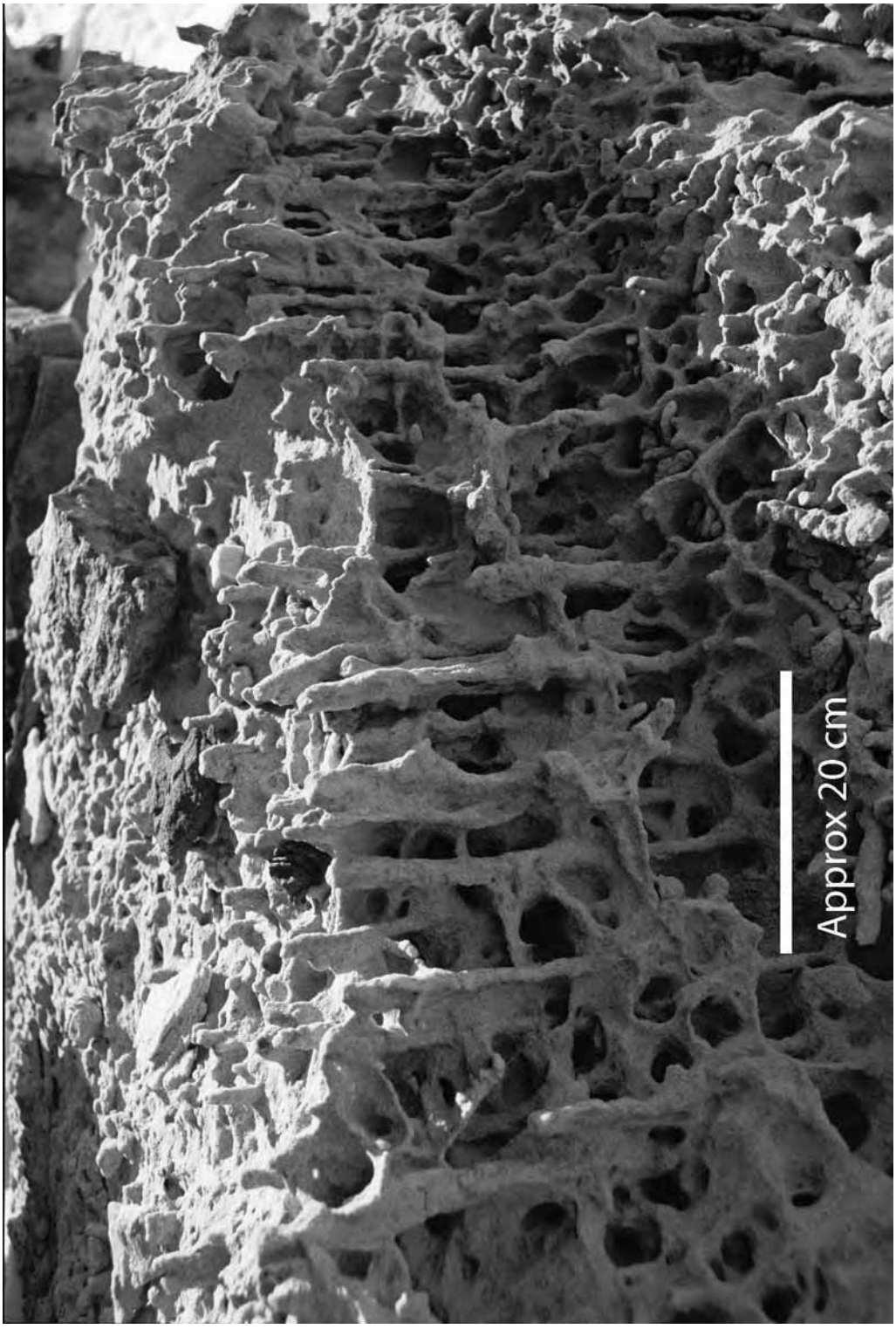

161°04'E
161°06'E
77°35'40"S
77°36'00"S
1550
1600
1650
1700
1750
1800
1850
1900
1950
161°04'29"E
77°35'50"S
Former helicopter landing site
Former campsite
Legend
Protected area boundary
C14 contamination
Index contour (50 m)
Contour (5 m)
Helicopter landing site
Designated campsite
0
100
200
Meters
N
ASPA No. 138: Linnaeus Terrace
Map 2: Topography and boundary

Figure 1. Fragile rock formations and trace fossils found on Linnaeus Terrace



II. Measures

Measure 11 (2008)

Antarctic Specially Protected Area No 154 (Botany Bay, Cape Geology, Victoria Land): Revised Management Plan

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas ("ASPA") and approval of Management Plans for those Areas;

Recalling

- Measure 3 (1997), which designated Botany Bay, Cape Geology, Victoria Land, as Site of Special Scientific Interest ("SSSI") No 37 and annexed a management plan for the site;
- Decision 1 (2002), which renamed and renumbered SSSI 37 as Antarctic Specially Protected Area No 154;
- Measure 2 (2003), which annexed a revised management plan for ASPA 154;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 154;

Desiring to replace the existing Management Plan for ASPA 154 with the revised Management Plan;

Recommend to their Governments the following Measure for approval in accordance with paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) the revised Management Plan for Antarctic Specially Protected Area No 154: Botany Bay, Cape Geology, Victoria Land, which is annexed to this Measure, be approved; and

2) all prior management plans for ASPA 154, namely those annexed to:

- Measure 3 (1997), and
- Measure 1 (2002);

shall cease to be effective.

Management Plan for Antarctic Specially Protected Area No 154

BOTANY BAY, CAPE GEOLOGY, VICTORIA LAND

1. Description of values to be protected

The Area at Botany Bay and Cape Geology (Granite Harbour, Victoria Land) has been proposed by New Zealand on the grounds that it is an extremely rich botanical refuge for such a high latitude location (162° 34' 00"E, 77° 00' 30"S), with a lichen and moss species diversity and abundance that is unique for southern Victoria Land. In addition to a high diversity and abundance of lichens and mosses there are abundant growths of algae, large populations of invertebrates (collembola, mites, nematodes, rotifers) and a colony (in excess of 40 pairs) of south polar skua (*Catharacta maccormicki*). The area is the type locality for the collembolan *Gomphiocephalus hodgsoni* Carpenter and the lichen *Caloplaca coeruleofrigida* Sochting.

The structure and development of the moss and lichen communities is similar to that found more than 10° of latitude further north, with several species at their known southern limit. The Area contains the most southerly record of the hepatic (*Cephaloziella varians*). Of great significance is the size (up to 15 cm diameter) of some lichen thalli (e.g. *Umbilicaria aprina*). The boulder beach has rich populations of both epilithic and endolithic lichens.

In addition to the biological values described, the Area contains within it the remains of a rock shelter and associated artifacts of historical importance, known as 'Granite House', designated as Historic Site No 67 in Measure 4 (1995). Constructed by members of the 1910-1913 British Antarctic Expedition, the shelter and associated artifacts are vulnerable to disturbance and are therefore managed as a Managed Zone within the Area, which is subject to access restrictions. A tent site used by the Western Geological Party under Griffith Taylor, is identifiable as a flat gravel area with a number of stones that were used to weigh down the tent valance. This area is outside the Managed Zone and is subject to access restrictions.

The limited geographical extent of the ecosystem, its unusual ecological features and importance, its exceptional scientific and historic values and the vulnerability of the Area to disturbance through trampling, sampling, pollution or alien introductions, are such that the Area requires long-term special protection.

2. Aims and objectives

Management at Cape Geology aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- allow scientific research on the ecosystem and elements of the ecosystem in particular on lichen and moss species, algae, invertebrates and skuas while ensuring protection from over-sampling;
- allow other scientific research provided it is for compelling reasons which cannot be served elsewhere;
- preserve a part of the natural ecosystem as a reference area for the purpose of future comparative studies;

- minimise the possibility of introduction of alien plants, animals and microbes to the Area;
- allow visits to 'Granite House', but under strict control by Permit;
- allow conservation visits to historic sites outside the Managed Zone, but under strict control by Permit;
- allow visits for management purposes in support of the aims of the Management Plan.

3. Management activities

The following management activities are to be undertaken to protect the values of the Area:

- Maps showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently, and copies of this Management Plan shall be kept in all of the research hut facilities located within 25km of the Area. Copies of the Management Plan will also be available at Scott Base (NZ).
- Signs illustrating the location, boundaries and clearly stating entry restrictions shall be placed at appropriate locations at the boundaries of the Area and Zones within to help avoid inadvertent entry.
- Markers, signs or structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition.
- Visits shall be made as necessary (no less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate.
- National Antarctic Programmes operating in the region shall consult together with a view to ensuring these steps are carried out.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

- Map A: Botany Bay and Cape Geology, protected area topographic map. Map specifications:
  Projection: Lambert conformal conic; Standard parallels: 1st 79° 20' 00" S; 2nd 76° 40' 00"S Central Meridian: 162° 30' 00" E Latitude of Origin: 78° 01' 16.211" S; Spheroid: WGS84.
  Inset 1: Southern Victoria Land, Ross Sea and Ross Island, showing location of Granite Harbour.
  Inset 2: Cape Geology location map, and Granite Harbour region.
- Map B: Managed Zone with 'Granite House' and viewing area, site topographic, derived from Map A.
- Map C: Vegetation density layers, site topographic, showing the distribution density of moss, lichen and algae within ASPA 154. Map specifications are the same as those in Map A.

6. Description of the Area

6(i) Geographical coordinates, boundary markers and natural features

Cape Geology is situated in the south-western corner of Granite Harbour, southern Victoria Land, at 162°32’52"E, 77°00’14"S, approximately 100km north-west of Ross Island (Map A, Insets). The Area encompasses much of the catchment above Botany Bay and consists of raised boulder beach terraces, weathered rocky steppes and irregular rock platforms around Cape Geology, extending south to include a well-defined elevated cirque containing a small ice field. The bedrock geology at Cape Geology has been described as a porphyritic grey biotite-granite, with phenocrysts of orthoclase of reddish colour, casting the weathered rock with a reddish tinge.

The north-west corner of the Area is marked by a brass plaque in a boulder (M1, 2 m: Map A, 162°31’53"E, 77°00’19’S) 400m SW of Cape Geology. The west boundary is defined by a line extending first 260m SSE from M1 to a large boulder (marked by a cairn) with terrier bolt (M2) at an elevation of 118m on the ridge above the campsite; thence the boundary extends 250m up this ridge to a point at 162m elevation marked by an iron tube with bamboo pole. The west boundary extends a further 300m up this ridge to a large pointed rock at 255m elevation (162°31’46"E, 77°00’40"S) near the edge of the permanent ice field. The boundary then extends 150m south across the ice field to the west edge of a prominent line of exposed rock and moraine in the SW corner of the Area at 325m elevation. The south boundary follows this line of rock east until the exposure is buried by the ice-field, thence SE across the ice field for 500m to the edge of a second and more prominent exposure at an elevation of just over 400m (M3, 162°33’22"E, 77°00’59"S). The boundary follows the upper edge of this exposure and then crosses the ice field SE to an elevation of approximately 325m where the ice-free eastern boundary ridge and the ice field converge, (162°34’15"E, 77°01’16"S). The east boundary follows the ridge crest for 1550m in a NE direction to a low point on the ridge (M4, 392 m, 162°36’10"E, 77°00’13"S) where the east boundary turns to descend due north to the coast at the eastern extremity of the boulder beach of Botany Bay (M5, 5 m). The mean high water mark of the coastline of Botany Bay and Cape Geology forms the northern boundary of the Area.

The Area is extremely rich botanically for such a high-latitude location — it is also one of the richest sites in the whole of continental Antarctica. There is a high diversity and abundance of lichens (more than 30 species) and mosses (seven species), and the structure and development of these communities are similar to those found 10° of latitude further north (Table 1). Some lichen thalli (e.g. *Umbilicaria aprina*) measure up to 15 cm diameter. The boulder beach has rich populations of both epilithic and endolithic lichens. The Area is the type locality for the lichen *Caloplaca coeruleofrigida* Sochting. The Area contains by far the most southerly record of an hepatic (*Cephaloziella varians*) and the mosses *Bryoerythrophyllum recurvirostre* and possibly *Ceratodon purpureus*. There are abundant growths of algae (at least 85 taxa), although the algal flora is not considered particularly unusual for the locality.

Table 1. Estimated species list for lichen and mosses found at Botany Bay (species in bold are common)

Lichen	Mosses
Acarospora gwynnii	*Breyoerythrophyllum recurvirostre*
Amandinea petermannii	***Bryum argenteum***
Buellia frigida	***Bryum pseudotriquetrum***
Buellia papillata	***Ceratodon purpureus***
Buellia subfrigida	*Hennediella heimii*
Caloplaca athallina	*Hennediella heimii*
Caloplaca citrina	*Syntrichia sarconeurum*
Caloplaca coeruleofrigida	
Caloplaca saxicola	
Candelariella flava	

Lichen	Mosses
Carbonea vorticosa?	
Lecanora expectans	
Lecanora fuscobrunnea	
Lecanora mons-nivis	
Lecidea andersonii	
Lecidea cancriformis	
Lecidella siplei	
Lepraria cacuminum	
Physcia caesia	
Physcia dubia	
Rhizocarpon geminatum	
Rhizocarpon geographicum	
Rhizoplaca sp.	
Rhizoplaca melanophthalma	
Rinodina olivaceobrunnea	
Umbilicaria aprina	
Xanthoria elegans	
Xanthoria mawsonii	
indeterminate grey crust	

There are large populations of invertebrates (collembola, mites, nematodes, rotifers) and the area is the type locality for the collembolan *Gomphiocephalus hodgsoni* Carpenter. There is a colony of between 40 – 50 breeding pairs (and numerous non-breeders) of the south polar skua (*Catharacta maccormicki*), which is approximately the same number present in 1911–12. No other bird species are known to breed in the Cape Geology area.

6(ii) Restricted and managed zones within the Area

Restricted Zone

An area directly above Botany Bay is designated as a Restricted Zone in order to preserve part of the Area as a reference site for future comparative studies, while the remainder of the Area (which is similar in biology, features and character) is more generally available for research programmes and sample collection. The west boundary of the Restricted Zone is defined by a line from a marker (iron tube in rock, 20 metres from mean high water mark, elevation 8 m) at the west side of Botany Bay (Map A), extending SW for 170m up to a second iron tube marker on the crest of the adjacent ridge (87 m). This boundary extends 100m to a third iron tube and a cairn (98 m), thence 50m to a large flat rock in the centre of the main flush (marked '1' on Map A). The south boundary of the Restricted Zone extends from the flat rock in the flush in a straight line 820m to the first of two prominent boulders closely adjacent to each other, approximately in the middle of the ice-free slopes above Botany Bay (marked '2' on Map A at 165 m). The east boundary extends 300m from there to a large rock at 135m elevation (marked '3' on Map A), thence NE downslope to the NE boundary point (M5, 5 m). The north boundary of the Restricted Zone is the mean high water mark of Botany Bay and is coincident with the north boundary of the Area.

Access to the Restricted Zone is allowed only for compelling scientific or management (such as inspection or review) purposes, which cannot be served elsewhere in the Area.

Managed Zone

Situated along the coast from the north-west corner of ASPA 154 to just west of the northernmost tip of Cape Geology, a Managed Zone is designated to protect historic artifacts and plant communities within this vicinity, yet also to allow access to the rock shelter known as 'Granite House', which

was designated as Historic Site No 67 in Measure 4 (1995). The Managed Zone is an area of 470m by 20m along the coast and by 80m at the point that surrounds a rock ridge leading from the coast at Cape Geology to the old shelter. The boundaries are marked on Map B. The shelter was constructed by members of the 1910-1913 British Antarctic Expedition, and used between December 1911 and January 1912 while the party carried out geological and biological exploration in the vicinity. The structure was built using a natural hollow in the rocks, with walls built up from granite boulders and a roof of seal skins: in January 2007 parts of the walls remained, but while several of the skins were present the roof had collapsed. Access to the Managed Zone may be allowed by Permit, subject to the conditions of this Management Plan.

6(iii) Structures within and near the Area

The only structures known to exist in the Area are 'Granite House', the boundary survey markers and signposts in appropriate locations.

6(iv) Location of other protected areas within close proximity of the Area

Botany Bay lies within Antarctic Specially Managed Area (ASMA No 2), McMurdo Dry Valleys. Within the ASMA, the nearest Special Feature is the Sand Dune Feature in Lower Victoria Valley. The nearest protected area to Cape Geology is ASPA 123 at Barwick Valley, 50km distant in a SW direction in the Victoria Land Dry Valleys.

7. Permit conditions

Entry into the Area is prohibited except in accordance with a Permit issued by appropriate national authorities. Conditions for issuing a Permit to enter the Area are that:

- outside of the Restricted and Managed Zones, it is issued only for scientific study of the ecosystem, or for compelling scientific reasons that cannot be served elsewhere, or for conservation at historic sites, or for essential management purposes consistent with plan objectives such as inspection or review;
- access to the Restricted Zone is allowed only for compelling scientific or management reasons that cannot be served elsewhere in the Area;
- access to the Managed Zone may be permitted for scientific, management, historical, educational or recreational purposes;
- the actions permitted will not jeopardise the ecological, scientific or historic values of the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- the Permit, or an authorized copy, shall be carried within the Area;
- a visit report shall be supplied to the authority named in the Permit;
- permits shall be issued for a stated period.

7(i) Access to and movement within the Area

Vehicles are prohibited within the Area and access should be by foot. Helicopters are normally prohibited from landing within the Area: there is a designated site 60m outside of the Area (162° 31' 47.7"E, 77° 00' 20.8"S: Map A, Map B and Map C). Access to the landing site should be from the open water / sea ice to the north of the Area. Overflight of the Area lower than 300m (~1000 ft)

above ground level is normally prohibited. When required for essential scientific or management purposes, transient overflight or landing may be allowed: conduct of such anticipated overflights or landings must be specifically authorised by Permit. Use of helicopter smoke grenades within the Area is prohibited unless necessary for safety, and all grenades should be retrieved. All helicopter landing or overflight lower than 300m AGL is prohibited within the Restricted Zone.

Access into the Area should preferably be from the recommended camping area along a preferred walking route 10–20m from the coast, which is relatively devoid of vegetation. Visitors should avoid walking on visible vegetation, or unnecessary disturbance to bird populations. Care should be exercised walking in areas of moist ground, where foot traffic can easily damage sensitive soils, plant and algal communities, and degrade water quality: walk around such areas, on ice or rocky ground. Pedestrian traffic should be kept to the minimum necessary consistent with the objectives of any permitted activities and every reasonable effort should be made to minimise effects.

Access to the Managed Zone should preferably be from the coast, following the ridge leading up to 'Granite House' (Map B). An alternative route may be used from the recommended camping area and helicopter landing site, along a preferred walking route 10-20m from the coast, if sea-ice travel is unsafe (Map B). Unless specifically authorised by Permit, visitors are prohibited from entering the historic shelter, and are limited to access and viewing from the rock ridge designated for access from the coast in order to prevent damage to the rich vegetation within the Managed Zone. Visitors shall not venture south of 'Granite House', unless specifically authorised by Permit. A maximum of 10 people is permitted to enter the Managed Zone at any one time, and a maximum of 5 people is allowed in the viewing area overlooking 'Granite House' at any one time (Map B).

7(ii) Activities that are or may be conducted in the Area, including restrictions on time or place

- Scientific research that will not jeopardise the ecosystem of the Area;
- essential management activities, including monitoring;
- limited visits to the Managed Zone for reasons other than science or management subject to the conditions described in this plan;
- activities with the aim of preserving or protecting the historic resources within the Area.

7(iii) Installation, modification or removal of structures

No structures are to be erected within the Area except as specified in a Permit. All scientific equipment installed in the Area must be authorised by Permit and clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area. Removal of specific equipment for which the Permit has expired shall be a condition of the Permit.

7(iv) Location of field camps

Camping within the Area is prohibited and should be at a site outside of the Area, 100m from the NW corner (Map A), adjacent to the designated helicopter landing site. This camping site has been disturbed by previous activities and visitors should reoccupy these disturbed positions for tents and other facilities.

7(v) Restrictions on materials and organisms which can be brought into the Area

No living animals, plant material or microorganisms shall be deliberately introduced into the Area and precautions shall be taken against accidental introductions. No herbicides or pesticides shall be brought into the Area. Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the Permit, shall be removed from

the Area at or before the conclusion of the activity for which the Permit was granted. Fuel is not to be stored in the Area, unless required for essential purposes connected with the activity for which the Permit has been granted. All materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimised.

7(vi) Taking or harmful interference with native flora or fauna

This is prohibited, except in accordance with a Permit. Where animal taking or harmful interference is involved this should, as a minimum standard, be in accordance with the *SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica*.

7(vii) Collection or removal of anything not brought into the Area by the Permit holder

Material may be collected or removed from the Area only in accordance with a Permit and should be limited to the minimum necessary to meet scientific or management needs. Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the Permit Holder or otherwise authorised, may be removed unless the impact of removal is likely to be greater than leaving the material *in situ* : if this is the case the appropriate authority should be notified.

Unless specifically authorised by Permit, visitors are prohibited from interfering with or attempting restoration of 'Granite House' in any way, or from handling, taking or damaging any artifacts found within the Managed Zone. Evidence of recent changes, damage or new artifacts observed should be notified to the appropriate national authority. Relocation or removal of artifacts for the purposes of preservation, protection or to re-establish historical accuracy is allowable by Permit.

7(viii) Disposal of waste

All wastes, including all human wastes, shall be removed from the Area.

7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

Permits may be granted to enter the Area to carry out biological monitoring and site inspection activities, which may involve the collection of small samples for analysis or review, to erect or maintain signposts, or for management activities, especially those associated with the Historic Sites.

Any specific sites of long-term monitoring shall be appropriately marked.

To help maintain the ecological and scientific values of the isolation and relatively low level of human impact at the Area visitors shall take special precautions against introductions. Of particular concern are microbial or vegetation introductions sourced from soils at other Antarctic sites, including stations, or from regions outside Antarctica. To minimize the risk of introductions, visitors shall thoroughly clean footwear and any equipment to be used in the area - particularly sampling equipment and markers – before entering the Area.

Visitors shall consult and apply where appropriate the comprehensive Code of Conduct and *Guidelines for Conduct of Scientific Research* developed for use within the McMurdo Dry Valleys (ASMA No 2).

7(x) Requirements for reports

Parties should ensure that the principal holder for each permit issued submit to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate,

the information identified in the Visit Report form suggested by SCAR. Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, which should be in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the management plan and in organising the scientific use of the Area.

8. Bibliography

Broady, P.A., 2005. The distribution of terrestrial and hydro-terrestrial algal associations at three contrasting locations in southern Victoria Land, Antarctica. Algological Studies, 118, 95-112.

Davidson, M.M., Broady, P.A. (1996). Analysis of gut contents of Gomphiocephalus hodgsoni Carpenter (Collembola: Hypogastruridae) at Cape Geology, Antarctica. Polar Biology, 16 (7), 463-467.

Green, T.G.A. 2001. The state of the Ross Sea region terrestrial environment: Terrestrial biota. in: Ross Sea Region 2001: A state of the environment report for the Ross Sea region of Antarctica.Waterhouse E.(ed), Christchurch: New Zealand Antarctic Institute. pp.4.36-4.54

Green, T.G.A. Kulle, D. Pannewitz, S. Sancho, L.G. Schroeter, B. 2005. UV-A protection in mosses growing in continental Antarctica. Polar biology 28(11): 822-827.

Green, T.G.A. Schroeter, B. Sancho, L.D. 1999. Plant life in Antarctica. in: Handbook of functional plant ecology.Pugnaire F.I. Valladares F. (eds) New York, Basel: Marcel Dekker. pp.495-543 ISBN 0824719506

Green, T.G.A. Schroeter, B. Seppelt, D. 2000. Effect of temperature, light and ambient UV on the hotosynthesis of the moss Bryum argenteum Hedw. in continental Antarctica. in: Antarctic Ecosystems: models for wider ecological understanding.Davison W. Howard-Williams C. Broady P.(eds) Christchurch, New Zealand: New Zealand Natural Sciences. pp.165-170 ISBN 047306877X

Kappen, L. Schroeter, B. 1997. Activity of lichens under the influence of snow and ice. Proceedings of the NIPR Symposium on Antarctic Geosciences 10: 163-168.

Kappen, L. Schroeter, B. Green, T.G.A. Seppelt, R.D. 1998. Chlorophyll a fluorescence and CO2 exchange of Umbilicaria aprina under extreme light stress in the cold. Oecologia 113(3): 325-331.

Kappen, L., Schroeter, B., Green, T.G. A., Seppelt, R.D. 1998. Microclimate conditions, meltwater moistening, and the distributional pattern of Buellia frigida on rock in a southern continental Antarctic habitat. Polar biology, 19 (2), 101-106.

Montes, M.J., Andrés, C., Ferrer, S., Guinea, J. 1997. Cryptococcus a new Antarctic yeast isolated from Botany Bay, Tierra Victoria. Real Sociedad Española de Historia Natural. Boletín. Sección Biológica. 93 (1-4), 45-50.

Pannewitz, S. Schlensog, M. Green, T.G.A. Sancho, L.G. Schroeter, B. 2003. Are lichens active under snow in continental Antarctica? Oecologia 135: 30-38, 2003.

Pannewitz, S. Green, T.G.A. Maysek, K. Schlensog, M. Seppelt, R. Sancho, L.G. Türk, R. Schroeter, B. 2005. Photosynthetic responses of three common mosses from continental Antarctica. Antarctic science 17(3): 341-352.

Rees, P.M., Cleal, C.J. 2004. Lower Jurassic floras from Hope Bay and Botany Bay, Antarctica. Special Papers in Palaeontology, Vol. 72, 90p. Palaeontology Association, London, United Kingdom.

Sancho, L.G. Pintado, A. Green, T.G.A. Pannewitz, S. Schroeter, B. 2003. Photosynthetic and morphological variation within and among populations of the Antarctic lichen Umbilicaria aprina: implications of the thallus size. Bibliotheca lichenologica 86: 299-311.

Schlensog, M. Pannewitz, S. Green, T.G.A. Schroeter, B. 2004. Metabolic recovery of continental Antarctic cryptogams after winter. Polar biology 27(7): 399-408.

Schroeter, B., Green, T.G.A., Seppelt, R.D. 1993. History of Granite House and the western geological party of Scott's Terra Nova expedition. Polar record, 29 (170), 219-224.

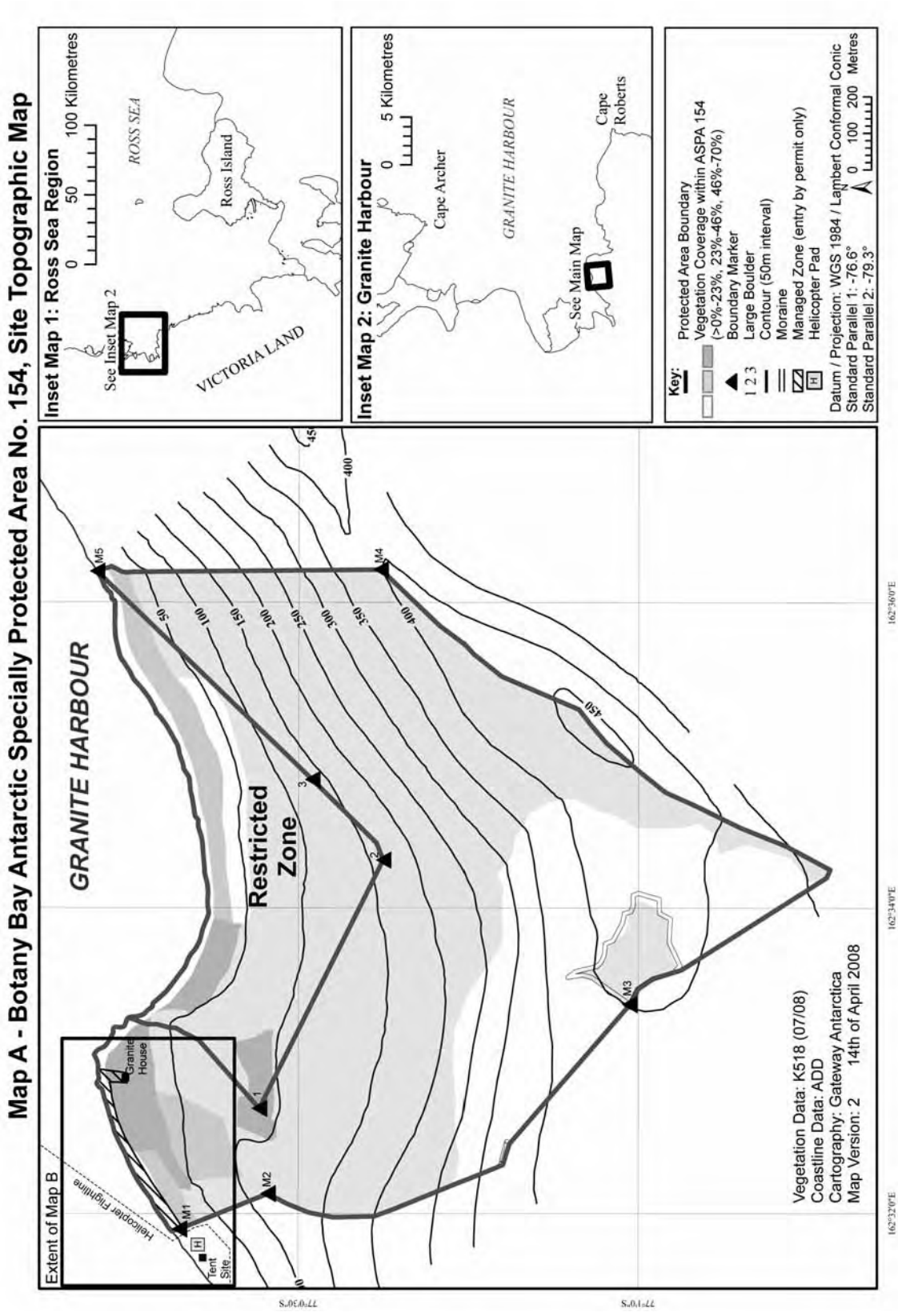
Schroeter, B. Green, T.G.A. Kappen, L. Seppelt, R.D. 1994. Carbon dioxide exchange at subzero temperatures. Field measurements on Umbilicaria aprina in Antarctica. Cryptogamic botany 4(2): 233-241.

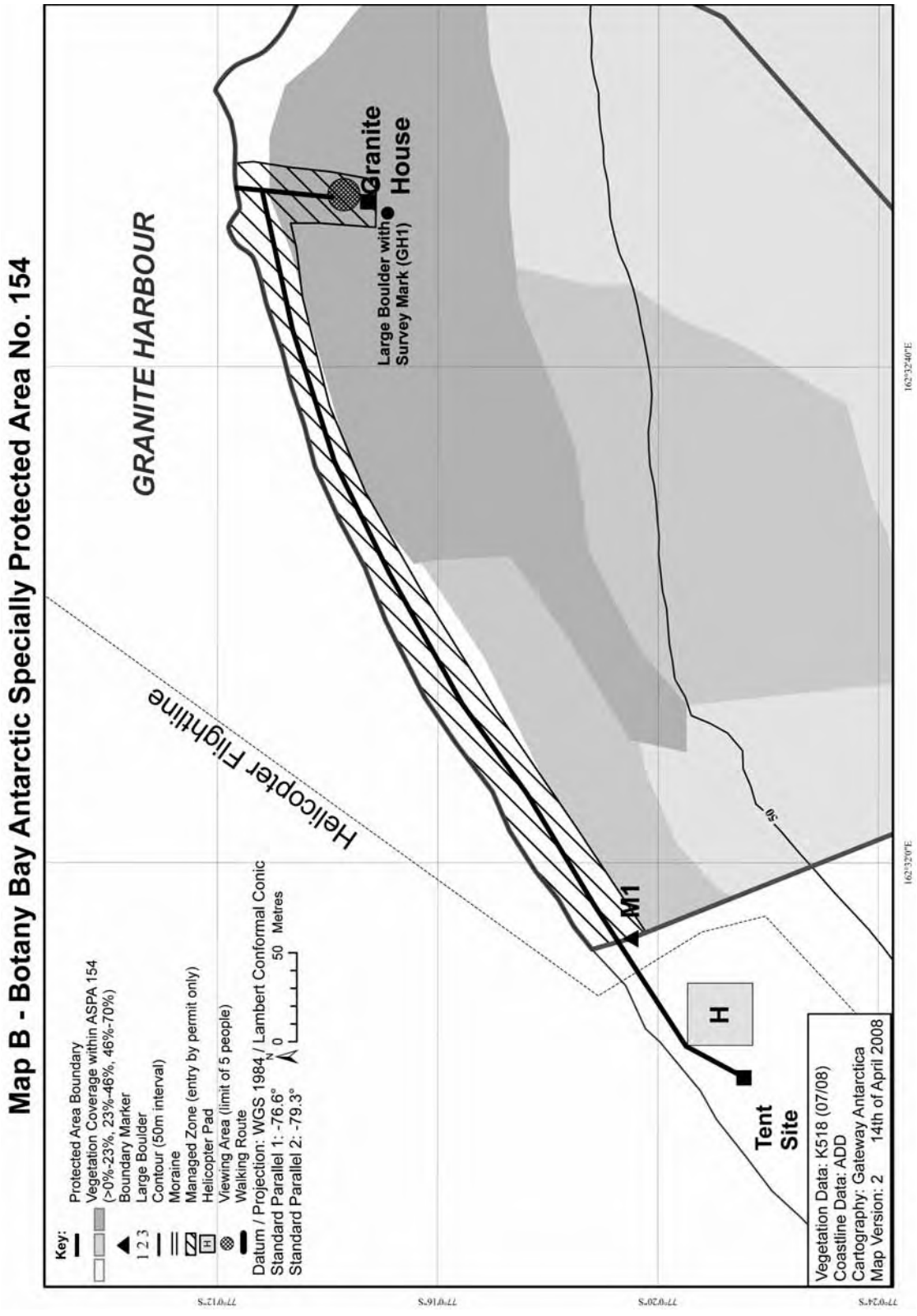
Schroeter, B. Green, T.G.A. Seppelt, R.D. Kappen, L. 1992. Monitoring photosynthetic activity of crustose lichens using a PAM-2000 fluorescence system. Oecologia 92: 457-462.

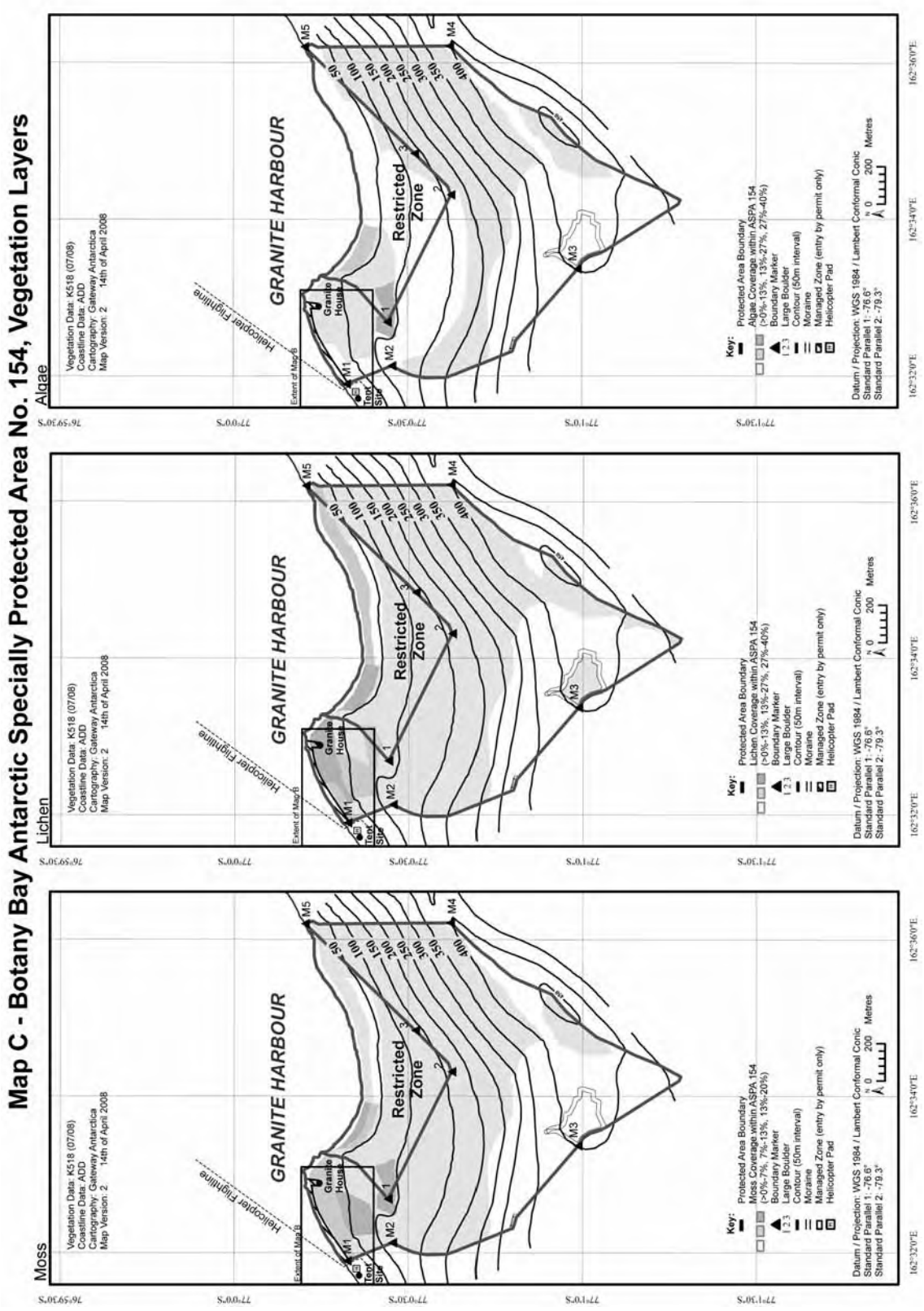
Schroeter, B. Kappen, L. Green, T.G.A. Seppelt, R.D. 1997. Lichens and the Antarctic environment: effects of temperature and water availability on photosynthesis. in: Ecosystem processes in Antarctic ice-free landscapes: proceedings of an International Workshop on Polar Desert Ecosystems, Christchurch, NZ, 1-4 July 1996.Lyons W.B. Howard-Williams C. Hawes I. (eds) The Netherlands: Balkema Press. pp.103-117 ISBN 9054109254

Schroeter, B. Scheiddegger, C. 1995. Water relations in lichens at subzero temperatures: structural changes and carbon dioxide exchange in the lichen Umbilicaria aprina from continental Antarctica. New phytologist 131(2): 273-285.

Seppelt, R.D., Green, T.G.A., 1998. A bryophyte flora for southern Victoria Land, Antarctica. New Zealand Journal of Botany, 36 (4), p. 617-635.


Map A - Botany Bay Antarctic Specially Protected Area No. 154, Site Topographic Map
Inset Map 1: Ross Sea Region
0 50 100 Kilometres
See Inset Map 2
ROSS SEA
Ross Island
VICTORIA LAND
Inset Map 2: Granite Harbour
0 5 Kilometres
Cape Archer
GRANITE HARBOUR
See Main Map
Cape Roberts
Key:
Protected Area Boundary
Vegetation Coverage within ASPA 154
(>0%-23%, 23%-46%, 46%-70%)
Boundary Marker
1 2 3
Large Boulder
Contour (50m interval)
Moraine
Managed Zone (entry by permit only)
Helicopter Pad
Datum / Projection: WGS 1984 / Lambert Conformal Conic
Standard Parallel 1: -76.6°
Standard Parallel 2: -79.3°
0 100 200 Metres
Extent of Map B
Helicopter Flightline
Granite House
Tent Site
GRANITE HARBOUR
Restricted Zone
M1
M2
M3
M4
M5
1
2
3
0
50
100
150
200
250
300
350
400
450
Vegetation Data: K518 (07/08)
Coastline Data: ADD
Cartography: Gateway Antarctica
Map Version: 2 14th of April 2008
162°32'0"E
162°34'0"E
162°36'0"E
77°0'30"S
77°1'0"S


Map B - Botany Bay Antarctic Specially Protected Area No. 154
GRANITE HARBOUR
Granite House
Large Boulder with Survey Mark (GH1)
Helicopter Flightline
M1
H
Tent Site
50
Key:
Protected Area Boundary
Vegetation Coverage within ASPA 154 (>0%-23%, 23%-46%, 46%-70%)
Boundary Marker
Large Boulder
Contour (50m interval)
Moraine
Managed Zone (entry by permit only)
Helicopter Pad
Viewing Area (limit of 5 people)
Walking Route
Datum / Projection: WGS 1984 / Lambert Conformal Conic
Standard Parallel 1: -76.6°
Standard Parallel 2: -79.3°
0 50 Metres
Vegetation Data: K518 (07/08)
Coastline Data: ADD
Cartography: Gateway Antarctica
Map Version: 2 14th of April 2008
162°32'40"E
162°32'0"E
77°0'12"S
77°0'16"S
77°0'20"S
77°0'24"S


Map C - Botany Bay Antarctic Specially Protected Area No. 154, Vegetation Layers
Moss
Lichen
Algae
GRANITE HARBOUR
Restricted Zone
Granite House
Helicopter Flightline
Extent of Map 6
Tent Site
M1
M2
M3
M4
M5
Vegetation Data: K518 (07/08)
Coastline Data: ADD
Cartography: Gateway Antarctica
Map Version: 2 14th of April 2008
Key:
Protected Area Boundary
Moss Coverage within ASPA 154 (>0%-7%, 7%-13%, 13%-20%)
Lichen Coverage within ASPA 154 (>0%-13%, 13%-27%, 27%-40%)
Algae Coverage within ASPA 154 (>0%-13%, 13%-27%, 27%-40%)
Boundary Marker
Large Boulder
Contour (50m interval)
Moraine
Managed Zone (entry by permit only)
Helicopter Pad
Datum / Projection: WGS 1984 / Lambert Conformal Conic
Standard Parallel 1: -76.6°
Standard Parallel 2: -79.3°
0 200 Metres
76°59'30"S
77°0'0"S
77°0'30"S
77°1'0"S
77°1'30"S
162°32'0"E
162°34'0"E
162°36'0"E

Measure 12 (2008)

Antarctic Specially Protected Area No 155 (Cape Evans, Ross Island): Revised Management Plan

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas ("ASPA") and approval of Management Plans for those Areas;

Recalling

- Measure 2 (1997), which designated the Cape Evans Historic Site and its environs as Specially Protected Area ("SPA") No 25 and annexed a management plan for the site;
- Decision 1 (2002), which renamed and renumbered SPA 25 as Antarctic Specially Protected Area No 155;
- Measure 2 (2005), which adopted a revised management plan for ASPA 155;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 155;

Desiring to replace the existing Management Plan for ASPA 155 with the revised Management Plan;

Recommend to their Governments the following Measure for approval in accordance with paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) the revised Management Plan for Antarctic Specially Protected Area No 155: Cape Evans, Ross Island, which is annexed to this Measure, be approved; and
2) all prior Management Plans for ASPA No 155, namely those annexed to:

    - Measure 2 (1997), and
    - Measure 2 (2005);

    shall cease to be effective.

II. Measures

Management Plan for Antarctic Specially Protected Area No 155

CAPE EVANS, ROSS ISLAND

(including Historic Sites and Monuments Nos. 16 and 17, the historic *Terra Nova* hut of Captain R.F. Scott and its precincts)

1. Description of values to be protected

The significant historic value of this Area was formally recognised when it was listed as Historic Site and Monument Nos 16 and 17 in Recommendation 9 (1972). An area containing both sites was designated as Specially Protected Area No 25 in Measure 2 (1997) and redesignated as Antarctic Specially Protected Area 155 in Decision 1 (2002).

The Terra Nova hut (Historic Site and Monument No 16) is the largest of the historic huts in the Ross Sea region. It was built in January 1911 by the British Antarctic Terra Nova Expedition of 1910-1913, led by Captain Robert Falcon Scott, RN. It was subsequently used as a base by the Ross Sea party of Sir Ernest Shackleton's Imperial Trans-Antarctic Expedition of 1914-1917.

Historic Site and Monument No 17 contains the Cross on Wind Vane Hill, (erected in the memory of three members of Shackleton's Ross Sea party who died in 1916). In addition to this, the anchors of the ship Aurora from the Imperial Trans-Antarctic Expedition, an instrument shelter, several supply dumps and dog kennels, and numerous artefacts are distributed around the site.

Some of the earliest advances in the study of earth sciences, meteorology, flora and fauna are associated with the Terra Nova Expedition based at this site. The data collected can provide a bench mark against which to compare current measurements. The history of these activities and the contribution they have made to the understanding and awareness of Antarctica therefore contribute to both the historic and scientific value of the site.

The Cape Evans site is one of the principal sites of early human activity in Antarctica. It is an important symbol of the Heroic Age of Antarctic exploration, and as such, has considerable historical significance.

2. Aims and objectives

The aim of this Management Plan is to provide protection for the Area and its features so that its values can be preserved. The objectives of the Plan are to:

- avoid degradation of, or substantial risk to, the values of the Area;
- maintain the historic values of the area through planned conservation work which may include:
    a) an annual 'on-site' maintenance programme,
    b) a programme of monitoring the condition of artefacts and structures, and the factors which affect them, and conservation of artefacts to be conducted on and off site;

- allow management activities which support the protection of the values and features of the Area including:
  a) mapping and otherwise recording the disposition of historic items in the hut environs, and
  b) recording other relevant historic data; and
- prevent unnecessary human disturbance to the Area, its features and artefacts through managed access to the Terra Nova hut.

3. Management activities

The following management activities will be undertaken to protect the values of the Area:

- A regular programme of conservation work shall be undertaken on the Terra Nova hut and associated artefacts in the Area.
- Systematic monitoring shall be put in place to assess the impacts of present visitor limits, and the results and any related management recommendations included in reviews of this Management Plan.
- Visits shall be made as necessary for management purposes.
- National Antarctic Programmes operating in, or those with an interest in, the Area shall consult together with a view to ensuring the above management activities are implemented.

4. Period of designation

Designated for an indefinite period.

5. Maps

- Map A: Cape Evans regional map. This map shows the boundaries of the proposed Antarctic Specially Protected Areas with significant topographical features, approaches, field camp sites and helicopter landing sites. It also shows the approximate location of significant historical items within the area. Inset: Ross Island showing sites of nearby protected areas and stations.
- Map B: Cape Evans site map. This map shows the approximate location of specific historic artefacts and sites within the Area.

6. Description of the Area

6(i) Geographical co-ordinates boundary markers and natural features

Cape Evans is a small, triangular shaped, ice-free area in the south west of Ross Island, 10 kilometres to the south of Cape Royds and 22 kilometres to the north of Hut Point Peninsula on Ross Island. The ice-free area is composed of till-covered basalt bedrock. The designated Area is located on the north western coast of Cape Evans adjacent to Home Beach and centred on Scott's *Terra Nova* hut. The boundaries of the ASPA are:

- South: a line extending east from a point at 77º 38' 15.47" S, 166º 25' 9.48" E – 20 metres south of the cross on Wind Vane Hill;
- South-west: a line from the reference point above extended to follow the crest of the small ridge descending in a north westerly direction to the shoreline at 77º 38' 11.50" S, 166º 24' 49.47" E;
- North-west: by the shoreline of Home Beach;
- North-east: by the line of the outlet stream from Skua Lake to Home Beach at 77º 38' 4.89" S, 166º 25' 13.46" E;
- East: by the line extending south from the western edge of Skua Lake at 77º 38' 5.96" S, 166º 25' 35.74" E – to intersect with the southern boundary at 77º 38' 15.48" S, 166º 25' 35.68" E.

Skuas (*Catharacta maccormicki*) nest on Cape Evans and Adelie penguins (*Pygoscelis adeliae*) from the rookery at Cape Royds may occasionally transit the Area. Weddell seals have also been seen hauled up on Home Beach.

6(ii) Access to the Area

When safe conditions exist, vehicle approach to the Area can be made across the sea ice. Vehicles are prohibited from entering the Area, unless approved to do so for management activities in accordance with 7(i) below. During open water, landings by boat may be made directly in front of the hut at Home Beach. Helicopter landings may be made at either of the existing designated landing sites marked on Maps 1 and 2. One site is approximately 100 metres to the north of the hut, just outside the Area. The other is located adjacent to the New Zealand refuge hut approximately 250 metres beyond the south western boundary of the Area.

6(iii) Location of structures within and adjacent to the Area

All structures located within the Area are of historic origin, although a temporary, modern protective enclosure around the magnetic hut remains in place. A major feature of the Area is Scott's Terra Nova hut located on the north western coast of Cape Evans at Home Beach. The hut is surrounded by many historic relics including the anchors from the Aurora, dog skeletons, instrument shelters, dog line, meteorological screen, fuel dump, magnetic hut, coal, stores, rubbish dumps and flag pole. A memorial cross to three members of Shackleton's Ross Sea party of 1914-1917 stands on West Vane Hill. All these features are included within the boundaries of the Area.

A New Zealand refuge hut, camp site and helicopter landing site are situated approximately 250m to the south west of the Area.

The Greenpeace year-round World Park Base was sited to the north east of Scott's hut from 1987 to 1992. No visible sign of the base remains.

6(iv) Location of other Protected Areas in the vicinity

- ASPA 121 (previously SSSI No 1) and
- ASPA 157 (SPA No 27), Cape Royds are 10 kilometres north of Cape Evans.
- ASPA 122 (SSSI No 2), Arrival Heights and
- ASPA 158 (SPA No 28), Hut Point are approximately 20 kilometres south of Cape Evans at Hut Point Peninsula.
- ASPA 130 (SSSI No 11), Tramway Ridge is approximately 20 kilometres east of Cape Evans.

All sites are located on Ross Island.

6(v) Special Zones within the Area

There are no special zones within the Area.

7. Terms and conditions for entry permits

Entry to the Area is prohibited except in accordance with a Permit. Permits shall be issued only by appropriate national authorities and may contain both general and specific conditions. A Permit may be issued by a national authority to cover a number of visits in a season. Parties operating in the Area shall consult together and with groups and organisations interested in visiting the Area to ensure that visitor numbers are not exceeded.

Permits to enter the site may be issued for a stated period for:

- activities related to conservation, research and/or monitoring purposes;
- management activities in support of the objectives of the Plan;
- activities related to educational or recreational activities including tourism, providing they do not conflict with the objectives of this Plan.

7(i) Access to and movement within or over the Area

- Control of movement within the Area is necessary to prevent damage caused by crowding around the many vulnerable features within the Area. The maximum number in the Area at any time (including guides and those within the hut) shall be: 40 people.
- Control of numbers within the hut is necessary to prevent damage caused by crowding around the many vulnerable features within the hut. The maximum number within the hut at any time (including guides) shall be: 12 people.
- Avoidance of cumulative impacts on the interior of the hut requires an annual limit on visitor numbers. The effects of the current visitor levels (average 1489 per year between 1998 and 2004) suggest that a significant increase could cause significant adverse impacts. The maximum annual number of visitors shall be: 2,000 people.
- These limits have been set based on current visitor levels and on the best advice available from conservation advisory agencies (which include conservators, archaeologists, historians, museologists and other heritage protection professionals). The limits are based on the proposition that any significant increase in the current level of visitor numbers would be detrimental to the values to be protected. An ongoing monitoring programme to assess the effects of visitors is required to provide the basis for future reviews of the Management Plan, in particular whether the current limits on numbers of visitors are appropriate.
- Adequate supervision of visits to the Area is necessary to prevent damage caused by crowding and by actions inconsistent with the Code of Conduct set out in section 7(ii). All tourism, educational and recreational visits must be supervised by an experienced guide nominated by the operator (refer section 7(ix)).
- Helicopter landings are prohibited within the Area as they have the potential to damage the site by blowing scoria and ice particles and to accelerate the abrasion of the hut and surrounding artefacts. Refer to 6(ii) for recommended approaches and landing sites.
- Vehicles are prohibited from entering the Area except where it is necessary to use vehicles for management activities. This may include, but is not limited to activities such as clearing

snow and ice that is judged to be a threat to the historic hut or other artefacts. In all such cases consideration shall be given to:

i. using the minimum sized vehicle required for the job;
ii. ensuring the vehicle operator is fully trained and aware of the provisions of this management plan, and of the sensitivities at the site of operation of the vehicle;
iii. careful planning and monitoring of all vehicle movements within the site so as to avoid damage to either the hut or artefacts buried beneath accumulated snow and ice.

7(ii) Activities which may be conducted within the Area

Activities which may be conducted within the Area include:

- visits for conservation purposes;
- educational and/or recreational visits including tourism; and
- scientific activity which does not detract from the values of the Area.

Visitors should adhere to the following Code of Conduct, except where conservation, research, monitoring or management activities specified in the Permit require otherwise:

- To reduce floor abrasion, thoroughly clean grit and scoria, ice and snow from boots using the brushes provided before entering the hut;
- Remove any clothing made wet by sea water, and any sea ice crystals from boots, as salt particles accelerate corrosion of metal objects;
- Do not touch, move or sit on any items or furniture in the huts - handling artefacts causes damage;
- As many areas are cramped and artefacts can be accidentally bumped, do not wear packs inside;
- When moving around the sites, take great care not to tread on any items which may be obscured by snow;
- Use of combustion style lanterns, naked flames or smoking in or around the huts is strictly forbidden as fire is a major risk; and
- Visits should be recorded in the book provided. This allows times and levels of visitation to be correlated with temperature and humidity data automatically logged inside the hut.

7(iii) Installation, modification or removal of structures

- No new structures are to be erected in the Area, or scientific equipment installed, except for conservation activities as specified in section 3.
- No historic structure shall be removed from the Area, unless specified in a Permit issued in accordance with the provisions of section 7(vii).

7(iv) Location of field camps

- Use of the historic hut for living purposes is not permitted. Camping is prohibited in the Area under any circumstances.
- An existing field camp site is associated with the two New Zealand field shelters located 250m south west of the Area and should be used by all parties intending to camp in this area.

7(v) Restrictions on materials and organisms which may be brought to the Area

- No living animals, plant material, micro-organisms or soil shall be introduced to the Area. No food products shall be taken into the Area.
- Chemicals may only be introduced for permitted scientific or conservation purposes. Chemicals (including fuel) or other materials are not to be left in the Area, unless required for essential purposes connected with the conservation of the historic structures or associated relics.
- All materials are to be removed when no longer required and before a date to be specified in the relevant Permit.

7(vi) Taking or harmful interference with native flora and fauna

- This activity is prohibited except in accordance with a Permit issued by the appropriate national authority specifically for that purpose under Article 3, Annex II to the Protocol on Environmental Protection.
- Where animal taking or harmful interference is involved, this should, as a minimum standard, be in accordance with the SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica.

7(vii) Collection or removal of anything not imported by the permit holder

- Material may be collected and removed from the Area for conservation reasons consistent with the objectives of this Plan only when specified in a Permit issued by the appropriate national authority.
- Materials which pose a threat to the environment or human health may be removed from the Area for disposal, in accordance with a Permit, where they meet one or more of the following criteria:

  i. the artefact presents a threat to the environment, wildlife or human health and safety;
  ii. it is in such poor condition that it is not reasonably possible to conserve it;
  iii. it does not contribute in any significant way to our understanding of the hut, its occupants or the history of Antarctica;
  iv. it does not contribute to, or it detracts from, the visual qualities of the site or the hut, and/or;
  v. it is not a unique or rare item;

  and where such action is:

  vi. undertaken by parties with appropriate heritage conservation expertise; and
  vii. part of an overall plan for conservation work at the site.

- National authorities should ensure that any removal of artefacts and assessment against the above criteria is carried out by personnel with appropriate heritage conservation expertise.
- Artefacts judged to be of high historic value, which cannot be conserved on site with currently available techniques, may be removed in accordance with a Permit for storage in a controlled environment until such time as they can safely be returned to the Area.
- Samples of soil and other natural materials may be removed for scientific purposes only in accordance with an appropriate Permit.

7(viii) Disposal of waste

- All human waste, grey water and other waste generated by work parties or visitors shall be removed from the Area.

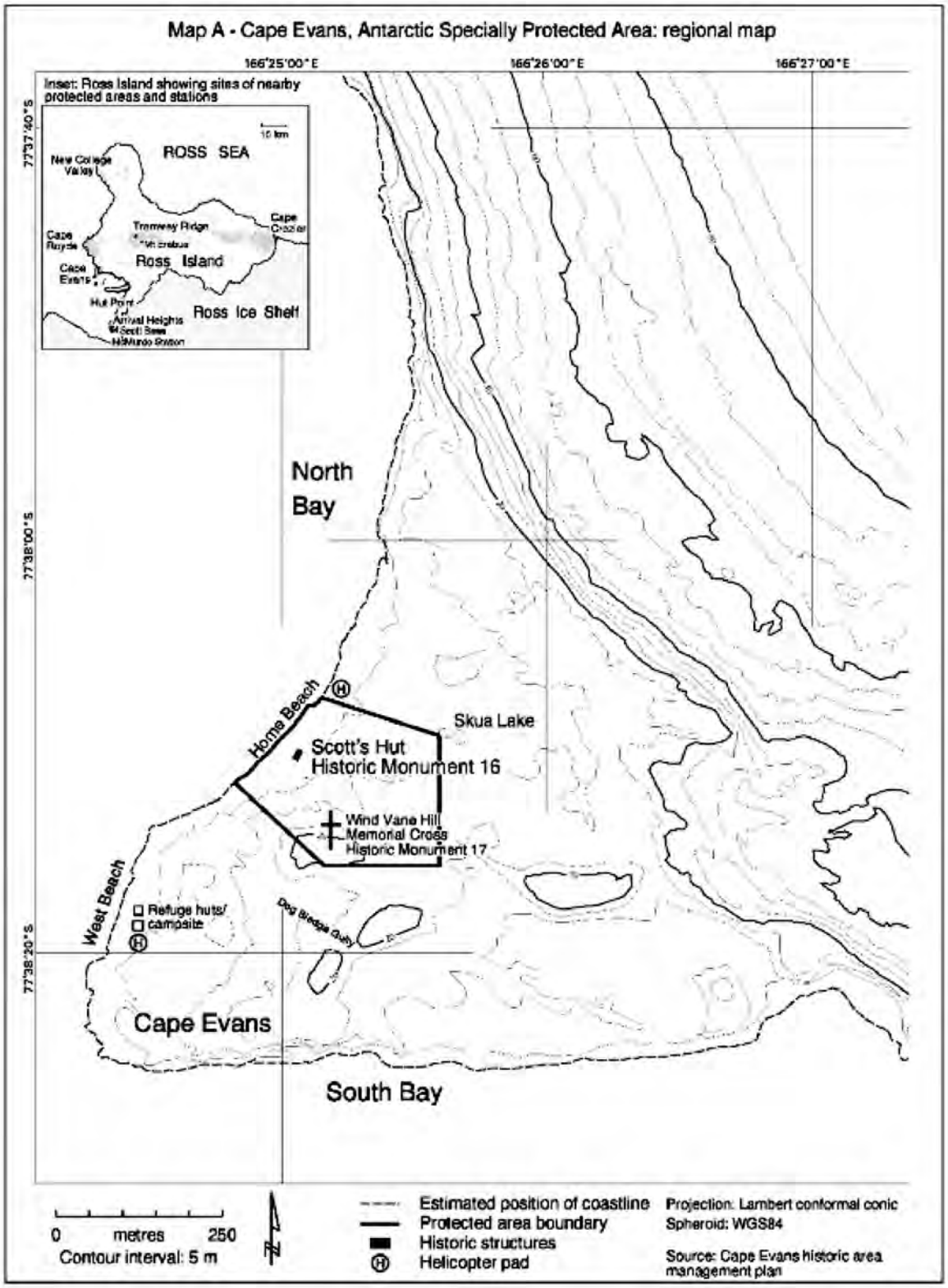
7(ix) Measures that may be necessary to ensure that the aims and objectives of the Management Plan continue to be met

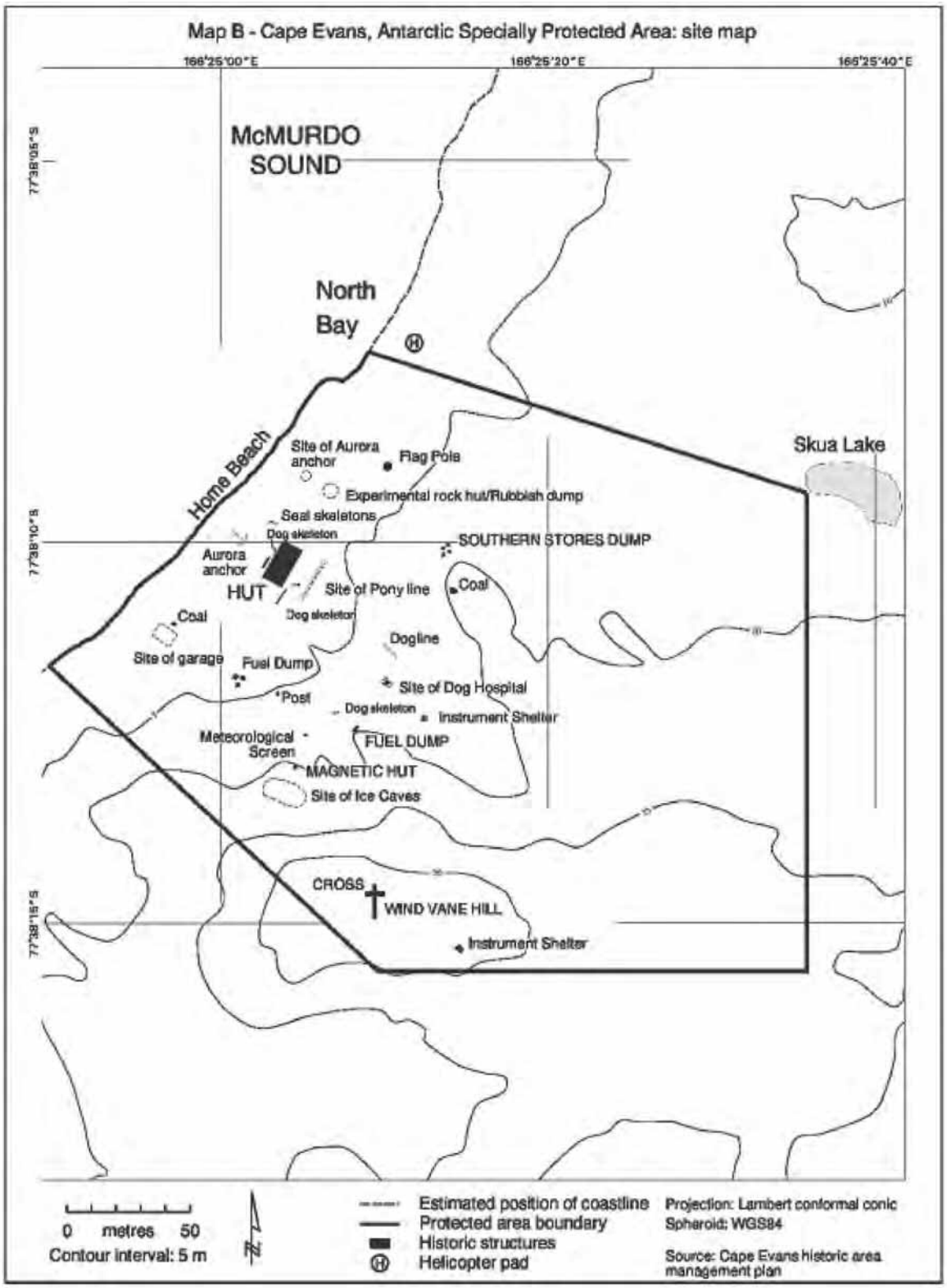
- The Permit, or an authorised copy, shall be carried within the Area.
- Information on the requirements of this Plan shall be provided to all visitors.
- The Code of Conduct set out in section 7(ii) shall be followed by all visitors, except where conservation, research, monitoring or management purposes require otherwise.
- Operators facilitating educational and recreational visits (including tourism) to the Area shall, prior to commencement of the summer season, nominate people with a working knowledge of both the site and this Management Plan to act as guides during visits.
- All educational and recreational visits (including tourism) shall be supervised by a nominated guide, who is responsible for briefing visitors on the code of conduct and ensuring it is complied with.
- Parties shall consult and coordinate to develop skills and resources, particularly those related to conservation techniques, to assist with the protection of the Area's values.

7(x) Requirements for reports

Parties shall ensure that the principal holder for each Permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports shall include, as appropriate, the information identified in the Visit Report provided in Appendix 4 of Resolution 2 (1998). In addition, any removal of materials in accordance with section 7(vii) shall be detailed, including the reason for removal and the current location of the items or the date of disposal. Any return of such items to the site shall also be reported.

Parties shall maintain a record of activities within the Area and, in the Annual Exchange of Information, shall provide summary descriptions of activities conducted by persons subject to their jurisdiction, in sufficient detail to allow an evaluation of the effectiveness of the Management Plan. Parties should wherever possible deposit originals or copies of such reports in a publicly accessible archive to maintain a record of visitation, to be used both for review of the Management Plan and in managing further visitation to the site.


Map A - Cape Evans, Antarctic Specially Protected Area: regional map
166°25'00" E
166°26'00" E
166°27'00" E
77°37'40" S
77°38'00" S
77°38'20" S
Inset: Ross Island showing sites of nearby protected areas and stations
ROSS SEA
Ross Island
Ross Ice Shelf
North Bay
Skua Lake
Scott's Hut
Historic Monument 16
Wind Vane Hill
Memorial Cross
Historic Monument 17
Home Beach
West Beach
Refuge huts/ campsite
Cape Evans
South Bay
0 metres 250
Contour interval: 5 m
Estimated position of coastline
Protected area boundary
Historic structures
Helicopter pad
Projection: Lambert conformal conic
Spheroid: WGS84
Source: Cape Evans historic area management plan


Map B - Cape Evans, Antarctic Specially Protected Area: site map
166°25'00"E
166°25'20"E
165°25'40"E
77°38'05"S
77°38'10"S
77°38'15"S
McMURDO SOUND
North Bay
Home Beach
Skua Lake
Site of Aurora anchor
Flag Pole
Experimental rock hut/Rubbish dump
Seal skeletons
Dog skeleton
SOUTHERN STORES DUMP
Aurora anchor
HUT
Site of Pony line
Coal
Dog skeleton
Coal
Dogline
Site of garage
Fuel Dump
Site of Dog Hospital
Post
Dog skeleton
Instrument Shelter
Meteorological Screen
FUEL DUMP
MAGNETIC HUT
Site of Ice Caves
CROSS
WIND VANE HILL
Instrument Shelter
0 metres 50
Contour interval: 5 m
Estimated position of coastline
Protected area boundary
Historic structures
Helicopter pad
Projection: Lambert conformal conic
Spheroid: WGS84
Source: Cape Evans historic area management plan

II. Measures

Measure 13 (2008)

Antarctic Specially Protected Area No 160 (Frazier Islands, Windmill Islands, Wilkes Land, East Antarctica): Revised Management Plan

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas ("ASPA") and approval of Management Plans for the Areas;

Recalling Measure 2 (2003), which designated Frazier Islands, Wilkes Land, as Antarctic Specially Protected Area No 160, and annexed a management plan for the site;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 160;

Desiring to replace the existing Management Plan for ASPA 160 with the revised Management Plan;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) the revised Management Plan for Antarctic Specially Protected Area No 160: Frazier Islands, Windmill Islands, Wilkes Land, East Antarctica which is annexed to this Measure, be approved;
2) the Management Plan for ASPA 160 annexed to Measure 2 (2003) shall cease to be effective.

II. MEASURES

Management Plan for Antarctic Specially Protected Area No 160

FRAZIER ISLANDS, WINDMILL ISLANDS, WILKES LAND, EAST ANTARCTICA

Introduction

The Frazier Islands consists of a group of three islands located approximately 16km offshore from the Australian Casey station, in East Antarctica (see Map A). The islands support the largest of only four known breeding colonies of southern giant petrels *Macronectes giganteus* on continental Antarctica, and were designated as an Antarctic Specially Protected Area under Measure 2 (2003) for the sanctuary of the birds.

Following their discovery in 1955, the southern giant petrel colonies at the Frazier Islands were visited intermittently during the period mid-January to late March. The aim of these visits was usually the banding of southern giant petrel chicks. Weather permitting, counts of the chicks present were made but were often restricted to Nelly Island. Thus, the early data available do not offer the information needed for an analysis of possible changes in the status of the population. In more recent years, occupied nests were counted in December, usually covering all three islands. The indication is that the breeding population, especially at Dewart Island, may be increasing.

Apart from visits for seabird observations, the Frazier Islands have been visited very infrequently. Twenty three visits, or on average one visit every two years, have occurred since the late 1950s (see Appendix 1). In the mid-1980s, a formal management strategy was implemented to minimise human disturbance to breeding colonies of southern giant petrels in the vicinity of Australia's Antarctic stations. The Australian Antarctic Division restricted access by Australian Antarctic programme participants so that census visits occurred once in every three- to five-year period and implemented tight administrative controls over visits for other purposes. The census interval was considered an appropriate compromise between the risk of disturbance to breeding birds from monitoring activities and the need to obtain population data. Current thinking suggests it is desirable to provide for more frequent censuses, if conducted in an appropriate manner, to allow more detailed understanding of population status and trends.

A recent ostensible increase in the breeding population of southern giant petrels at the Frazier Islands, combined with the apparent positive effects of the existing protective measures, suggests that continued and formalised protection of southern giant petrel breeding colonies is warranted. Long-term protection and monitoring of southern giant petrels at the Frazier Islands will contribute to the development of appropriate regional and global conservation strategies for the species and will provide information for comparisons with populations elsewhere.

This revised Management Plan reaffirms the values of the original designation and accords with Annex V of the Protocol on Environmental Protection.

1. Description of values to be protected

The Area is primarily designated to protect the breeding colony of southern giant petrels, which is the largest known in the continental Antarctic.

In the late 1980s the world breeding population of southern giant petrels was estimated at 38,000 pairs. Declines in the 1990s appear to have stabilised and, while some populations appear to be decreasing and others are stable, the major colonies appear to be increasing. Recognising this global trend, but mindful of the potential continuing threat posed by demersal longline fisheries, the IUCN in 2007 down-listed the species from Vulnerable to Near Threatened.

The southern giant petrel is also listed in Annex 1 of the Agreement on the Conservation of Albatrosses and Petrels (ACAP), a multilateral agreement which seeks to conserve albatrosses and petrels by coordinating international activity to mitigate known threats to their populations, and in Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals.

In East Antarctica, southern giant petrels are uncommon as they are at the southern limit of their distribution range. The most recent estimate of the population at the Frazier Islands was 274 breeding pairs in 2005/06. Colonies are found on all three of the islands in the group (Nelly, Dewart and Charlton Islands – Map B), the largest being located on Dewart Island.

The Frazier Islands are one of only four known breeding localities of southern giant petrels around the coastline of continental Antarctica and are the only known site in nearly 3000km of coastline between Davis station and Dumont d'Urville. The other three continental breeding colonies are located near the Australian stations of Mawson (Giganteus Island, Rookery Islands, ASPA 102) and Davis (Hawker Island, ASPA 167), and near the French station Dumont d'Urville (Pointe-Géologie Archipelago, ASPA 120). The southern giant petrels on the Antarctic continent comprise less than 1% of the global breeding population. The current population for continental Antarctica is estimated at approximately 320 pairs, comprised of 3 pairs on Giganteus Island, 25 pairs on Hawker Island, 16 pairs at Pointe Géologie archipelago (Terre Adélie) and approximately 270 pairs on the Frazier Islands. However, incidental observations at the coast near Mawson station indicate there may be additional colonies that have not been discovered yet.

The breeding season for southern giant petrels at the Frazier Islands usually commences between late October and mid November, and extends through to April with the birds' departure northward for the winter. Banded chicks from the Frazier Islands dispersed throughout the Southern Hemisphere and have previously been recovered in New Zealand, South America, Easter Island, and South Africa within nine months of departure.

2. Aims and objectives

Management of the Frazier Islands aims to:

- minimise human disturbance to the breeding colonies of southern giant petrels to assist further the protection of the population in the wild;
- conserve the Frazier Islands as a reference area for future comparative studies with other breeding populations of southern giant petrels; and
- minimise the possibility of the introduction of alien plants, animals and microbes to the Frazier Islands.

3. Management activities

The following management activities shall be undertaken to protect the values of the Area:

- where practicable, at least one research visit should be conducted to census the southern giant petrels and other seabird populations in each 5 year period, to enable assessment of

breeding populations. These visits should be conducted by a team including at least one bird biologist associated with a national Antarctic programme or someone with relevant scientific skills and experience;

- information about the location of the Area and the restrictions that apply shall be produced and prominently displayed at Casey station. Copies of this Management Plan shall be available at the station. Informative material and the Management Plan shall be provided to ships visiting the vicinity;
- the Management Plan shall be reviewed at least every five years and updated/modified as required.

4. Period of designation

Designation is for an indefinite period.

5. Maps

- Map A: Windmill Islands, showing location of the Frazier Islands and protected areas within the region.

  Map specifications:

  Projection: UTM Zone 49

  Horizontal Datum: WGS84
- Map B: Frazier Islands, Antarctic Specially Protected Area showing distribution of seabird nesting sites.

  Map Specifications:

  Projection: UTM Zone 49

  Horizontal Datum: WGS84

6. Description of the Area

6(i) Geographical co-ordinates, boundary markers and natural features

The Frazier Islands are located at latitude 66°14'S, longitude 110°10'E (Map A). The three islands (Nelly, Dewart and Charlton) lie in the eastern part of Vincennes Bay approximately 16km to the west north west of Casey station. Nelly Island is the largest of the three islands (approximately 0.35km² in area), and was named for the presence of several colonies of southern giant petrels or "Nellies". The Area comprises the entire terrestrial area of the three islands, with the seaward boundary at the low water mark (Map B). The total area of the Antarctic Specially Protected Area is approximately 0.6km². There are no boundary markers.

Nelly Island supports the largest and most varied avian community of the three islands, with records indicating that snow petrels (*Pagodroma nivea*), cape petrels (*Daption capense*), Antarctic petrels (*Thalassoica antarctica*), Wilson's storm-petrels (*Oceanites oceanicus*), southern fulmars (*Fulmarus glacialoides*), and South Polar skuas (*Catharacta maccormicki*) all nest on the island. South Polar skua nests have also been observed on Dewart Island (Appendix 2, Map B).

In 1961/62, 100 Adélie penguin (*Pygoscelis adeliae*) nests were reported in one colony on Nelly Island. During the 1989/90 season, three colonies were recorded on the north-west ridge of Nelly Island with a total of 554 nests. The increase corresponds with those recorded for most other Adélie penguin populations in the Windmill Islands region during the period from 1959/60 to 1989/90. In the 2001/02 season, approximately 1,000 pairs were estimated to be nesting on Nelly Island. A brief inspection of the Adélie penguin colonies in 2005/06 suggested that the breeding population continues to increase.

Recorded sightings of marine mammals at the Frazier Islands are scarce. In 1968 three Weddell seals (*Leptonychotes weddellii*) were observed on an ice floe located between Nelly and Dewart Islands. An Orca (killer whale: *Orcinus orca*) was also sighted offshore from the islands during the same year, and a small pod was sighted during 2005/06. A few leopard seals (*Hydrurga leptonyx*) were sighted on sea ice near Nelly Island and a small number of Weddell seals were recorded on the sea ice near the Frazier Islands in the 2001/02 season (Appendix 2).

Vegetation recorded at Nelly Island comprises at least 11 species, including lichens *Buellia frigida*, *Usnea antarctica*, *Rhizoplaca melanophthalma*, *Candelariella flava*; a terrestrial alga *Prasiola crispa*, an indeterminate green crust which is thought to be 'a mixture of fungal hyphae and green alga *Desmococcus olivaceus*', and several species of snow algae including *Chlorococcum* sp., *Chloromonas polyptera*, *Chlorosarcina antarctica*, *Prasiococcus calcarius* (Appendix 2). There are no published records of terrestrial invertebrates on the Frazier Islands; however, no surveys have been undertaken.

The topography of the Frazier Islands is characterised by steep cliffs rising from the sea. The highest peak on Nelly Island is approximately 65 metres. There is a broad 'U' shaped ice-filled valley on both Nelly and Dewart Islands.

The geology of the Frazier Islands is typical of the Windmill Islands group and is characterised by the layered schists and finely crenulated gneisses of the Windmill metamorphics. The geological character of the Frazier Islands developed as a result of two phases of metamorphosis at 1400-1310 Ma and about 1200 Ma of pre-existing volcanics, greywacke and shale. On Nelly Island there are steep cliffs of biotite and gneiss. A red sandstone erratic is located in the 'U' shaped valley on Nelly Island below the 30m contour. Highly polished glacial striae in the gneisses provide evidence of recent glaciation and indicate the former direction of ice flow of 265º and 280º T. Surface sediments consist of fine gravelly sand located in bedrock depressions.

The climate at the Frazier Islands is characteristic of that experienced at the Windmill Islands and other Antarctic coastal locations in the region. At Casey station, located 16 kilometres to the east south eastESE of the Frazier Islands group, mean temperatures are 0.3°C for the warmest month and –14.9°C for the coldest month. Precipitation is low and the high albedo of the exposed rock surfaces results in persistent ice-free areas that provide attractive nesting sites for the avifauna.

6(ii) Special zones within the Area

There are no special zones within the Area.

6(iii) Location of structures within the Area

There are no structures within or adjacent to the Area and none are to be erected.

6(iv) Location of other Protected Areas within close proximity

The following Protected Areas are located on the Budd Coast near the Frazier Islands (see Map A):

- ASPA No 135, North-east Bailey Peninsula (66°17'S, 110°32'E);

- ASPA No 136, Clark Peninsula (66º15'S, 110º36'E); and
- ASPA No 103, Ardery Island and Odbert Island (66º22'S, 110º30'E).

7. Permit conditions

Entry to the Area is prohibited except in accordance with a Permit issued by an appropriate national authority.

Permits shall include a condition requiring that the Permit or a copy shall be carried at all times when within the Area. Additional conditions, consistent with the objectives and provisions of the Management Plan, may be included by the issuing authority. The principal Permit Holder for each Permit issued should be required to submit to the Permit issuing authority a visit report detailing all activities undertaken within the Area, and include all census data obtained during the visit.

7(i) Access to and movement within or over the Area

- Vehicles are prohibited within the Area.
- The only permitted access to the Frazier Islands is by watercraft. Landings must be made at the designated sites as marked on Map B. Boats used to visit the islands must be left at the shoreline and movement within the Area is by foot only. Only personnel who are required to carry out scientific/management work in the Area should leave the landing site;
- Any movement within the Area is to be consistent with the minimum approach distances to nesting birds specified in Appendix 3. Persons shall not approach closer than is necessary to obtain census data or biological data from any nesting southern giant petrels, and in no case closer than 20m;
- To reduce disturbance to wildlife, noise levels including verbal communication are to be kept to a minimum. The use of motor-driven tools and any other activity likely to generate noise and thereby cause disturbance to nesting birds is prohibited within the Area during the breeding period for southern giant petrels (1 October to 30 April);
- Landing of aircraft in the Area is prohibited at any time; and
- Clothing (particularly all footwear) and field equipment shall be thoroughly cleaned before entering the Area.

7(ii) Activities which are, or may be conducted within the Area, including restrictions on time and place

Permits to enter the Area during the non-breeding period for southern giant petrels (1 May to 30 September), may be issued for compelling scientific research that cannot be undertaken elsewhere, or for essential management purposes consistent with the objectives and provisions of this Management Plan. Permits are only to be issued for activities that will not jeopardise the ecological or scientific values of the Area, or interfere with existing scientific studies.

Permits to enter the Area during the breeding period for southern giant petrels (1 October to 30 April) may be issued for the purpose of conducting censuses. The Permit issuing authority is to refer to the provision under the first dot point of section 3 of this Management Plan when issuing Permits. Wherever practicable, censuses are to be conducted from outside the giant petrel colonies. In most cases there are vantage points from where the nesting giant petrels may be counted. Access to the Area should be limited to the minimum amount of time reasonably required to undertake the census. Boat operators and other support personnel should remain at the landing site for safety reasons.

7(iii) Installation, modification, or removal of structures

No permanent structures are to be erected in the Area.

7(iv) Location of field camps

Camping is prohibited in the Area except in an emergency.

7(v) Restrictions on materials and organisms that may be brought into the Area

- Fuel is not to be depoted on the islands. Boat refuelling is permitted at shoreline landing sites. A small amount of fuel is permitted for an emergency stove.
- The only poultry products that may be brought into the Area are pasteurized egg powder, stock cubes, powdered soups and canned soups .
- No herbicides or pesticides are to be brought into the Area.
- Any chemical which may be introduced for compelling scientific purposes as authorised in a Permit shall be removed from the Area, at or before the conclusion of the activity for which the Permit was granted. The use of radio-nuclides or stable isotopes is prohibited.
- No animals, plant material or microorganisms shall be deliberately introduced into the Area and precautions shall be taken against accidental introductions. All equipment and clothing should be thoroughly cleaned before entering the Area.

7(vi) Taking of, or harmful interference with, native flora and fauna

Taking of, or harmful interference with, native flora and fauna, is prohibited unless specifically authorised by permit issued in accordance with Article 3 of Annex II to the Protocol on Environmental Protection to the Antarctic Treaty.

Disturbance of southern giant petrels should be avoided at all times. Visitors should be alert to changes in wildlife behaviour, especially changes in posture or vocalisaton. If birds are showing signs of wanting to leave the nest, all persons should retreat immediately.

7(vii) Collection or removal of anything not brought into the Area by the permit holder

Material may only be collected or removed from the Area as authorised in a Permit and should be limited to the minimum necessary to meet scientific or management needs.

Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the Permit Holder or otherwise authorised, may be removed unless the impact of the removal is likely to be greater than leaving the material *in situ*. If such material is found, the appropriate national authority must be notified. Where possible, photographic documentation should be obtained and included with site visit report.

7(viii) Disposal of waste

No wastes, including human wastes, are to be deposited or left in the Area.

7(ix) Measures that may be necessary to ensure that the aims and objectives of the Management Plan continue to be met

A census of southern giant petrels should be conducted at least once in each 5 year period. Censuses of other species may be undertaken during these visits provided no additional disturbance is caused to the southern giant petrels.

All GPS data obtained for specific sites of long-term monitoring shall be registered in the Antarctic Master Directory, through the appropriate national authority.

7(x) Requirements for reports

Parties should ensure that the principal Permit Holder for each permit issued submits to the appropriate national authority a report on activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report form contained in Appendix 4 of the *Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas* appended to Resolution 2 (1998). Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction in sufficient detail to allow evaluation of the effectiveness of the Plan of Management. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, for the purpose of any review of the Management Plan and in organising the scientific use of the Area. A copy of the report should be forwarded to the Party responsible for development of the Management Plan to assist in management of the Area, and monitoring of bird populations. Additionally, visit reports should provide detailed information on census data, locations of any new colonies or nests not previously recorded, a brief summary of research findings and copies of photographs taken of the Area.

8. Supporting documentation

ANARE (1968) Unpublished data.

Birdlife International (2000) *Threatened birds of the world*. Barcelona and Cambridge U. K: Lynx Edicions and Birdlife International.

BirdLife International 2007. *Macronectes giganteus*. In: IUCN 2007. *2007 IUCN Red List of Threatened Species. www.iucnredlist.org*. Downloaded on 12 March 2008.

Blight, D.F., Oliver, R. L. Aspects of the Geologic History of the Windmill Islands, Antarctica in Craddock C. (ed.) (1982) *Antarctic Geoscience*. University of Wisconsin Press, Madison: 445-454.

Cooper, J., Woehler, E.J., Belbin, L. (2000) Guest editorial. Selecting Antarctic Specially Protected Areas: Important Bird Areas can help. *Antarctic Science* 12: 129.

Cowan, A.N. (1981) Size variation in the snow petrel. *Notornis* 28: 169-188.

Cowan, A.N. (1979) giant petrels at Casey. *Australian Bird Watcher* 8: 66-67.

Creuwels, J.C.S., Stark, J.S., Woehler, E.J., Van Franeker, J.A., Ribic, C.A. (2005) Monitoring of a Southern giant petrel Macronectes giganteus population on the Frazier Islands, Wilkes Land, Antarctica. *Polar Biology* 28:483–493

Croxall, J.P., Steele, W.K., McInnes, S.J., Prince, P.A. (1995) Breeding Distribution of the snow petrel *Pagodroma nivea*. *Marine Ornithology* 23: 69-99.

Environment Australia (2001) *Recovery Plan for Albatrosses and Giant Petrels*. prepared by Wildlife Scientific Advice, Natural Heritage Division in consultation with the Albatross and Giant Petrel Recovery Team, Canberra.

Environmental Code of Conduct for Australian Field Activities, Australian Antarctic Division.

Garnett, S.T., Crowley, G.M. (2000) *The Action Plan for Australian Birds 2000*. Commonwealth of Australia, Environment Australia, Canberra

Goodwin, I.D. (1993) Holocene Deglaciation, Sea-Level Change, and the Emergence of the Windmill Islands, Budd Coast, Antarctica. *Quaternary Research* 40: 70-80.

Ingham, S.E. (1959) Banding of Giant Petrels by the Australian National Antarctic Research Expeditions, 1955-58. *Emu* 59: 189-200.

IUCN (2001) *IUCN Red List Categories: Version 3.1.* Prepared by the IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

Jouventin, P., Weimerskirch, H. (1991) Changes in the population size and demography of southern seabirds: management implications. In: Perrins, C.M., Lebreton, J.-D. and Hirons, G.J.M. *Bird population studies*: *Relevance to conservation and management*. Oxford University Press: 297-314.

Law, P. (1958) Australian Coastal Exploration in Antarctica *The Geographical Journal* CXXIV: 151-162.

Mackinlay, S.J. (1997) *A Management Zoning System for Casey Station and the Windmill Islands, East Antarctica*. Project report for the MAppSc degree in Environmental Management, School of Geography, University of New South Wales.

Melick, D.R., Hovenden. M.J., Seppelt, R.D. (1994) Phytogeography of bryophyte and lichen vegetation in the Windmill Islands, Wilkes Land, Continental Antarctica. *Vegetatio* 111: 71-87.

Micol, T., Jouventin, P. (2001) Long-term population trends in seven Antarctic seabirds at Point Géologie (Terre Adélie): Human impact compared with environmental change. *Polar Biology* 24: 175-185.

Murray, M.D. (1972) Banding Giant Petrels on Frazier Islands, Antarctica. *The Australian Bird Bander* 10(3): 57-58.

Murray M.D., Luders D.J. (1990) Faunistic studies at the Windmill Islands, Wilkes Land, East Antarctica, 1959-80. *ANARE Research Notes* 73: 1-45.

Orton, M.N. (1963) A Brief Survey of the Fauna of the Windmill Islands, Wilkes Land, Antarctica. *Emu* 63: 14-22.

Orton, M.N. (1963) Movements of young giant petrels bred in Antarctica. *Emu* 63: 260.

Patterson D.L., Woehler, E.J., Croxall, J.P., Cooper, J., Poncet, S., Fraser, W.R. (in press) Breeding distribution and population status of the northern giant petrel *Macronectes halli* and the southern giant petrel *M. giganteus*. *Marine Ornithology*.

Paul, E., Stüwe, K., Teasdale, J., Worley, B. (1995) Structural and metamorphic geology of the Windmill Islands, east Antarctica: field evidence for repeated tectonothermal activity. *Australian Journal of Earth Sciences* 42: 453-469.

Robertson, R. (1961) Geology of the Windmill Islands, Antarctica. *IGY Bulletin* 43: 5-8.

van Franeker, J.A., Gavrilo, M., Mehlum, F., Veit, R.R., Woehler E.J. Distribution and Abundance of the Antarctic Petrel. *Waterbirds: The International Journal of Waterbird Biology*, Vol. 22, No 1 (1999), pp. 14-28

Woehler, E.J. (1990) Status of southern giant petrels at Casey. *ANARE News* 61: 18.

Woehler, E.J. (1991) Status and Conservation of the Seabirds of Heard and the McDonald Islands. In: Croxall, J.P. (ed.) Seabird Status and Conservation: A Supplement. *ICBP Technical Publication* No 11: 263-277.

Woehler E.J., Croxall J.P. (1997) The status and trends of Antarctic and subantarctic seabirds. *Marine Ornithology* 25: 43-66.

Woehler, E.J., Johnstone, G.W. (1991) Status and Conservation of the Seabirds of the Australian Antarctic Territory. In Croxall, J.P. (ed.) Seabird Status and Conservation: A Supplement. *ICBP Technical Publication* No 11: 279-308.

Woehler, E.J., Martin, M.R., Johnstone, G.W. (1990) The Status of Southern Giant Petrels *Macronectes giganteus* at the Frazier Islands, Wilkes Land, East Antarctica. *Corella* 14: 101-106.

Woehler, E.J. (2005) Southern giant petrels critically endangered in the Antarctic. World Birdwatch 27(3), 9.

Woehler, E.J. (2006) Status and conservation of the seabirds of Heard Island and the McDonald Islands. In: Green K & Woehler EJ (eds) *Heard Island, Southern Ocean Sentinel*. Surrey Beatty & Sons, Chipping Norton, pp 128-165.

Woehler, E.J., Riddle MJ & Ribic CA (2003) Long-term population trends in southern giant petrels in East Antarctica. In: Huiskes AHL, Gieskes WWC, Rozema J, Schorno RML, van der Vies SM & Wolff W (eds) Antarctic Biology in a global context. Backhuys Publishers, Leiden, pp 290-295.

Woehler, E.J., Cooper, J., Croxall, J.P., Fraser, W.R., Kooyman, G.L., Miller, G.D., Nel, D.C., Patterson, D.L., Peter, H-U, Ribic, C.A., Salwicka, K., Trivelpiece, W.Z., Weimerskirch, H. (2001) *A Statistical Assessment of the Status and Trends of Antarctic and Subantarctic Seabirds*. SCAR/CCAMLR/NSF, 43 pp.; Patterson *et al*. Breeding distribution and population status of the giant petrel; Woehler *et al.* "*Long-term population trends in southern giant petrels*".

Woehler, E.J., Riddle, M.J. (2003) *Long-term population trends in southern giant petrels in the Southern Indian Ocean*. Poster presented at 8th SCAR Biology Symposium 2001, Amsterdam.

Woehler, E.J., Slip, D.J., Robertson, L.M., Fullagar, P.J., Burton, H.R. (1991) The distribution, abundance and status of Adélie penguins *Pygoscelis adeliae* at the Windmill Islands, Wilkes Land, Antarctica. *Marine Ornithology* 19(1): 1-17.

Woehler, E.J., Cooper, J., Croxall, J.P., Fraser, W.R., Kooyman, G.L., Miller, G.D., Nel, D.C., Patterson, D.L., Peter, H-U, Ribic, C.A., Salwicka, K., Trivelpiece, W.Z., Wiemerskirch, H. (2001) *A Statistical Assessment of the Status and Trends of Antarctic and Subantarctic Seabirds*. SCAR/CCAMLR/NSF, 43 pp.

II. Measures

Appendix 1: Southern giant petrel populations at the Frazier Islands, Antarctica

Note: To the extent possible, each observation below has been validated by a review of the primary data records. The comments indicate where variations from published literature were identified. Further consideration of each observation would be required before using and of these data in analyses.

Date	Nelly Island	Dewart Island	Charlton Island	Source	Comment
21, 22 Jan. 1956	250 N	not visited	not visited	Unpublished data: J Bunt 2008 pers. comm.; Law (1958)	Counted at four separate rookeries on higher parts of Nelly Island. Notes say that most nests contained chicks. Many of these nests could be old nests.
24-5 Jan. 1959	25 N	not visited	not visited	Unpublished data: Bird log Magga Dan-Wilkes & Oates Land Voyage (Jan-Mar 1959); Unpublished data: Biology report for Wilkes, (1959/60-1960-61), R Penny.	It is not clear whether these observations are all chicks, but Penny comments that some of them were chicks.
15 Dec. 1959	60 A	not visited	not visited	Unpublished data: Biology report for Wilkes, Appendix F (1961) M. Orton; Creuwels *et al*. (2005)	20 other birds were associated with nests.
12 Feb. 1960	46 C	not visited	not visited	Unpublished data: Biology report for Wilkes, (1959/60-1960-61), R Penny; Unpublished data: Biology report for Wilkes, Appendix F (1961) M. Orton.	Orton reports that there were 47 chicks on Nelly Island when in fact it was 46 (Penny 1960).
15 Dec. 1960	not visited	60 N	not visited	Unpublished data: Biology report for Wilkes, Appendix F (1961) M. Orton; Woehler *et al.* (1990); Creuwels *et al*. (2005)	20 other birds were associated with nests. Woehler *et al*. (1990) and Creuwels *et a*l. (2005) have both quoted directly from R. Penny's unpublished report.
22 Mar. 1961	34 C	10 C	no data	Unpublished data: Biology report for Wilkes, Appendix F (1961) M. Orton; Unpublished data: Biology: Giant petrel Wilkes report (1961); Creuwels *et al*. (2005)	All chicks observed on Nelly Island were banded. Only a subset of the chicks observed at Dewart Island were banded.
23 Nov. 1962	11 eggs	not visited	not visited	Unpublished data: Davis and Mawson station biology log records (1962)	This count appears to have been a subset of the population only.

Date	Nelly Island	Dewart Island	Charlton Island	Source	Comment
21 Jan. 1964	10 C	not visited	not visited	Unpublished data: Wilkes station report, biology log records (1964), L.G. Murray	Birds were observed on the north-east ridge, with about 20 occupied nests in this area, and more on the lower area on the southern side of the ridge. There were many old and uninhabited nests.
7 Mar. 1968	72	no data	not visited	Unpublished data: Bird Log Nella Dan (1967-8) Vol. 1; Shaughessey (1971); Murray & Luders (1990)	This count is the total for all four rookeries found on Nelly Island. There is a map of their location in the field notes.
20, 21 Jan. 1972	52 C	53 C	10-20 N (aerial survey only)	Murray (1972)	Land survey primarily for banding. 49 of 52 chicks seen were banded on Nelly Island. 51 of 53 chicks seen were banded on Dewart Island. Please note counts quoted in Murray & Luders (1990) are incorrect.
31 Jan. 1974	27 BC	no data	no data	Unpublished data: Biology report for Casey (1974) A. Jones; Murray & Luders (1990); Woehler *et al*. (1990); Creuwels *et al*. (2005)	All peer-reviewed papers appear to have reported an incorrect count of a total of 76, however only 27 chicks were banded in this season.
13-17 Feb. 1977	27 C	43 C	no data	Cowan (1979); Murray & Luders (1990); Woehler et al. (1990); Creuwels et al. (2005)	All peer-reviewed papers appear to have reported the wrong count. Cowan is the original reference, where data has gone straight to peer-reviewed publication.
25 Jan. 1978	48 C	48 C	6 C	Cowan (1979); Murray & Luders (1990); Woehler *et al*. (1990); Creuwels *et al*. (2005)	
30 Jan., 2 Feb. 1979	35 (method unknown)	46 (method unknown)	5 (method unknown)	Murray & Luders (1990); Woehler *et al*. (1990); Creuwels *et al*. (2005)	The earliest reference to this work is Murray & Luders (1990), but they did not do the original counts. For Nelly, Woehler *et al*. (1990) and Creuwels *et al*. (2005) further report the chick count as 37 and not 35 as reported in Murray & Luders (1990). Further work is required to know which figure reflects the correct count. K. de Jong's original data is unable to be located.

Date	Nelly Island	Dewart Island	Charlton Island	Source	Comment
18 Jan. 1980	43 C	10 (method unknown)	no data	Murray & Luders (1990); Woehler *et al*. (1990); Creuwels *et al*. (2005)	Original data not located. Creuwels *et al*. (2005) note that the census data from Dewart Island and Charlton Island are confused with banding data.
28 & 29 Nov. 1983	63 AON	68 AON	9 AON	Unpublished data: Casey station report (1983); Woehler *et al*. (1990); Creuwels *et al*. (2005)	Woehler *et al*. (1990) conducted the survey.
25 & 26 Jan 1984	52 (method unknown)	not visited	not visited	Woehler *et al*. (1990); Creuwels *et al*. (2005)	Original data not located.
3, 6 Mar. 1985	64 C	69 C	no data	Woehler *et al*. (1990); Crewels *et al*. (2005)	Original data not located.
14 Feb. 1986	59	50	9	Woehler *et al*. (1990); Creuwels *et al*. (2005)	Census type cannot be attributed to any island. Original data not located.
23 Dec. 1989	73 AON	106 AON	14 AON	Woehler *et al*. (1990); Creuwels *et al*. (2005)	Apparently occupied nests (AON) may contain a proportion of failed or non-breeding nest sites (Creuwels *et al*. 2005).
18 Feb. 1996	11 C	not visited	not visited	Creuwels *et al*. (2005)	
23 Dec. 1997	96 AON	104 AON	21 AON	Creuwels *et al*. (2005)	Apparently occupied nests (AON) may contain a proportion of failed or non-breeding nest sites (Creuwels *et al*. 2005).
26 Dec. 1998	95 AON	103 AON	17 AON	Creuwels *et al*. (2005)	
14 Mar. 1999	66 C	82 C	11 C	Creuwels *et al*. (2005)	
26 Dec. 2001	93 AON	135 AON	20 AON	Creuwels *et al*. (2005)	
14 Dec. 2005	110 ON	149 ON	25 ON	Unpublished data: E.J. Woehler	

'A' = count of adults, 'AON' = apparently occupied nests, 'BC' = banded chicks, 'C' = count of chicks, 'N' = count of nests, 'ON' = occupied nests

Appendix 2: Biota recorded at the Frazier Islands

	Nelly Island	Dewart Island	Charlton Island
Seabirds			
Adélie penguins (*Pygoscelis adeliae*)	c.>1400 (2005)		
Antarctic petrel (*Thalassoica antarctica*)	P		
Cape petrel (*Daption capense*)	P	P (2001)	P (2001)
Snow petrel (*Pagodroma nivea*)	P	P	
Southern giant petrel (*Macronectes giganteus*)	100N (2005)	149N (2005)	25N (2005)
Wilson's storm petrels (*Oceanites oceanicus*)	P		
South Polar skua (*Catharacta maccormicki*)	1N (2005)	1N (2005)	
Southern fulmar (*Fulmarus glacialoides*)	P	P	
Mammals			
Leopard seal (*Hydrurga leptonyx*)	X (2001)		
Weddell seal (*Leptonychotes weddellii*)	X (2001)		
Orca (killer whale: *Orcinus orca*)	Small pod observed close to island (2005)		
Lichens			
Buellia frigida	R		
Usnea antarctica	R		
Rhizoplaca melanophthalma	R		
Candelariella flava	R	R	
Moss			
Bryum pseudotriquetrum	R		
Algae			
Indeterminate green crust	F		
Prasiola crispa	F		
Chlorococcum sp.	F		
Chloromonas polyptera	F		
Chlorosarcina antarctica	R		
Prasiococcus calcarius	F		

Census data for breeding seabirds provided where available, 'P' indicates recorded breeding seabirds but no census data available, 2001 indicates observations in December 2001 visit, 2005 indicates observations from December 2005 visit, 'X' indicates recorded on or near the island, 'N' a count of nests, 'R' rare, and 'F' frequent. Data compiled from records held by the Australian Antarctic Data Centre, ANARE records 1968, Appendix 1, Melick *et al*. 1994, Seppelt, R. pers. comm., Ling, H. pers. comm., Woehler, E.J. pers. comm., and Woehler, E.J. and Olivier, F. unpublished data (December 2001), Woehler, E.J. unpublished data (December 2005).

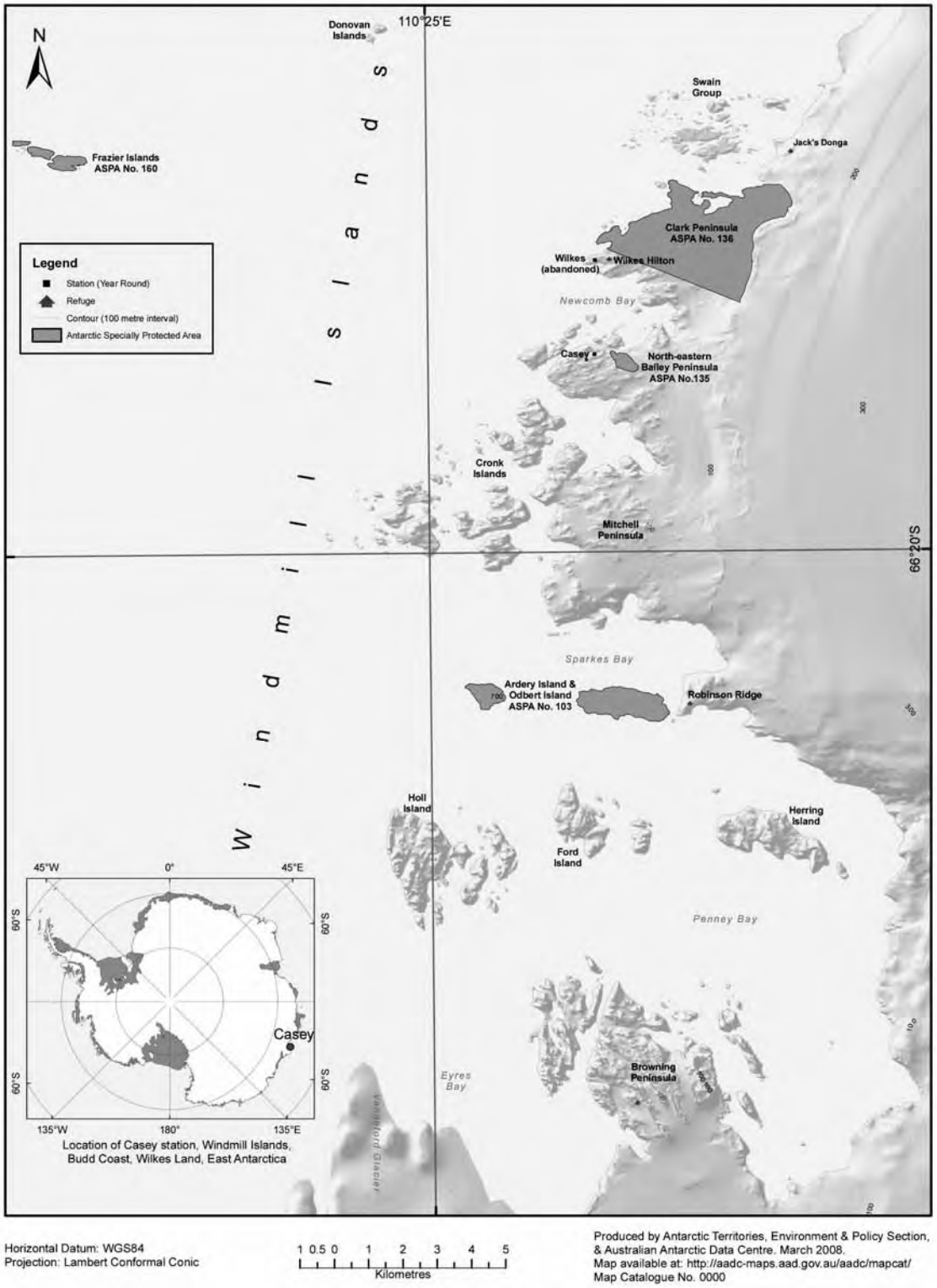
Appendix 3: Minimum wildlife approach distances

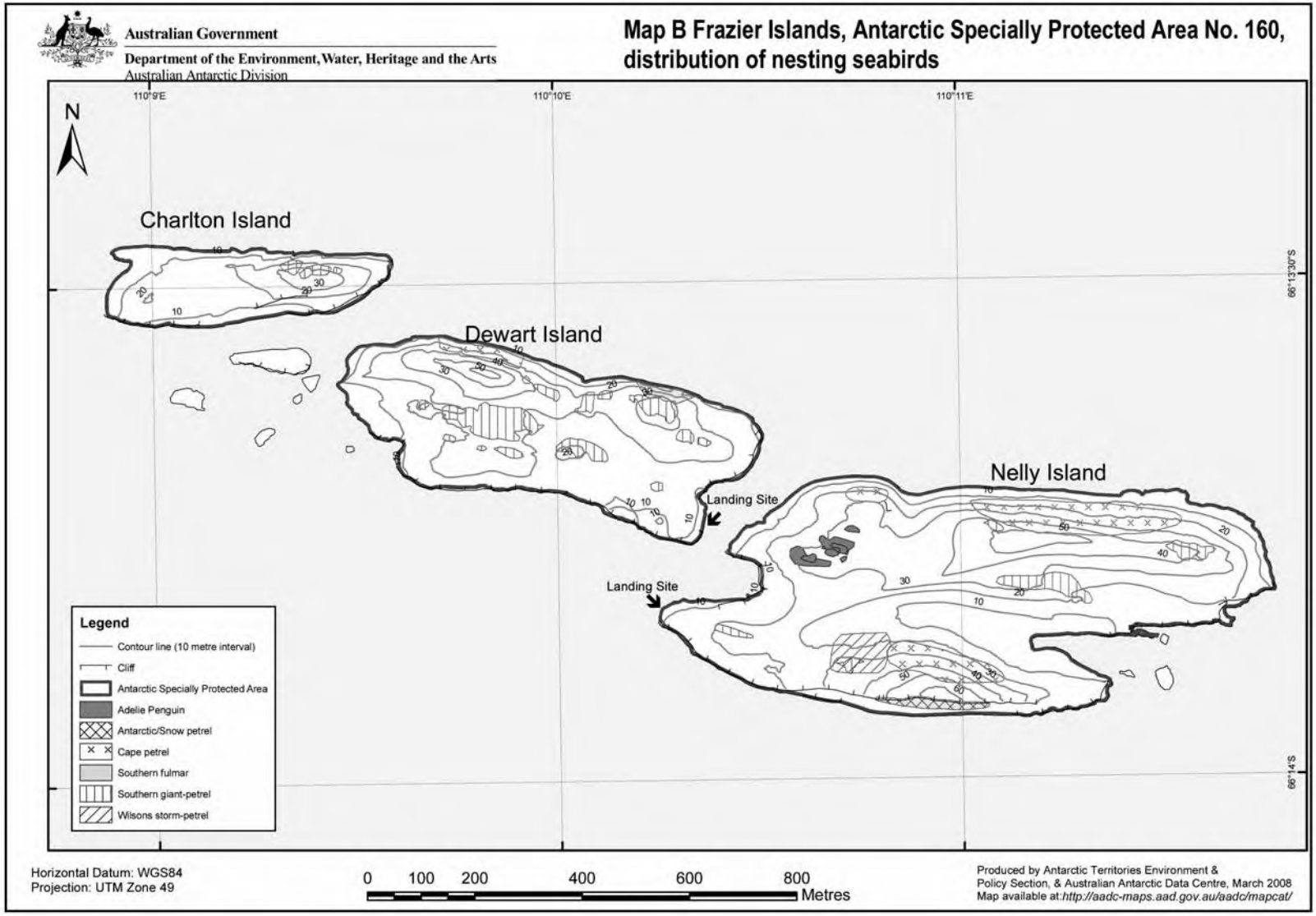
The minimum (closest) approach distances as set out below are to be maintained when approaching any wildlife on, or in the vicinity of the Frazier Islands unless a closer approach distance is authorised in a Permit. These distances are a guide and should an activity disturb wildlife, a greater distance is to be maintained.

Species	**Approach distance (on foot)**
Giant petrels	100m
Other penguins in colonies Moulting penguins Seals with pups Seal pups on their own Prions and petrels on nest South polar skua on nest	30m
Penguins on sea ice Non breeding adult seals	5m

Notes:

1. Includes cape petrels, Antarctic petrels, Wilson's storm petrels, snow petrels and southern fulmars.


Australian Government
Department of the Environment, Water, Heritage and the Arts
Australian Antarctic Division
Map A: Windmill Islands, showing location of the Frazier Islands ASPA No. 160 and protected areas within the region
N
Donovan Islands
110°25'E
Swain Group
Jack's Donga
Frazier Islands ASPA No. 160
Clark Peninsula ASPA No. 136
Wilkes (abandoned)
Wilkes Hilton
Newcomb Bay
Legend
Station (Year Round)
Refuge
Contour (100 metre interval)
Antarctic Specially Protected Area
Casey
North-eastern Bailey Peninsula ASPA No.135
Cronk Islands
Mitchell Peninsula
66°20'S
Windmill Islands
Sparkes Bay
Ardery Island & Odbert Island ASPA No. 103
Robinson Ridge
Holl Island
Herring Island
Ford Island
Penney Bay
45°W
0°
45°E
60°S
135°W
180°
135°E
Casey
Location of Casey station, Windmill Islands, Budd Coast, Wilkes Land, East Antarctica
Eyres Bay
Browning Peninsula
Vanderford Glacier
Horizontal Datum: WGS84
Projection: Lambert Conformal Conic
1 0.5 0 1 2 3 4 5
Kilometres
Produced by Antarctic Territories, Environment & Policy Section, & Australian Antarctic Data Centre. March 2008.
Map available at: http://aadc-maps.aad.gov.au/aadc/mapcat/
Map Catalogue No. 0000


Australian Government
Department of the Environment, Water, Heritage and the Arts
Australian Antarctic Division
Map B Frazier Islands, Antarctic Specially Protected Area No. 160, distribution of nesting seabirds
110°9'E
110°10'E
110°11'E
N
Charlton Island
Dewart Island
Nelly Island
Landing Site
Landing Site
66°13'30"S
66°14'S
Legend
Contour line (10 metre interval)
Cliff
Antarctic Specially Protected Area
Adelie Penguin
Antarctic/Snow petrel
Cape petrel
Southern fulmar
Southern giant-petrel
Wilsons storm-petrel
Horizontal Datum: WGS84
Projection: UTM Zone 49
0 100 200 400 600 800
Metres
Produced by Antarctic Territories Environment & Policy Section, & Australian Antarctic Data Centre, March 2008
Map available at: http://aadc-maps.aad.gov.au/aadc/mapcat/

II. Measures

Measure 14 (2008)

Antarctic Specially Protected Area No 161 (Terra Nova Bay, Ross Sea): Revised Management Plan

The Representatives,

Recalling Articles 3, 5 and 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty providing for the designation of Antarctic Specially Protected Areas ("ASPA") and approval of Management Plans for those Areas;

Recalling Measure 2 (2003), which designated Terra Nova Bay, Ross Sea, as Antarctic Specially Protected Area No 161, and annexed a management plan for the site;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 161;

Desiring to replace the existing Management Plan for ASPA 161 with the revised Management Plan;

Recommend to their Governments the following Measure for approval in accordance with paragraph 1 of Article 6 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That:

1) the revised Management Plan for Antarctic Specially Protected Area No 161: Terra Nova Bay, Ross Sea, which is annexed to this Measure, be approved;
2) the Management Plan for ASPA 161 annexed to Measure 2 (2003) shall cease to be effective.

Management Plan for Antarctic Specially Protected Area No 161

TERRA NOVA BAY, ROSS SEA

1. Description values to be protected

A coastal marine area encompassing 29.4km^2 between Adélie Cove and Tethys Bay, Terra Nova Bay, is proposed as an Antarctic Specially Protected Area (ASPA) by Italy on the grounds that it is an important littoral area for well-established and long-term scientific investigations. The Area is confined to a narrow strip of waters extending approximately 9.4km in length immediately to the south of the Mario Zucchelli Station (MZS) and up to a maximum of 7km from the shore. No marine resource harvesting has been, is currently, or is planned to be, conducted within the Area, nor in the immediate surrounding vicinity. The site typically remains ice-free in summer, which is rare for coastal areas in the Ross Sea region, making it an ideal and accessible site for research into the near-shore benthic communities of the region. Extensive marine ecological research has been carried out at Terra Nova Bay since 1986/87, contributing substantially to our understanding of these communities which had not previously been well-described.

High diversity at both species and community levels make this Area of high ecological and scientific value. Studies have revealed a complex array of species assemblages, often co-existing in mosaics (Cattaneo-Vietti, 1991; Sarà *et al.*, 1992; Cattaneo-Vietti *et al*., 1997; 2000b; 2000c; Gambi *et al.*, 1997; Cantone *et al.*, 2000). There exist assemblages with high species richness and complex functioning, such as the sponge and anthozoan communities, alongside loosely structured, low diversity assemblages. Moreover, the sponge and anthozoan communities at Terra Nova Bay show an unique structure and long-term transects have been established to monitor changes in coastal benthic communities, both natural and human-induced. The presence of a population of Adélie penguins (*Pygoscelis adeliae*) at Adélie Cove allows assessment of the effects of this colony on the adjacent marine environment (Povero *et al.*, 2001).

It is important to protect the Area as far as possible from direct human impacts in order that it can be used to monitor potential impacts arising from activities at the nearby permanent scientific station of MZS at Terra Nova Bay (Mauri *et al.*, 1990; Berkman & Nigro, 1992; Focardi *et al.*, 1993; Minganti *et al.*, 1995; Bruni *et al.*, 1997; Nonnis Marzano *et al.*, 2000). The high ecological and scientific values derived from the diverse range of species and assemblages, in particular through the collection of extensive data on these features, together with the vulnerability of the Area to disturbance by pollution, over-sampling and alien introductions, are such that the Area requires long-term special protection.

2. Aims and objectives

Management at Terra Nova Bay aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- allow scientific research on the ecosystem, in particular on the marine species assemblages, while ensuring it is protected from oversampling or other possible scientific impacts;
- allow other scientific research and support activities provided they are for compelling reasons which cannot be served elsewhere;

- maintain long-term monitoring sites to evaluate natural changes in marine communities;
- monitor the effects of the research station and its associated activities on the marine ecosystem;
- minimise the possibility of introduction of alien plants, animals and microbes to the Area;
- allow visits for management purposes in support of the aims of the Management Plan.

3. Management activities

The following management activities are to be undertaken to protect the values of the Area:

- A map showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently, and a copy of this Management Plan shall be kept available, at MZS (Italy);
- A sign illustrating the location and boundaries with clear statements of entry restrictions shall be installed at MZS at a prominent location;
- Buoys, or other markers or structures erected for scientific or management purposes shall be secured and maintained in good condition, and removed when no longer necessary;
- Visits shall be made as necessary to assess whether the Area continues to serve the purposes for which it was designated and whether management and maintenance measures are adequate.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

- Map 1: Terra Nova Bay, Antarctic Specially Protected Area No 161, bathymetric map.

  Map specifications: Projection: UTM Zone 58S; Spheroid: WGS84. Bathymetric contour interval 50m. Land contours and coast derived from 1:50,000 Northern Foothills Satellite Image Map (Frezzotti *et. al.* 2001). Bathymetry within ASPA derived from high resolution sidescan sonar data surveyed by Kvitek, 2002. Bathymetry outside of ASPA supplied by Italian Hydrographic Office 2000. Marine data collected under Terra Nova Bay marine protected area Project (PNRA 1999-2001).

  Inset 1: The location of Terra Nova Bay in Antarctica.

  Inset 2: Terra Nova Bay location map, showing the region covered by Map 1, stations, and sites of nearby protected areas.

6. Description of the Area

6(i) Geographical co-ordinates, boundary markers and natural features

The designated Area is situated in Terra Nova Bay, between the Campbell Glacier Tongue and Drygalski Ice Tongue, Victoria Land. The Area is confined to a narrow strip of coastal waters to the south of MZS (Italy), extending approximately 9.4km in length and generally within 1.5 – 7km of

the shore, comprising an area of 29.4km^2 (Map 1). No marine resource harvesting has been, is currently, or is planned to be, conducted within the Area, nor in the immediate surrounding vicinity.

The western boundary of the Area is defined as the mean high water mark along the coastline extending between 74°42'57"S in the north (2.3km south of MZS) and 74°48'00"S in the south (the southern shore of Adélie Cove), and includes the intertidal zone (Map 1). The northern boundary of the Area is defined as the 74°42'57"S line of latitude, extending from the coast 1.55km eastward to the 164°10'00"E line of longitude. The boundary position may be recognised near the shore by the presence of a large and distinctive offshore rock in the northernmost cove on the coast south of MZS, which is an unique feature on this stretch of coast. The southern boundary is defined as the 74°48'00"S line of latitude, extending from the coast 3.63km eastward to the 164°10'00"E line of longitude. The boundary position may be recognised visually as being at the southern shore of the mouth of Adélie Cove, immediately south of a distinctive rocky outcrop at the base of the coastal cliffs. The eastern boundary of the Area is defined as the 164°10'00"E line of longitude extending between 74°42'57"S in the north and 74°48'00"S in the south.

The coastline of Terra Nova Bay is characterised predominantly by rocky cliffs, with large boulders forming occasional 'beaches' (Simeoni *et al.*, 1989). In the sheltered areas, the soft bottom begins at a depth of 20–30m. The tidal range is 1.5–2m and pack ice approximately 2–2.5m thick covers the sea surface for 9–10 months of the year (Stocchino & Lusetti, 1988; 1990). Data available for the summer period suggest that ocean currents in the Area are likely to be slow and to flow generally in a north-south direction. Along the coastline of the Area there are two main coves; the larger Adélie Cove in the south and a smaller cove around 3km to its north. The sea floor substrate of the smaller consists of pebbles of various sizes, while Adélie Cove is characterised by fine-grained, muddy sediments. An Adélie penguin (*Pygoscelis adeliae*) colony is situated at Adélie Cove, with a 1991 population of 7899 breeding pairs. Outside of the coves, the sea floor characteristics and benthic species assemblages are relatively homogenous along the coastal length of the Area, and are observed to vary more particularly with the vertical gradient.

An aerial survey on cetacean species, conducted in the coastal area surrounding the Italian Station Mario Zucchelli in summer 2004, showed the presence of killer whale (*Orcinus orca* (L.)), types B and C and minke whale (*Balaenoptera bonaerensis* Burmeister) (Lauriano et al., 2007a; 2007b; Lauriano pers.com.).

The seafloor within the Area is primarily granitic rock, with softer substrates composed of coarse sands or gravels. In the supralittoral zone, only cyanobacteria and diatoms colonise the hard substrates, while the intertidal zone (1.5–2.0m wide) has, in the most sheltered areas, a high coverage of the green alga *Urospora penicilliformis* and *Prasiola crispa* (Cormaci *et al.*, 1992b). Below the tidal zone, down to 2–3m depth, the community is very poor, due to the persistent presence and scouring action of pack ice, and is mainly composed of epilithic diatoms and the crustacean amphipod *Paramoera walkeri*. Immediately deeper, rocks can be fully colonised by the red alga *Iridaea cordata* (Cormaci *et al.*, 1996), frequently found with *Plocamium cartilagineum*, to a depth of 12m (Gambi *et al.*, 1994; 2000a). At this level large sessile animals such as *Alcyonium antarcticum* and *Urticinopsis antarctica* can be occasionally observed, while frequent are the asteroid *Odontaster validus* and the echinoid *Sterechinus neumayeri*. *Phyllophora antarctica* is another red alga forming expanded mats from 12 to 25m depth, often fully colonised by sessile organisms, mainly hydroids (Cerrano *et al.*, 2000c, Puce *et al.*, 2002), serpulids and bryozoans (*Celleporella antarctica* and *Harpecia spinosissima*). The upper algal belts represent shelter and a food source for diversified and abundant communities of mobile fauna. Numerous invertebrates, such as the polychaete *Harmothoe brevipalpa*, the mollusc *Laevilittorina antarctica*, the crustacean amphipod *Paramoera walkeri* and the isopod *Nototanais dimorphus* feed on these algal species and can be very abundant. On rocky bottoms in

deeper layers, the algal colonisation is replaced by a calcareous crustose coralline alga (*Clathromorphum lemoineanum*) on which sea-urchins feed.

The soft bottoms from 20–40m depth are coarse sands and gravels, where the community is characterised by the mollusc bivalve *Laternula elliptica* and the polychaete *Aglaophamus ornatus* (Nephtiidae). The bivalve *Yoldia eightsi* is abundant in fine-sand sediments.

Between 30–70m, the substrate becomes finer and is completely colonised by the bivalve *Adamussium colbecki*, the shells of which are colonised by a micro-community comprising mainly forams, bryozoans (*Aimulosia antarctica, Arachnopusia decipiens, Ellisina antarctica*, *Micropora brevissima*) and the spirorbid *Paralaeospira levinsenii* (Albertelli *et al.*, 1998; Ansell *et al.*, 1998; Chiantore *et al.*, 1998; 2000; 2001; 2002; Vacchi *et al.*, 2000a; Cerrano *et al.*, 2001a; 2001b). In this region, large predators such as the gastropod *Neobuccinum eatoni* and the nemertean *Parborlasia corrugatus* are frequent. The echinoid *Sterechinus neumayeri* and the starfish *Odontaster validus* are still very frequent at all depths on both hard and mobile substrates (Chiantore *et al.*, 2002; Cerrano *et al.*, 2000b).

Below 70–75m down to 120–130m depth, heterogeneous substrates allow hard- and soft-bottom communities to coexist. On the sparse rocky outcrops the encrusting algae disappear and the benthic communities are dominated by the sessile zoobenthos. This diversified filter feeding assemblage is mainly characterised by sponges and anthozoans, while in soft sediments detritus-feeder polychaetes and bivalves dominate. Among sponges, which can reach very high biomass values, A*xociella nidificata, Calyx arcuarius, Gellius rudis, Phorbas glaberrima, Tedania charcoti,* are very abundant (Sarà *et al.*, 1992; 2002; Gaino *et al.*, 1992; Cattaneo-Vietti *et al.*, 1996; 2000c; Bavestrello *et al.*, 2000; Cerrano *et al.*, 2000a). Numerous invertebrates constitute an important component of this assemblage which develops down to 120-140m depth. These include the epibiont polychaete *Barrukia cristata* on Thouarellid gorgonians, crustacean peracarids, pycnogonids, mollusc opisthobranchs (*Austrodoris kerguelenensis, Tritoniella belli*) (Cattaneo-Vietti, 1991; Gavagnin *et al.*, 1995) and bivalves, ophiuroids and holothuroids, bryozoans, and the endobionts. The conspicuous sponge spicule mats found at these depths underline the important role of sponges in this area, besides the one played by diatoms, in determining the sediment texture and silica content. A peculiar community, dominated by polychaetes and by the bivalve *Limatula hodgsoni*, can be associated with these mats.

Below 130m the hard substrates become very sparse and are mainly colonised by the polychaete *Serpula narconensis* (Schiaparelli *et al.*, 2000) and several bryozoans (*Arachnopusia decipiens, Ellisina antarctica*, *Flustra angusta*, *F. vulgaris* and *Isoschizoporella similis*). The dominant muddy bottoms are instead characterised by tubicolous polychaetes (Gambi *et al.*, 2000b), mainly *Spiophanes*. Much deeper, at about 150-200m depth, brachiopods and various species of bivalves characterise the environment on small gravels as well as on the soft bottom (Cattaneo-Vietti *et al.*, 2000b). The great heterogeneity of these substrates contributes to the creation of communities with considerable species richness, diversity and biomass.

Finally, the faunal assemblage of the Area includes notothenioid fishes, represented especially by species of the *Trematomus* group, including *T. bernacchi*, *T. pennelli*, *T. hansoni* and *T. loennbergii*. These exert an important role in benthic food webs as consumers of many invertebrate species, mainly crustaceans and polychaetes (Vacchi *et al.*, 1991; 1992; 1994a; 1994b; 1995; 1997; 2000b; La Mesa *et al.*, 1996; 1997; 2000; Guglielmo *et al.*, 1998).

The platelet ice occurring at Terra Nova Bay in early spring has been shown to house an important nursery for the Antarctic silverfish, *Pleuragramma antarcticum,* a key organism in the ecology of Antarctic food webs (La Mesa et al., 2004; Vacchi et al., 2004). The platelet ice environment has strong prooxidant characteristics at the beginning of austral spring, and the marked responsiveness of antioxidant defences represents a fundamental strategy for *P. antarcticum* (Regoli et al., 2005b).

The elevated prooxidant challenge, to which these organisms are naturally adapted, also influences the susceptibility of *P. antarcticum* toward prooxidant chemicals of anthropogenic origin (Regoli et al., 2005b).

Oxyradical metabolism and antioxidant defenses have a fundamental role in several marine invertebrates, fish and penguins from Terra Nova Bay, representing important counteractive strategies toward, i.e. extreme environmental conditions, marked seasonal fluctuations of biotic and abiotic factors, symbiotic relationships, specific physiological features, long-term protection of biological macromolecules and aging (Regoli et al., 1997a,b; 2000a,b, 2002, 2004; Corsolini et al., 2001; Cerrano et al., 2004).

Susceptibility to oxidative stress is of particular value also for monitoring the impact of human activities and cellular responses to pollutants were characterized in key Antarctic organisms developing a wide array of biomarkers sensitive to biological disturbance (Focardi et al., 1995; Regoli et al., 1998; Jimenez et al., 1999; Regoli et al., 2005a; Benedetti et al., 2005, 2007; Canapa et al., 2007; Di Bello et al., 2007). At the moment, there is no evidence of polluted areas in Terra Nova Bay, but organisms are exposed to a naturally elevated bioavailability of cadmium causing tissue concentrations generally 10-50 folds higher than those typical of temperate species (Mauri et al., 1990; Nigro et al., 1992, 1997; Canapa et al., 2007). Despite elevated levels of this element do not cause direct adverse effects to the organisms, nonetheless the environmental characteristics of Terra Nova Bay influence the responsiveness of organisms to other chemicals with important implications for monitoring the impact of anthropogenic pressure or accidental spills (Regoli et al., 2005a); in particular, elevated level ofcadmium at Terra Nova Bay modulates bioaccumulation and metabolism of polycyclic aromatic hydrocarbons and of organochlorine xenobiotics in local marine organisms suggesting also endocrine effects from the chronic exposure to this element (Regoli et al., 2005a; Benedetti et al., 2007; Canapa et al., 2007).

Human impacts within the Area are believed to be minimal and confined to those arising from the nearby Terra Nova Bay Station and scientific work conducted within the Area. The station can accommodate approximately 80 people, has facilities for helicopter operations and a jetty for the docking of small boats. Fuel used at the station is a light petroleum diesel, stored in three double-walled steel tanks with a total capacity of 1.8 million litres. Fuel is transferred to the station annually from resupply ship either via hoses routed across sea ice or via barge when sea ice is not present. Station waste water, purified by a biological plant, is discharged into the sea adjacent to the station on the eastern side of the peninsula on which the station is located, 2.3km from the northern boundary of the Area. Combustible rubbish generated at the Station is incinerated and the smoke washed and filtered with water. This water is discharged into the waste water treatment plant at time intervals which intovary with incinerator usage. An atmospheric monitoring facility (locally referred to as ‘Campo Icaro’) is situated approximately 650m north of the northern boundary of the Area and 150m from the shore: no wastes are discharged from this facility. A support ship regularly visits Mario Zucchelli Station during the summer, and there are occasional visits by tourist ships. These usually stop offshore several kilometres to the north of the Area.

6(ii) Restricted zones within the Area

None.

6(iii) Structures within and near the Area

There are no structures within the Area. The nearest structure is the atmospheric monitoring facility (locally referred to as ‘Campo Icaro’) 650m north of the northern boundary of the Area, while Mario Zucchelli Station (74°41’42"S, 164°07’23"E) is situated on a small peninsula on the coast adjacent to Tethys Bay, a further 1.65km to the north.

6(iv) Location of other protected areas within close proximity of the Area

ASPA No 118, summit of Mount Melbourne, is a terrestrial site situated 45km to the NE, which is the only other protected area within close proximity.

7. Permit conditions

Entry into the Area is prohibited except in accordance with a Permit issued by the appropriate national authority. Conditions for issuing a Permit are that:

- it is issued for scientific study of the marine environment in the Area, or for other scientific purposes which cannot be served elsewhere; and/or
- it is issued for essential management purposes consistent with plan objectives such as inspection, maintenance or review;
- the actions permitted will not jeopardise the values of the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- the Permit, or an authorised copy, shall be carried by the holderwithin the Area;
- a visit report shall be supplied to the authority named in the Permit;
- permits shall be issued for a stated period.

7(i) Access to and movement within the Area

Access into the Area shall be by sea, land, over sea ice or by air. There are no specific restrictions on routes of access to and movement within the Area, although movements should be kept to the minimum necessary consistent with the objectives of any permitted activities and every reasonable effort should be made to minimise disturbance. Anchoring is prohibited within the Area. There are no overflight restrictions within the Area and aircraft may land by Permit when sea ice conditions allow. Ship or small boat crew, or other people on small boats or ships, are prohibited from moving beyond the immediate vicinity of their vessel unless specifically authorized by Permit.

7(ii) Activities that are or may be conducted within the Area, including restrictions on time or place

- Scientific research or essential operational activities that will not jeopardise the values of the Area;
- Essential management activities, including monitoring;
- Activities that involve trawling, dragging, grabbing, dredging, or deployment of nets within the Area should be undertaken with great care because of the sensitivity of the rich bottom communities to disturbance: before Permits are granted for such activities careful consideration should be given to the impact of such activities on the ecosystem under special protection versus the expected scientific or management benefits, with consideration given to alternative, more selective and less-invasive, sampling methods;
- The appropriate authority should be notified of any activities/measures undertaken that were not included in the authorized Permit.

7(iii) Installation, modification or removal of structures

Structures or scientific equipment shall not be installed within the Area except as specified in a Permit. All markers, structures or scientific equipment installed in the Area shall be clearly identified

by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area. Removal of specific equipment for which the Permit has expired shall be a condition of the Permit. Permanent installations are prohibited.

7(iv) Location of field camps

None within the Area. An occasional field camp has been positioned on the beach at Adélie Cove.

7(v) Restrictions on materials and organisms which can be brought into the Area

No living animals, plant material, pathogens or microorganisms shall be deliberately introduced into the Area. Poultry products, including food products containing uncooked dried eggs, shall not be released into the Area. No herbicides or pesticides shall be introduced into the Area. Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the Permit, shall be used in the minimum quantities necessary to achieve the purpose of the activity for which the Permit was granted. Such chemicals shall be used with due regard for the values of the Area. All materials shall be stored and handled so that risk of their accidental introduction into the environment is minimized. Where practical, materials introduced shall remain for a stated period only and shall be removed at or before the conclusion of that stated period. If release occurs which is likely to compromise the values of the Area, removal is encouraged only where the impact of removal is not likely to be greater than that of leaving the material *in situ*. The appropriate authority should be notified of any materials released that were not included in the authorized Permit.

7(vi) Taking or harmful interference with native flora or fauna

Taking or harmful interference with native flora or fauna is prohibited, except by Permit issued in accordance with Annex II to the Protocol on Environmental Protection to the Antarctic Treaty. Where taking or harmful interference with animals is involved, the *SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica* should be used as a minimum standard.

7(vii) Collection and removal of anything not brought into the Area by the Permit holder

Material may be collected or removed from the Area only in accordance with a Permit and should be limited to the minimum necessary to meet scientific or management needs. Permits shall not be granted if there is a reasonable concern that the sampling proposed would take, remove or damage such quantities of substrate, native flora or fauna that their distribution or abundance within the Area would be significantly affected. All samples collected shall be described in terms of their type, quantity and the location from which they were taken. This information shall held in an archive accessible at MZS in order to maintain a record of usage that will assist assessment of the impacts of sampling activities and in the planning of future sampling. Material of human origin likely to compromise the values of the Area, which was not brought into the Area by the Permit Holder or otherwise authorized, may be removed unless the impact of removal is likely to be greater than leaving the material *in situ*: if this is the case the appropriate authority should be notified.

7(viii) Disposal of waste

All wastes, including all human wastes, shall be removed from the Area.

7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

Permits may be granted to enter the Area to carry out biological monitoring and site inspection activities, which may involve the collection of limited samples for analysis or review, or for protective measures.

Any specific sites of long-term monitoring that are vulnerable to inadvertent disturbance should be appropriately marked on site where practical and, as appropriate, on maps of the Area.

To help maintain the ecological and scientific values of the marine communities found within the Area, visitors shall take special precautions against marine pollution. Of concern are the release or spillage of hydrocarbons from ships, and biological introductions. To minimize the risk of such pollution, visitors shall ensure that sampling equipment or markers brought into the Area are clean. Vessels that are found to show fuel leakage, or a significant risk of such leakage, are prohibited from entering the Area. If a fuel leak from a vessel is discovered while within the Area, the vessel shall leave the Area unless the leak can be promptly stopped. Handling of fuels and oil within the Area shall be the minimum necessary consistent with meeting the objectives of the permitted activities.

7(x) Requirements for reports

Antarctic Treaty Parties should ensure that the principal holder for each Permit issued submits to the appropriate authority a report describing the activities undertaken. Such reports should include, as appropriate, the information identified in the Visit Report form suggested by SCAR. Parties should maintain a record of such activities and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, which should be in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the management plan and in organizing the scientific use of the Area.

8. References

Albertelli G., Cattaneo-Vietti R., Chiantore M., Pusceddu A., Fabiano M., 1998. Food availability to an *Adamussium* bed during the austral Summer 1993/94 (Terra Nova Bay, Ross Sea). *Journal of Marine Systems* 17: 425-34.

Ansell A.D., Cattaneo-Vietti R., Chiantore M., 1998. Swimming in the Antarctic scallop *Adamussium colbecki*: analysis of *in situ* video recordings. *Antarctic Science* **10** (4): 369-75.

Bavestrello G., Arillo A., Calcinai B., Cattaneo-Vietti R., Cerrano C., Gaino E., Penna A., Sara' M., 2000. Parasitic diatoms inside Antarctic sponges. *Biol. Bull*. **198**: 29-33.

Benedetti M., Gorbi S., Bocchetti R., Fattorini D., Notti A., Martuccio G., Nigro M., Regoli F. (2005). Characterization of cytochrome P450 in the Antarctic key sentinel species Trematomus bernacchii. Pharmacologyonline 3: 1-8 ISSN-1827-8620

Benedetti M., Martuccio G., Fattorini D., Canapa A., Barucca M., Nigro M., Regoli F. (2007). Oxidative and modulatory effects of trace metals on metabolism of polycyclic aromatic hydrocarbons in the Antarctic fish Trematomus bernacchii. Aquat. Toxicol. 85: 167-175

Berkman P.A., Nigro M., 1992. Trace metal concentrations in scallops around Antarctica: Extending the Mussel Watch Programme to the Southern Ocean. *Marine Pollution Bulletin* **24** (124): 322-23.

Bruni V., Maugeri M.L., Monticelli L.S., 1997. Faecal pollution indicators in the Terra Nova Bay (Ross Sea, Antarctica). *Marine Pollution Bulletin* **34** (11): 908-12.

Canapa A, Barucca M, Gorbi S, Benedetti M, Zucchi S, Biscotti MA, Olmo E, Nigro M, Regoli F 2007 Vitellogenin gene expression in males of the Antarctic fish *Trematomus bernacchii* from Terra Nova Bay (Ross Sea): A role for environmental cadmium? *Chemosphere, 66:1270-1277*.

Cantone G., Castelli A., Gambi M.C., 2000. The Polychaete fauna off Terra Nova Bay and Ross Sea: biogeography, structural aspects and ecological role. In: *Ross Sea Ecology*, F. Faranda, L. Guglielmo and A. Ianora Eds., Springer Verlag, Berlin Heidelberg: 551-61.

Cattaneo-Vietti R., 1991. Nudibranch Molluscs from the Ross Sea, Antarctica. *J. Moll. Stud.* **57**: 223-28.

Cattaneo-Vietti R., Bavestrello G., Cerrano C., Sara' M., Benatti U., Giovine M., Gaino E., 1996. Optical fibres in an Antarctic sponge. *Nature* **383**: 397-98.

Cattaneo-Vietti R., Chiantore M., Albertelli G., 1997. The population structure and ecology of the Antarctic Scallop, *Adamussium colbecki* in Terra Nova Bay (Ross Sea, Antarctica). *Scientia Marina* **61** (Suppl. 2): 15-24.

Cattaneo-Vietti R., Chiantore M., Misic C., Povero P., Fabiano M., 1999. The role of pelagic-benthic coupling in structuring littoral benthic communities at Terra Nova Bay (Ross Sea) and inside the Strait of Magellan. *Scientia Marina* **63** (Supl. 1): 113-21.

Cattaneo-Vietti R., Chiantore M., Gambi M.C., Albertelli G., Cormaci M., Di Geronimo I., 2000a. Spatial and vertical distribution of benthic littoral communities in Terra Nova Bay. In: *Ross Sea Ecology*, F. Faranda, L. Guglielmo and A. Ianora Eds., Springer Verlag, Berlin Heidelberg: 503-14.

Cattaneo-Vietti R., Chiantore M., Schiaparelli S., Albertelli G., 2000b. Shallow and deep-water mollusc distribution at Terra Nova Bay (Ross Sea, Antarctica). *Polar Biology* **23**: 173-82.

Cattaneo-Vietti R., Bavestrello G., Cerrano C., Gaino E., Mazzella L., Pansini M., Sarà M., 2000c. The role of sponges of Terra Nova Bay ecosystem. In: *Ross Sea Ecology*, F. Faranda, L. Guglielmo and A. Ianora Eds., Springer Verlag, Berlin Heidelberg: 539-49.

Cerrano C., Arillo A., Bavestrello G., Calcinai B., Cattaneo-Vietti R., Penna A., Sarà M., Totti C., 2000a. Diatom invasion in the Antarctic hexactinellid sponge *Scolymastra joubini*. *Polar Biology* **23**: 441-44.

Cerrano C., Bavestrello G., Calcinai B., Cattaneo-Vietti R., Sarà A., 2000b. Asteroids eating sponges from Tethys Bay, East Antarctica. *Antarctic Science* **12**(4): 431-32.

Cerrano C., Puce S., Chiantore M., Bavestrello G., 2000c. Unusual trophic strategies of *Hydractinia angusta* (Cnidaria, Hydrozoa) from Terra Nova Bay, Antarctica. *Polar Biology* **23**(7): 488-94.

Cerrano C., G. Bavestrello, B. Calcinai, R. Cattaneo-Vietti, M. Chiantore, M. Guidetti, A. Sarà, 2001a. Bioerosive processes in Antarctic seas. *Polar Biology* **24**: 790-92.

Cerrano C., S. Puce, M. Chiantore, G. Bavestrello, R. Cattaneo-Vietti, 2001b. The influence of the epizooic hydroid *Hydractinia angusta* on the recruitment of the Antarctic scallop *Adamussium colbecki*. *Polar Biology* **24**: 577-81.

Cerrano C, Calcinai B, Cucchiari E, Di Camillo C, Nigro M, Regoli F, Sarà A, Schiapparelli S, Totti C, Bavestrello G 2004 Are diatoms a food source for Antarctic sponges? *Chemistry and Ecology, vol. 20: 57-64.*

Chiantore M., Cattaneo-Vietti R., Albertelli G., Misic M., Fabiano M., 1998. Role of filtering and biodeposition by *Adamussium colbecki* in circulation of organic matter in Terra Nova Bay (Ross Sea, Antarctica). *Journal of Marine Systems* **17**: 411-24.

Chiantore M., Cattaneo-Vietti R., Povero P., Albertelli G., 2000. The population structure and ecology of the antarctic scallop *Adamussium colbecki* in Terra Nova Bay. In: *Ross Sea Ecology*, F. Faranda, L. Guglielmo and A. Ianora Eds., Springer Verlag, Berlin Heidelberg: 563-73.

Chiantore M., Cattaneo-Vietti R., Berkman P.A., Nigro M., Vacchi M., Schiaparelli S., Albertelli G., 2001. Antarctic scallop (*Adamussium colbecki*) spatial population variability along the Victoria Land Coast, Antarctica. *Polar Biology* **24**: 139-43.

Chiantore M., R. Cattaneo-Vietti, L. Elia, M. Guidetti, M. Antonini, 2002. Reproduction and condition of the scallop *Adamussium colbecki* (Smith 1902), the sea-urchin *Sterechinus neumayeri* (Meissner, 1900) and the sea-star *Odontaster validus* Koehler, 1911 at Terra Nova Bay (Ross Sea): different strategies related to inter-annual variations in food availability. *Polar Biology* **22**: 251-55.

Cormaci M., Furnari G., Scammacca B., Casazza G., 1992a. Il fitobenthos di Baia Terra Nova (Mare di Ross, Antartide): osservazioni sulla flora e sulla zonazione dei popolamenti. In: Gallardo VA, Ferretti O, Moyano HI (eds) *Actas del Semin. Int. Oceanografia in Antartide*. Centro EULA, Universitad de Concepción, Chile. ENEA: 395-408.

Cormaci M., Furnari G., Scammacca B., 1992b. The benthic algal flora of Terra Nova Bay (Ross Sea, Antarctica). *Botanica Marina* **35**(6): 541-52

Cormaci M., Furnari G., Scammacca B., 1992c. Carta della vegetazione marina di Baia Terra Nova (Mare di Ross, Antartide). *Biologia Marina* **1**: 313-14.

Cormaci M., Furnari G., Scammacca B., Alongi G., 1996. Summer biomass of a population of *Iridaea cordata* (Gigartinaceae, Rhodophyta) from Antarctica. In: Lindstrom SC, Chapman DJ (Eds) Proceedings of the XV Seeweeds Symposium. *Hydrobiologia* **326/327**: 267-72.

Corsolini S, Nigro M, Olmastroni S, Focardi S, Regoli F 2001 Susceptibility to oxidative stress in Adelie and Emperor penguin, *Polar Biology, vol. 24: 365-368.*

Di Bello D., Vaccaio E., Longo V., Regoli F., Nigro M., Benedetti M., Gervasi PG, Pretti C. (2007). Presence and inducibility by â-Naphtoflavone of CYP 1A1, CYP 1B1, UDP-GT, GST and DT-Diaphorase enzymes in Trematomus bernacchii, an Antarctic fish. Aquatic Toxicol. 84: 19-26

Fabiano M., Danovaro R., Crisafi E., La Ferla R., Povero P., Acosta Pomar L., 1995. Particulate matter composition and bacterial distribution in Terra Nova Bay (Antarctica) during summer 1989-90. *Polar Biology* **15**: 393-400.

Fabiano M., Povero P., Danovaro R., 1996. Particulate organic matter composition in Terra Nova Bay (Ross Sea, Antarctica) during summer 1990. *Antarctic Science* **8**(1): 7-13.

Fabiano M., Chiantore M., Povero P., Cattaneo-Vietti R., Pusceddu A., Misic C., Albertelli G., 1997. Short-term variations in particulate matter flux in Terra Nova Bay, Ross Sea. *Antarctic Science* **9**(2): 143-149.

Focardi S., Bargagli R., Corsolini S., 1993. Organochlorines in marine Antarctic food chain at Terra Nova Bay (Ross Sea). *Korean Journal of Polar Research* **4**: 73-77.

Focardi S, Fossi MC, Lari L, Casini S, Leonzio C, Meidel SK, Nigro M. 1995 Induction of MFO Activity in the Antarctic fish *Pagothenia bernacchii*: Preliminary results. *Marine Environmental Research., 39: 97-100*.

Gaino E., Bavestrello G., Cattaneo-Vietti R., Sara' M., 1994. Scanning electron microscope evidence for diatom uptake by two Antarctic sponges. *Polar Biology* **14**: 55-58.

Gambi M.C., Lorenti M., Russo G.F., Scipione M.B., 1994. Benthic associations of the shallow hard bottoms off Terra Nova Bay (Ross Sea, Antarctica): zonation, biomass and population structure. *Antarctic Science* **6**(4): 449-62.

Gambi M.C., Castelli A., Guizzardi M., 1997. Polychaete populations of the shallow soft bottoms off Terra Nova Bay (Ross Sea, Antarctica): distribution, diversity and biomass. *Polar Biology* **17**: 199-210.

Gambi M.C., Buia M.C., Mazzella L., Lorenti M., Scipione M.B., 2000a. Spatio-temporal variability in the structure of benthic populations in a physically controlled system off Terra Nova Bay: the shallow hard bottoms. In: *Ross Sea Ecology*, F. Faranda, L. Guglielmo and A. Ianora Eds., Springer Verlag, Berlin Heidelberg: 527-538.

Gambi M.C., Giangrande A., Patti F.P., 2000b. Comparative observations on reproductive biology of four species of *Perkinsiana* (Polychaeta, Sabellidae). *Bulletin of Marine Science* **67**(1): 299-309.

Gavagnin M., Trivellone E., Castelluccio F., Cimino G., Cattaneo-Vietti R., 1995. Glyceryl ester of a new halimane diterpenoic acid from the skin of the antarctic nudibranch *Austrodoris kerguelenensis*. *Tetrahedron Letters* **36**: 7319-22.

Guglielmo L., Granata A., Greco S., 1998. Distribution and abundance of postlarval and juvenile *Pleuragramma antarticum* (Pisces, Nototheniidae)of Terra Nova Bay (Ross Sea, Antarctica). *Polar Biology* **19**: 37-51.

Guglielmo L., Carrada G.C., Catalano G., Dell'Anno A., Fabiano M., Lazzara L., Mangoni O., Pusceddu A., Saggiomo V., 2000. Structural and functional properties of sympagic communities in the annual sea ice at Terra Nova Bay (Ross Sea, Antarctica). *Polar Biology* **23**(2): 137-46.

Jimenez B, Fossi MC, Nigro M, Focardi S. 1999 Biomarker approach to evaluating the impact of scientific stations on the Antarctic environment using *trematomus bernacchii* as a bioindicator organism. *Chemosphere*, 39: 2073-2078.

La Mesa M., Arneri E., Giannetti G., Greco S., Vacchi M., 1996. Age and growth of the notothenid fish *Trematomus bernacchii* Boulenger from Terra Nova Bay, Antarctica. *Polar Biology***16**: 139-45.

La Mesa M., Vacchi M., Castelli A., Diviacco G., 1997. Feeding ecology of two notothenid fishes *Trematomus hansoni* and *Trematomus loennbergi* from Terra Nova Bay, Ross Sea. *Polar Biology* **17**: 62-68.

La Mesa M., Vacchi M., T. Zunini Sertorio, 2000. Feeding plasticity of *Trematomus newnesi* (Pisces, Nototheniidae) in Terra Nova Bay, Ross Sea, in relation to environmental conditions. *Polar Biology* **23**(1): 38-45.

La Mesa M., J.T. Eastman, M. Vacchi, 2004. The role of notothenioid fish in the food web of the Ross Sea shelf waters: a review. *Polar Biol., 27: 321-338.*

Lauriano G., Fortuna C.M., Vacchi M., 2007a. Observation of killer whale (*Orcinus orca*) possibly eating penguins in Terra Nova Bay, Antarctica. *Antarctic Science*, 19(1): 95-96.

Lauriano G., Vacchi M., Ainley D., Ballard G., 2007b. Observations of top predators foraging on fish in the pack ice of the southern Ross Sea. *Antarctic Science*, 19(4): 439-440.

Mauri M., Orlando E., Nigro M., Regoli F., 1990. Heavy metals in the Antarctic scallop *Adamussium colbecki* (Smith). *Mar. Ecol. Progr. Ser*. **67**: 27-33.

Mauri M, Orlando E, Nigro M, Regoli F. 1990 Heavy metals in the Antarctic scallop *Adamussium colbecki* (Smith). *Marine Ecology Progress Series, 67: 27-33*. **I.f. 2.286**

Minganti V., Capelli R., Fiorentino F., De Pellegrini R., Vacchi M., 1995. Variations of mercury and selenium concentrations in *Adamussium colbecki* and *Pagothenia bernacchii* from Terra Nova Bay (Antarctica) during a five year period. *Int. J. Environ. Anal. Chem.* **61**: 239-48.

Nonnis Marzano F., Fiori F., Jia G., Chiantore M., 2000. Anthropogenic radionuclides bioaccumulation in Antarctic marine fauna and its ecological relevance. *Polar Biology* **23**: 753-58.

Nigro M, Orlando E, Regoli F. 1992 Ultrastructural localisation of metal binding sites in the kidney of the Antarctic scallop *Adamussium colbecki. Marine Biology, 113: 637-643.*

Nigro M., Regoli F., Rocchi R., Orlando E. (1997). Heavy metals in Antarctic Molluscs. In "Antarctic Communities" (B. Battaglia, J. Valencia and D.W.H Walton Eds.), Cambridge University Press, 409-412

Povero P., Chiantore M., Misic C., Budillon G., Cattaneo-Vietti R., 2001. Pelagic-benthic coupling in Adélie Cove (Terra Nova Bay, Antarctica): a strongly land forcing controlled system? *Polar Biology* **24**: 875-882.

Puce S., Cerrano C., Bavestrello G., 2002. *Eudendrium* (Cnidaria, Anthomedusae) from the Antarctic Ocean with a description of new species. *Polar Biology* **25**: 366-73.

Pusceddu A., Cattaneo-Vietti R., Albertelli G., Fabiano M., 1999. Origin, biochemical composition and vertical flux of particulate organic matter under the pack ice in Terra Nova Bay (Ross Sea, Antarctica) during late summer 1995. *Polar Biology* **22**: 124-32.

Regoli F, Principato GB, Bertoli E, Nigro M, Orlando E. 1997a Biochemical characterisation of the antioxidant system in the scallop *Adamussium colbecki*, a sentinel organism for monitoring the Antarctic environment. *Polar Biology, 17: 251-25.*

Regoli F, Nigro M, Bertoli E, Principato GB, Orlando E. 1997b Defences against oxidative stress in the Antarctic scallop *Adamussium colbecki* and effects of acute exposure to metals. *Hydrobiologia, 355: 139-144.*

Regoli F, Nigro M, Orlando E. 1998 Lysosomal and antioxidant defences to metals in the Antarctic scallop *Adamussium colbecki. Aquatic Toxicology*, 40: 375-392.

Regoli F, Nigro M, Bompadre S, Wiston G. 2000a Total oxidant scavenging capacity (TOSC) of microsomal and cytosolic fractions from Antarctic Arctic and Mediterranean Scallops: differentiation between three different potent oxidants. *Aquatic Toxicology, 49: 13-25.*

Regoli F, Nigro M, Chiantore MC, Gorbi S, Wiston G 2000b Total oxidant scavenging capacity of Antarctic, Arctic and Mediterranean scallops. *Italian Journal of Zoology, vol. 67: 5-94.*

Regoli F., M. Nigro, M. Chiantore, G.W. Winston, 2002. Seasonal variations of susceptibility to oxidative stress in *Adamussium colbecki*, a key bioindicator species for the Antarctic marine environment. *The Science of the Total Environment*, **289:** 205-211.

Regoli F, Nigro M, Chierici E, Cerrano C, Schiapparelli S, Totti C, Bavestrello G 2004 Variations of antioxidant efficiency and presence of endosymbiontic diatoms in the Antarctic porifera Haliclona dancoi, Marine Environmental Research, vol. 58: 637-640.

Regoli F, Nigro M, Benedetti M, Gorbi S, Pretti C, Gervasi PG, Fattorini D 2005a Interactions between metabolism of trace metals and xenobiotics agonist of the aryl hydrocarbon receptor in the Antarctic fish *Trematomus bernacchii*: environmental perspectives. *Environmental Toxicology and Chemistry, vol.* 24(6): 201-208

Regoli F, Nigro M, Benedetti M, Fattorini D, Gorbi S 2005b Antioxidant efficiency in early life stages of the Antarctic silverfish *Pleuragramma antarcticum*: Responsiveness to pro-oxidant conditions of platelet ice and chemical exposure. *Aquatic Toxicology, vol. 75: 43-52.*

Sarà A., Cerrano C., Sarà M., 2002. Viviparous development in the Antarctic sponge *Stylocordyla borealis* Loven, 1868. *Polar Biology* **25**: 425-31.

Sarà M., Balduzzi A., Barbieri M., Bavestrello G., Burlando B., 1992. Biogeographic traits and checklist of Antarctic demosponges. *Polar Biology* **12**: 559-85.

Schiaparelli S., Cattaneo-Vietti R., Chiantore M., 2000. Adaptive morphology of *Capulus subcompressus* Pelseneer, 1903 (Gastropoda: Capulidae) from Terra Nova Bay, Ross Sea (Antarctica). *Polar Biology* **23**: 11-16.

Simeoni U., Baroni C., Meccheri M., Taviani M., Zanon G., 1989. Coastal studies in Northern Victoria Land (Antarctica): Holocene beaches of Inexpressible island, Tethys Bay and Edmonson Point. *Boll. Ocean. Teor. Appl.* **7**(1-2): 5-16.

Stocchino C., Lusetti C., 1988. Le costanti armoniche di marea di Baia Terra Nova (Mare di Ross, Antartide). F.C. 1128 *Istituto Idrografico della Marina*, Genova.

Stocchino C., Lusetti C., 1990. Prime osservazioni sulle caratteristiche idrologiche e dinamiche di Baia Terra Nova (Mare di Ross, Antartide). F.C. 1132 *Istituto Idrografico della Marina*, Genova.

Vacchi M., Greco S., La Mesa M., 1991. Ichthyological survey by fixed gears in Terra Nova Bay (Antarctica). Fish list and first results. *Memorie di Biologia Marina e di Oceanografia* **19**: 197-202.

Vacchi M., Romanelli M., La Mesa M., 1992. Age structure of *Chionodraco hamatus* (Teleostei, Channichthyidae) samples caught in Terra Nova Bay, East Antarctica. *Polar Biology* **12**: 735-38.

Vacchi M., Greco S., 1994a. Capture of the giant Nototheniid fish *Dissostichus mawsoni* in Terra Nova Bay (Antarctica): Notes on the fishing equipment and the specimens caught. *Cybium* **18**(2): 199-203.

Vacchi M., La Mesa M., Castelli A., 1994b. Diet of two coastal nototheniid fish from Terra Nova Bay, Ross Sea. *Antarctic Science* **6**(1): 61-65.

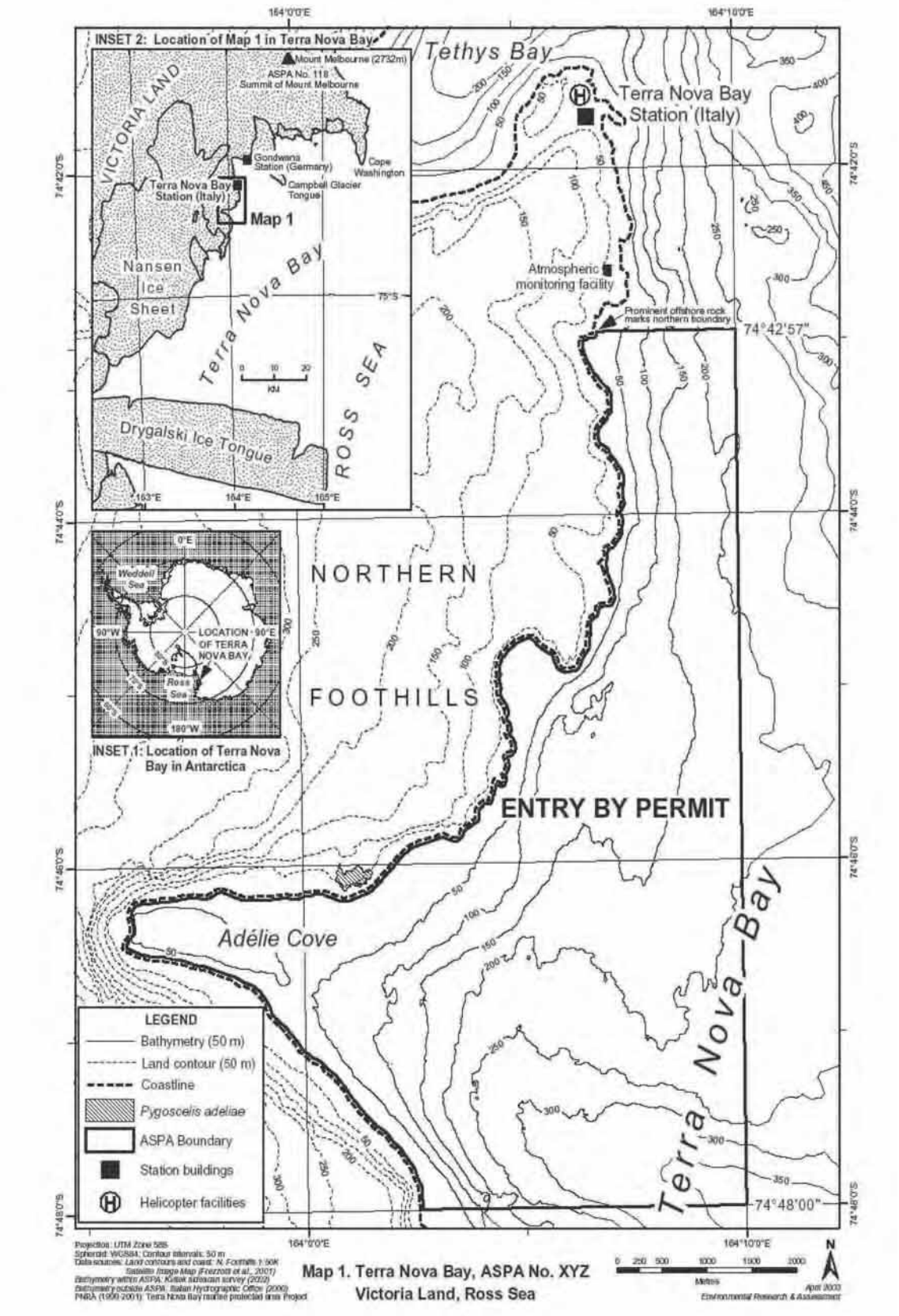
Vacchi M., La Mesa M., 1995. The diet of Antarctic fish *Trematomus newnesi* Boulenger, 1902 (Notothenidae) from Terra Nova Bay, Ross Sea. *Antarctic Science* **7**(1): 37-38.

Vacchi M., La Mesa M., 1997. Morphometry of *Cryodraco* specimens of Terra Nova Bay. *Cybium* 21(4): 363-68.

Vacchi M., Cattaneo-Vietti R., Chiantore M., Dalù M., 2000a. Predator-prey relationship between nototheniid fish *Trematomus bernacchii* and Antarctic scallop *Adamussium colbecki* at Terra Nova Bay (Ross Sea). *Antarctic Science* 12(1): 64-68.

Vacchi M., La Mesa M., Greco S., 2000b. The coastal fish fauna of Terra Nova Bay, Ross Sea (Antarctica). In: *Ross Sea Ecology*, F. Faranda, L. Guglielmo and A. Ianora Eds., Springer Verlag, Berlin Heidelberg: 457-68.

Vacchi M., M. La Mesa, M. Dalù, J. MacDonald, 2004. Early life stages in the life cycle of Antarctic silverfish,*Pleuragramma antarcticum* in Terra Nova Bay, Ross Sea. *Antarctic Science*


INSET 2: Location of Map 1 in Terra Nova Bay
Mount Melbourne (2732m)
ASPA No. 118
Summit of Mount Melbourne
VICTORIA LAND
Gondwana Station (Germany)
Cape Washington
Campbell Glacier Tongue
Terra Nova Bay Station (Italy)
Map 1
Nansen Ice Sheet
Terra Nova Bay
ROSS SEA
Drygalski Ice Tongue
163°E
164°E
165°E
75°S
INSET 1: Location of Terra Nova Bay in Antarctica
Weddell Sea
Ross Sea
LOCATION OF TERRA NOVA BAY
90°W
90°E
180°W
Tethys Bay
Terra Nova Bay Station (Italy)
Atmospheric monitoring facility
Prominent offshore rock marks northern boundary
74°42'57"
NORTHERN
FOOTHILLS
ENTRY BY PERMIT
Adélie Cove
Terra Nova Bay
74°48'00"
LEGEND
Bathymetry (50 m)
Land contour (50 m)
Coastline
Pygoscelis adeliae
ASPA Boundary
Station buildings
Helicopter facilities
164°0'0"E
164°10'0"E
74°42'0"S
74°44'0"S
74°46'0"S
74°48'0"S
Projection: UTM Zone 58S
Spheroid: WGS84; Contour intervals: 50 m
Data sources: Land contours and coast: N. Foothills 1:50K
Satellite Image Map (Frezzotti et al., 2001)
Bathymetry within ASPA: Kvitek sidescan survey (2002)
Bathymetry outside ASPA: Italian Hydrographic Office (2000)
PNRA (1990-2001) Terra Nova Bay marine protected area Project
Map 1. Terra Nova Bay, ASPA No. XYZ
Victoria Land, Ross Sea
Metres
April 2003
Environmental Research & Assessment

Appendix 1: Recent bibliography and other publications of interest for the research activities in the Terra Nova Bay

Berkman P.A., R. Cattaneo-Vietti, M. Chiantore, C. Howard-Williams, 2004. Polar emergence and the influence of increased sea ice extent on the Cenozoic biogeography of pectinid molluscs in Antarctic coastal seas. *Deep Sea Research II*, 1839-1855.

Berkman, P.A., R. Cattaneo-Vietti, Chiantore, M., Howard-Williams, C., Cummings, V., Kvitek, R., 2005. Marine research in the Latitudinal Gradient Project along Victoria Land, Antarctica. In: W.E. Arntz, G.A. Lovrich & S. Thatje (Eds), *The Magellan-Antarctic Connection: links and frontiers at hifh southern Latitudes. Scientia Marina,* 69 (suppl. 2): 57-63.

Cerrano C. B., Bavestrello, R, Calcinai, R Cattaneo Vietti., M. Chiantore, G. G. Guidetti, A. Sarà 2001. Bioerosive processes in Antarctic seas. *Polar Biology,* 24: 790-792

Cerrano C , S. Puce, M. Chiantore, G. Bavestrello, R. Cattaneo Vietti 2001. The influence of the epizooic hydroid *Hydractinia angusta* on the recruitment of the Antarctic scallop *Adamussium colbecki*. *Polar Biology*, 24: 577-581.

Chiantore M., R. Cattaneo-Vietti, P. Berkman, M. Nigro, M. Vacchi, S. Schiaparelli, M. Guidetti & G. Albertelli, 2001. Antarctic scallop (*Adamussium colbecki*) spatial and temporal population variability along the Victoria Land Coast, Antarctica. *Polar Biology*: 24: 139-143.

Chiantore M., Cattaneo-Vietti R., Heilmayer, O., 2003. Antarctic scallop (*Adamussium colbecki*) annual growth rate at Terra Nova Bay. *Polar Biology* 26, 416-419.

Chiantore M., M. Guidetti, M. Cavallero, F. De Domenico, G. Albertelli, R. Cattaneo-Vietti, 2005. Sea urchins, sea stars and brittle stars from Terra Nova Bay (Ross Sea, Antarctica). *Polar Biology*, 29: 467–475

Corsi I., S. Bonacci, G. Santovito, *M. Chiantore*, L. Castagnolo, S. Focardi, *2004.* Preliminary investigation on cholinesterase activity in *Adamussium colbecki* from Terra Nova Bay: field and laboratory study. *Chemistry and Ecology*, 20 Suppl 1: 79-87.

Corsi, I., S. Bonacci, G. Santovito, *M. Chiantore*, L. Castagnolo, S. Focardi, *2004.* Cholinesterase activities in the Antarctic scallop *Adamussium colbecki*: tissue expression and effect of $ZnCl_2$ exposure. *Marine Environmental Research*, 58: 401-406.

Dalla Riva S., Abelmoschi M. L., Grotti M., Soggia F., Bottaro M., Vacchi M., 2006. The occurrence of lead in the bone tissues of *Trematomus bernacchii* (Terra Nova Bay, Ross Sea, Antarctica). *Antarctic Science*, 18(1): 75-80.

Dalla Riva S., M.L. Abelmoschi, *M. Chiantore*, M. Grotti, E. Magi, F. Soggia, *2003.* Biogeochemical cycling of Pb in the coastal marine environment at Terra Nova Bay, Ross Sea. *Antarctic Science*, 15 (4): 425-432.

De Domenico F., M. Chiantore, S. Buongiovanni, M.P. Ferranti, S. Ghione, S. Thrush, V. Cummings, J. Hewin, K. Kroeger & R. Cattaneo-Vietti, 2006. Latitude versus local effects on echinoderm assemblages along the Victoria Land, Ross Sea, Antarctica. *Antarctic Science*, 18: 655-662.

Granata A., Cubeta A., Guglielmo L., Sidoti O., Greco S., Vacchi M. and M. La Mesa, 2002. Ichthyoplankton abundance and distribution in the Ross Sea during 1987-1996. *Polar Biol., 25(3): 187-202.*

Guidetti M., S. Marcato, M. Chiantore, T. Patarnello, G. Albertelli & R. Cattaneo-Vietti, 2006. *Adamussium colbecki* population structure in the Ross Sea. *Antarctic Science,* 18: 645-653.

Heilmayer O., C. Honnen, U. Jacob, M. Chiantore, R. Cattaneo-Vietti & T. Brey, 2005. Temperature effects on summer growth rates in the Antarctic scallop, *Adamussium colbecki*. *Polar Biology*, 28: 523–527.

Heilmayer O., T. Brey, M. Chiantore, R. Cattaneo-Vietti & W. Arntz, 2003. Age and productivity of the Antarctic scallop, *Adamussium colbecki*, in Terra Nova Bay (Ross Sea, Antarctica). *J. Exp. Mar. Biol. Ecol*., 288: 239-256.

Howard-Williams C., D. Peterson, W.B. Lyons, R. Cattaneo-Vietti & S. Gordon, 2006. Measuring Ecosystem Response in a Rapidly Changing Environment: The Latitudinal Gradient Project. *Antarctic Science*, 18: 465-471.

Koubbi P., Ozouf-Costaz C., Hureau J-C., Lecointre G., Pisano E., Vacchi M., Razouls S., White M., E. Le Guilloux, 2001. Le sous-Ordre des Notothenioidei (Ostéichthyens, Perciformes). Modèle unique de radiation adaptative en milieu marin isolé. *IFRTP (Institut Français pour la Recherche et la technologie Polaires)*: 64-70

La Mesa M. and M. Vacchi, 2001. Age and growth of high-Antarctic fish: a review. *Antarctic Science:* 13(3): 227-235

La Mesa M., Vacchi M., Iwami T. J.T. Eastman, 2002. Taxonomic studies of the icefish genus *Cryodraco* Dollo, 1900 (Notothenioidei: Channichthyidae). *Polar Biol., 25(4): 384-390.*

La Mesa M., Caputo V., Rampa R. and Vacchi M., 2003. Macroscopic and histological analyses of gonads during the spawning season of *Chionodraco hamatus* (Pisces, Channichthyidae) off Terra Nova Bay, Ross Sea, Southern Ocean. *Polar Biol*., 26: 621-628.

La Mesa M., M. Dalù, M. Vacchi, 2004. Trophic ecology of the emerald notothen *Trematomus bernacchii* (Pisces, Nototheniidae) from Terra Nova Bay, Ross Sea, Antarctica. *Polar Biol*. online 24 July 2004.

La Mesa M., Vacchi M., 2005. On the second record of the Antarctic plunderfish *Artedidraco glareobarbatus* (Artedidraconidae) from the Ross Sea. *Polar Biol.* 29(1): 40-43.

La Mesa M., Cattaneo-Vietti R., Vacchi M., 2006. Species composition and distribution of the Antarctic plunderfishes (Pisces, Artedidraconidae) from the Ross Sea off Victoria Land. *Deep-Sea Research II*, 53: 1061-1070.

Povero P., M. Castellano, N. Ruggieri, L. Monticelli, V. Saggiomo, M. Chiantore, M. Guidetti & R. Cattaneo-Vietti, 2006. Water column features and their relationship with sediments and benthic communities along Victoria Land Coast, Ross Sea, summer 2004. *Antarctic Science*, 18: 603-613.

Povero P., M. Chiantore, C. Misic, G. Budillon, R. Cattaneo-Vietti, 2001. Land forcing controls pelagic-benthic coupling in Adelie Cove (Terra Nova Bay, Ross Sea). *Polar Biology,* 24: 875-882.

Regoli F., M. Nigro, M. Chiantore, G.W. Winston, 2002. Seasonal variations of susceptibility to oxidative stress in *Adamussium colbecki*, a key bioindicator species for the Antarctic marine environment. *The Science of the Total Environment*, 289: 205-211

Regoli F., Nigro, M., Chiantore M., Winston G.W. (2002). Seasonal variations of susceptibility to oxidative stress in *Adamussium colbecki*, a key bioindicator species for the Antarctic marine environment. Sci. Total Envir. 289: 205-211

Schiaparelli S., Albertelli G., Cattaneo-Vietti R., 2003. The epibiotic assembly on the sponge *Haliclona dancoi* (Topsent, 1901) at Terra Nova Bay (Antarctica, Ross Sea). *Polar Biology*, 26: 342-347.

Schiaparelli S., A-N. Loerz, A. Rowden & R. Cattaneo-Vietti, 2006. Spatial variability of mollusc assemblages on the Victoria Land coast and Balleny Islands (Ross Sea, Antarctica. *Antarctic Science*, 18 (4): 615-631.

Schiaparelli S., Ghirardo C., Bohn J., Chiantore M., Albertelli G., Cattaneo-Vietti R., 2007. Antarctic associations: the parasitic relationship between the gastropod *Bathycrinicola tumidula* (Thiele, 1912) (Ptenoglossa: Eulimidae) and the comatulid *Notocrinus virilis* (Mortensen, 1917, Crinoidea: Notocrinidae) in the Ross Sea. *Polar Biology*, 30: 1545-1555.

Schiaparelli S., R. Cattaneo-Vietti & P. Mierzejewski, 2004. A "protective shell" around the larval cocoon of *Cephalodiscus densus* Andersson, 1907 (Graptolithoidea, Hemicordata). *Polar Biology*, 27: 813-817.

Smith W.O., Ainley D.J. & Cattaneo-Vietti R., 2007. Trophic interactions within the Ross Sea continental shelf ecosystem. *Philosophical Transactions of the Royal Society*, series B: 362: 95-111.

Thrush, S., Dayton, P., Cattaneo-Vietti, R., Chiantore, M., Cummings, V., Andrew, N., Hawes, I., Kim, S., Kvitek, R., Schwarz, A.M., 2006. Broad-scale factors influencing the biodiversity of coastal benthic communities of the Ross Sea. *Deep-Sea Research II,* 53: 959-971.

Vacchi M., La Mesa M. and C. Ozouf-Costaz, 2001. First occurrence of *Acanthodraco dewitti* Skora, 1995 (Notothenioidei, Bathydraconidae) in the Ross Sea. *Polar Biol.* 24(6): 471-472

Appendix 2

During 2003-2005 Italian Antarctic Campaign have been issued the permits for the sampling of following marine species into the Terra Nova Bay marine ASPA No 161:

Organism denomination	**Amount Kg**	**Sampling System**
Adamussium colbecki	150	Dedge Grab, Sediment cores
Odontaster validus	50	" " "
Laternula elliptica	20	" " "
Sterechinus neumayeri	150	" " "
Ophionotus victorie	10	" " "
Neobuccinum eatoni	20	" " "
Pycnogonidis-picnogonoidi	20	" " "
Gymnodraco acuticeps Phyllophora	20	" " "
Iridea cordata	10	" " "
Various species fishes	70	Hook and line fishing and nets

Sampling and studies activities into the ASPA area have been carried out in 40 different times for a total of 145 hours of work.

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