The Antarctic Treaty

Measures adopted at
the Thirty-fourth Consultative Meeting
held at Buenos Aires, 20 June – 1 July 2011

Presented to Parliament
by the Secretary of State for Foreign and Commonwealth Affairs
by Command of Her Majesty
January 2014

Cm 8809 £31.50

Any enquiries regarding this publication should be sent to us at Treaty Section, Foreign and Commonwealth Office, King Charles Street, London, SW1A 2AH.

ISBN: 9780101880923

Printed in the UK by The Stationery Office Limited

on behalf of the Controller of Her Majesty's Stationery Office

ID P002619602 01/14 36734 19585

Printed on paper containing 30% recycled fibre content minimum.

MEASURES ADOPTED AT THE THIRTY-FOURTH ANTARCTIC TREATY CONSULTATIVE MEETING

Buenos Aires, Argentina 20 June – 1 July 2011

The Measures[1] adopted at the Thirty-fourth 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 and colour copies of the maps found in this command paper, is available on the website of the Antarctic Treaty Secretariat at www.ats.aq/documents.

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 10 (2011).

The approval procedures set out in Article 8 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty apply to Measures 11 and 12 (2011).

---

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, Thirtieth, Thirty-first, Thirty-second and Thirty-third 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 XXXIV Consultative Meeting held at Buenos Aires, 20 June – 1 July 2011

Measure 1 (2011) Antarctic Specially Protected Area No. 116 (New College Valley, Caughley Beach, Cape Bird, Ross Island): Revised Management Plan. Pages 5 to 18.

Measure 2 (2011) Antarctic Specially Protected Area No. 120 (Pointe-Géologie Archipelago, Terre Adélie): Revised Management Plan. Pages 19 to 28.

Measure 3 (2011) Antarctic Specially Protected Area No. 122 (Arrival Heights, Hut Point Peninsula, Ross Island): Revised Management Plan. Pages 29 to 45.

Measure 4 (2011) Antarctic Specially Protected Area No. 126 (Byers Peninsula, Livingston Island, South Shetland Islands): Revised Management Plan. Pages 46 to 71.

Measure 5 (2011) ASPA Antarctic Specially Protected Area No. 127 (Haswell Island): Revised Management Plan. Pages 72 to 88.

Measure 6 (2011) Antarctic Specially Protected Area No. 131 (Canada Glacier, Lake Fryxell, Taylor Valley, Victoria Land): Revised Management Plan. Pages 89 to 101.

Measure 7 (2011) Antarctic Specially Protected Area No. 149 (Cape Shirreff and San Telmo Island, Livingston Island, South Shetland Islands): Revised Management Plan. Pages 102 to 130.

Measure 8 (2011) Antarctic Specially Protected Area No. 165 (Edmonson Point, Wood Bay, Ross Sea): Revised Management Plan. Pages 131 to 159.

Measure 9 (2011) Antarctic Specially Protected Area No. 167 (Hawker Island, Vestfold Hills, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica): Revised Management Plan. Pages 160 to 175.

Measure 10 (2011) Antarctic Specially Managed Area No. 2 (McMurdo Dry Valleys, Southern Victoria Land): Revised Management Plan. Pages 176 to 242.

Measure 11 (2011) Antarctic Historic Sites and Monuments: Monument to the Antarctic Treaty and Plaque. Page 243.

Measure 12 (2011) Antarctic Historic Sites and Monuments: No.1 Building at Great Wall Station. Page 244.

Measure 1

Antarctic Specially Protected Area No 116 (New College Valley, Caughley Beach, Cape Bird, 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 XIII-8 (1985), which designated Caughley Beach as Site of Special Scienti c Interest ("SSSI") No 10 and annexed a Management Plan for the site;
- Recommendation XIII-12 (1985), which designated New College Valley as Specially Protected Area ("SPA") No 20;
- Recommendation XVI-7 (1991), which extended the expiry date of SSSI 10 to 31 December 2001;
- Recommendation XVII-2 (1992), which annexed a Management Plan for SPA 20;
- Measure 1 (2000), which expanded SPA 20 to incorporate Caughley Beach, annexed a revised Management Plan for the Area, and provided that thereupon SSSI 10 shall cease to exist;
- Decision 1 (2002), which renamed and renumbered SPA 20 as ASPA 116;
- Measure 1 (2006), which adopted a revised Management Plan for ASPA 116;

Recalling that Recommendation XVI-7 (1991) and Measure 1 (2000) have not become effective, and that Recommendation XVII-2 (1992) was withdrawn by Measure 1 (2010);

Recalling that Recommendation XIII-12 (1985) and Recommendation XVI-7 (1991) are designated as no longer current by Decision 1 (2011);

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 116;

Desiring to replace the existing Management Plan for ASPA 116 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 116 (New College Valley, Caughley Beach, Cape Bird, Ross Island), which is annexed to this Measure, be approved; and

2. the prior Management Plans for ASPA 116, namely those annexed to Recommendation XIII-8 (1985), Measure 1 (2000) and Measure 1 (2006), shall cease to be effective.

Management Plan For Antarctic Specially Protected Area No. 116 NEW COLLEGE VALLEY, CAUGHLEY BEACH, CAPE BIRD, ROSS ISLAND

1. Description of values to be protected

In 1985, two areas at Cape Bird, Ross Island were designated as SSSI No. 10, Caughley Beach (Recommendation XIII-8 (1985)) and SPA No. 20, New College Valley (Recommendation XIII-12 (1985)), following proposals by New Zealand that these areas should be protected because they contained some of the richest stands of moss and associated microflora and fauna in the Ross Sea region of Antarctica. This is the only area on Ross Island where protection is specifically given to plant assemblages and associated ecosystems.

At that time, SPA No. 20 was enclosed within SSSI No. 10, in order to provide more stringent access conditions to that part of the Area. In 2000, SSSI No. 10 was incorporated with SPA No. 20 by Measure 1 (2000), with the former area covered by SPA No. 20 becoming a Restricted Zone within the revised SPA No. 20. The boundaries of the Area were revised from the boundaries in the original recommendations, in view of improved mapping and to follow more closely the ridges enclosing the catchment of New College Valley. Caughley Beach itself was adjacent to, but never a part of, the original Area, and for this reason the entire Area was renamed as New College Valley, which was within both of the original sites.

The Area was redesignated by Decision 1 (2002) as Antarctic Specially Protected Area (ASPA) No. 116 and a revised Management Plan was adopted through Measure 1 (2006).

The boundaries of the Area closely follow the ridges enclosing the catchment of New College Valley and cover approximately 0.33 km^2. Moss in this Area is restricted to localised areas of water-flushed ground, with cushions and carpets up to 20 m^2 in area. A diverse range of algal species also inhabit streams in the Area, and springtails, mites and nematodes are plentiful on water surfaces and underneath rocks. The absence of lichens makes the species assemblage in this Area unique on Ross Island.

The susceptibility of mosses to disturbance by trampling, sampling, pollution or introductions of non-native species is such that the Area requires long-term special protection. Designation of this Area is intended to ensure examples of this habitat type are adequately protected from visitors and overuse from scientific investigations. The ecosystem at this site remains of exceptional scientific value for ecological investigations and the Restricted Zone is valuable as a reference site for future comparative studies.

2. Aims and objectives

Management of New College Valley, Caughley Beach, Cape Bird aims to:

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

- preserve a part of the natural ecosystem of the Area as a reference area for the purpose of future comparative studies;
- allow scientific research on the ecosystem, in particular on mosses, algae and invertebrates in the Area, while ensuring protection from over-sampling;
- allow other scientific research in the Area provided it is for compelling reasons which cannot be served elsewhere;
- prevent or minimise the introduction to the Area of alien plants, animals and microbes;
- 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:

- Copies of this Management Plan, including maps of the Area, shall be made available at all adjacent operational research/field stations.
- Rock cairns or signs illustrating the location and boundaries of the Area, with clear statements of entry restrictions, shall be placed at appropriate locations on the boundary of the Area and the Restricted Zone 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, and removed when no longer required.
- Visits shall be made as necessary (preferably at least 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 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: New College Valley, Caughley Beach, Cape Bird, Ross Island, Regional Topographic Map. Map specifications: Projection - Lambert conformal conic. Standard parallels - 1st 76° 40' 00" S; 2nd 79° 20' 00"S. Central Meridian - 166° 30' 00" E. Latitude of Origin - 78° 01' 16. 211" S. Spheroid - WGS84.

Map B: New College Valley, Caughley Beach, Cape Bird, Ross Island, Vegetation Coverage Map. Map specification: Projection - Lambert conformal conic. Standard parallels – 1st - 76.6° S; 2nd -79.3° S. Spheroid - WGS84. Map includes vegetation coverage and streams.

6. Description of the Area

6(i) Geographical coordinates, boundary markers and natural features
Cape Bird is at the northwest extremity of Mount Bird (1,800 m), an inactive volcanic cone which is probably the oldest on Ross Island. New College Valley is located south of Cape Bird on ice-free slopes above Caughley Beach, and lies between two Adélie penguin colonies known as the Cape Bird Northern and Middle Rookeries (Map A). The Area, comprising veneered glacial moraines at the fore of the Cape Bird Ice Cap, consists of seaward dipping olivine-augite basalts with scoriaceous tops erupted from the main Mount Bird cone.

The northwest corner of the north boundary of the Area is approximately 100 m south of the Cape Bird hut (New Zealand) and is marked by an ASPA sign post (77° 13.128'S, 166° 26.147'E) (Map B). The north boundary of the Area extends upslope and eastward toward a prominent terminal moraine ridge, approximately 20 m from the Cape Bird Ice Cap and is marked with a rock cairn (77° 13.158'S, 166° 26.702'E).

The eastern boundary follows the terminal moraine ridge from the rock cairn (77° 13.158'S, 166° 26.702'E) southeast until the ridge disappears where it joins the Cape Bird Ice Cap. The boundary continues southeast following the glacier edge to the southern boundary.

The southern boundary is a straight line crossing the broad southern flank of New College Valley, and is marked with rock cairns at the south-western corner of the Area (77° 13.471'S, 166° 25.832'E) and the south-eastern corner of the area on the hilltop 100 m from the Cape Bird Ice Cap glacier edge (77° 13.571'S, 166° 27.122'E).

The western boundary of the Area follows the top of the coastal cliffs of Caughley Beach from the south-western corner rock cairn (77° 13.471'S, 166° 25.832'E) for a distance of 650 m to the northwest corner of the Area (77° 13.128'S, 166° 26.147'E) where the ASPA signpost is located.

Based on the Environmental Domain Analysis for Antarctica (Resolution 3 (2008)), New College Valley, Caughley Beach is located within Environment S *McMurdo South Victoria Land geologic*.

Northwest-facing New College Valley drains meltwater from the Cape Bird Ice Cap during the summer. Streams in the Area are fed by melt from persistent summer snow drifts and have eroded their own shallow gullies and channels. The ground is largely covered by stones and boulders of volcanic origin which have been reworked by glacial action.

The Area contains the most extensive ephemeral stream course distributions of the moss *Hennediella heimii* on Ross Island. Surveys have shown that this moss, together with much lower occurrences of two other species – *Bryum subrotundifolium* and *Bryum pseudotriquetrum* – are confined almost entirely to the stream courses across the steep till and scoria covered slopes (Map B). The mosses are generally associated with algal growths, namely rich, red-brown oscillatorian felts and occasional reddish-black growths of *Nostoc commune*. The Area includes the full course of three stream systems that contain significant growths of algae, together with the mosses.

The Area supports a terrestrial invertebrate community including populations of springtails *Gomphiocephalus hodgsonii* (Collembola: Hypogastruridae), mites *Nanorchestes antarcticus*

and *Stereotydeus mollis* (Acari: Prostigmata) and nematodes (*Panagrolaimus davidi*, *Plectus antarcticus, Plectus frigophilus, Scottnema lindsayae and Eudorylaimus antarcticus)* with the presence of rotifers, tardigrades, and ciliate and flagellate protozoa noted. The distribution of terrestrial invertebrates at this site is related to the abiotic environment with most arthropod species being associated with macroscopic vegetation or soil algal biomass level, although this relationship does not describe the distribution of all taxa.

Skuas (*Catharacta maccormicki*) frequently rest on Caughley Beach and overfly, land and nest within the Area. Adélie penguins (*Pygoscelis adeliae*) from the nearby rookeries do not nest in the Area, but have been observed occasionally to traverse across New College Valley.

6(ii) Special zones within the Area
An area of New College Valley 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 Restricted Zone encompasses ice-free slopes within New College Valley above Caughley Beach some of which are north-facing with snow drifts which provide a ready supply of melt water to foster moss and algal growth.

The northwest corner (77° 13.164'S, 166° 26.073'E) of the Restricted Zone is 60 m to the south and across a small gully from the northwest corner of the Area. The north boundary of the Restricted Zone extends 500 m upslope from the northwest corner to a cairn (77° 13.261'S, 166° 26.619'E), then following a faint but increasingly prominent ridge southeast to a point in the upper catchment of New College Valley marked by a cairn approximately 60 m from the ice terminus of the Cape Bird Ice Cap (77° 13.368'S, 166° 26.976'E). The Restricted Zone boundary extends 110 m southwest across the valley to a cairn marking the southeast corner of the Restricted Zone (77° 13.435'S, 166° 26.865'E). The south boundary of the Restricted Zone extends in a straight line from this cairn (77° 13.435'S, 166° 26.865'E) 440 m northwest down a broad and relatively featureless slope to the southwest corner of the Area (77° 13.328'S, 166° 26.006'E). A cairn is placed on the southwest boundary of the Restricted Zone to mark the lower position of the south boundary (77° 13.226'S, 166° 25.983'E).

Access to the Restricted Zone is allowed only for compelling scientific and management purposes that cannot be served by visits elsewhere in the Area.

6(iii) Location of structures within and adjacent to the Area
Structures known to exist within the Area include a United States Navy Astrofix marker, cairns marking the boundaries of the Area and the Restricted Zone, a signpost situated at the northwest corner of the Area and an approximately one meter square wooden frame marking the site of an experimental oil spill from 1982.

A field hut (New Zealand), stores hut and toilet are located north of the northwest corner of the Area (Map B).

6(iv) Location of other protected areas in the vicinity
The nearest protected areas are:

- Lewis Bay, Mount Erebus, Ross Island (ASPA No. 156), approximately 25 km SE;
- Tramway Ridge, Mount Erebus, Ross Island (ASPA No. 130) 30 km SSE;
- Cape Crozier, Ross Island (ASPA No. 124) 75 km SE;

- Cape Royds, Ross Island (ASPA No. 121 and No. 157) and Cape Evans, Ross Island (ASPA No. 155) 35 km and 45 km south on Ross Island respectively; and
- Beaufort Island, McMurdo Sound, Ross Sea (ASPA No. 105) 40 km to the north.

7. Terms and conditions for entry Permits

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:

- outside of the Restricted Zone, it is issued only for scientific study of the ecosystem, or for compelling scientific reasons that cannot be served elsewhere, or for essential management purposes consistent with the Management 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;
- the actions permitted are not likely to jeopardise the ecological or scientific values of the Area or other permitted activities;
- 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;
- the Permit shall be issued for a stated period.

7(i) Access to and movement within or over the Area
Helicopters are prohibited from landing within the Area. Two helicopter landing sites are located outside the Area. Between October to February, the preferred landing site is below the cliffs on Caughley Beach, 100 m west of the west boundary of the Area (Maps A and B). Between March and September, an alternative helicopter landing site is located adjacent to the Cape Bird field hut (New Zealand), above Caughley Beach (Map B).

Between October and February the preferred flight path is an approach from the south upslope from Middle Rookery (Map A). Under certain wind conditions, flights north of the helicopter pad may be necessary, and in this case should follow the recommended aircraft approach and departure routes, and be in accordance with the 'Guidelines for the Operation of Aircraft Near Concentrations of Bird in Antarctica' (Resolution 2, 2004) to the maximum extent possible. See Map A for the recommended aircraft approach routes into and out of Cape Bird.

Overflight of the Area lower than 50 m (~150 ft) above ground level is prohibited. Hovering over the Area is not permitted lower than 100 m (~300 ft) above ground level. Use of helicopter smoke grenades within the Area is prohibited.

Vehicles are prohibited within the Area and all movement within the Area should be on foot. Access into the Area should preferably follow the track from the Cape Bird Hut (New Zealand). Visitors should avoid areas of visible vegetation and care should be exercised walking in areas of moist ground, particularly the stream course beds, where foot traffic can easily damage sensitive soils, plant and algal communities, and degrade water quality. Visitors should avoid walking on such areas by walking 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 regions south of the Area from the Cape Bird Hut should be made by a route below the cliffs along Caughley Beach.

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

- Compelling scientific research which cannot be undertaken elsewhere and which will not jeopardise the ecosystem or values of the Area or interfere with existing scientific studies;
- Essential management activities, including monitoring and inspection.

7(iii) Installation, modification or removal of structures

No structures are to be erected within the Area, or scientific equipment installed, except for compelling scientific or management reasons, as specified in a Permit. All markers, structures or scientific equipment installed in the Area must be authorised by Permit and clearly identified by country, name of the principal investigator or agency, year of installation and date of expected removal. All such items should be free of organisms, propagules (e.g. seeds, eggs) and non-sterile soil, and be made of materials that pose minimal risk of contamination of the Area. Removal of specific structures or 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. A field hut (New Zealand), stores hut and toilet are located north of the northwest corner of the Area (Map B).

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 and precautions listed in 7(ix) shall be taken against accidental introductions. No poultry products shall be brought 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 or other chemicals shall not be stored in the Area, unless required for essential purposes connected with the activity for which the Permit has been granted, and must be 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 minimised.

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

Taking of, or harmful interference with native flora or fauna is prohibited, except in accordance with a separate Permit issued in accordance with Annex II of the Protocol on Environmental Protection to the Antarctic Treaty. 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) 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.

Similarly, sampling is to be carried out using techniques which minimise disturbance to the Area, as well as duplication. 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 and which is not an historical artefact or abandoned relic, may be removed from any part of the Area, including the Restricted Zone, unless the environmental impact of removal is likely to be greater than leaving the material *in situ*. Where the environmental impact of removal is likely to be greater than leaving the material *in situ*, 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 continue to meet the aims and objectives of the Management Plan
Permits may be granted to enter the Area to:

- carry out biological monitoring and Area inspection activities, which may involve the collection of a small number of samples or data for analysis or review;
- erect or maintain signposts, structures or scientific equipment; or
- carry out management activities.

Any specific sites of long-term monitoring shall be appropriately marked on site and on maps of the Area. A GPS position should be obtained for sites of long-term monitoring and scientific sampling for lodgement with the Antarctic Master Directory system through the appropriate national authority. If appropriate, metadata should also be provided for the Antarctic Master Directory system through the appropriate national authority.

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 minimise 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.

7(x) Requirements for reports

The principal permit holder for each visit to the Area shall submit a report to the appropriate national authority as soon as practicable, and no later than six months after the visit has been completed. Such reports should include, as appropriate, the information identified in the visit report form contained in the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas.

If appropriate, the national authority should also forward a copy of the visit report to the Party that proposed the Management Plan, to assist in managing the Area and reviewing the Management Plan. Parties should maintain a record of activities and report them in the Annual Exchange of Information. Parties should, wherever possible, deposit originals or copies of such original visit reports in a publicly accessible archive to maintain a record of usage, for the purposes of any review of the management plan and in organising the scientific use of the Area.

8. Bibliography

Ainley, D.G., Ballard, G., Barton, K.J., Karl, B.J., Rau, G.H., Ribic, C.A. and Wilson, P.R. 2003. Spatial and temporal variation of diet within a presumed metapopulation of Adelie penguins. Condor 105: 95-106.

Ainley, D.G., Ribic, C.A., Ballard, G., Heath, S., Gaffney, I., Karl, B.J., Barton, K.J., Wilson, P.R. and Webb, S. 2004. Geographic structure of Adelie penguin populations: overlap in colony-specific foraging areas. Ecological monographs 74(1): 159- 178.

Block, W. 1985. Ecological and physiological studies of terrestrial arthropods in the Ross Dependency 1984-85. British Antarctic Survey Bulletin 68: 115-122.

Broady, P.A. 1981. Non-marine algae of Cape Bird, Ross Island and Taylor Valley, Victoria Land, Antarctica. Report of the Melbourne University Programme in Antarctic Studies No. 37.

Broady, P.A. 1983. Botanical studies at Ross Island, Antarctica, in 1982-83; preliminary report. Report of the Melbourne University Programme in Antarctic Studies.

Broady, P.A. 1985. The vegetation of Cape Bird, Ross Island, Antarctica. Melbourne University Programme in Antarctic Studies, No. 62.

Broady, P.A. 1985. A preliminary report of phycological studies in northern Victoria Land and on Ross Island during 1984-85. Report of the Melbourne University Programme in Antarctic Studies, Report No. 66.

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.

Butler, E.R.T. 2001. Beaches in McMurdo Sound, Antarctica. Unpublished PhD, Victoria University of Wellington, New Zealand. (pg 219)

Cole, J.W. and Ewart, A. 1968. Contributions to the volcanic geology of the Black Island, Brown Peninsula, and Cape Bird areas, McMurdo Sound, Antarctica. New Zealand Journal of Geology and Geophysics 11(4): 793-823.

Dochat, T.M., Marchant, D.R. and Denton, G.H. 2000. Glacial geology of Cape Bird, Ross Island, Antarctica. Geografiska Annaler 82A (2-3): 237-247.

Duncan, K.W. 1979. A note on the distribution and abundance of the endemic collembolan *Gomphiocephalus hodgsonii* Carpenter 1908 at Cape Bird, Antarctica. Mauri Ora 7: 19-24.

Hall, B.L., Denton, G.H. and Hendy, C.H. 2000. Evidence from Taylor Valley for a Grounded Ice Sheet in the Ross Sea, Antarctica. Geografiska annaler 82A(2-3): 275-304.

Konlechner, J.C. 1985. An investigation of the fate and effects of a paraffin-based crude oil in an Antarctic terrestrial ecosystem. New Zealand Antarctic Record 6(3): 40-46.

Lambert, D.M., Ritchie, P.A., Millar, C.D., Holland, B., Drummond, A.J. and Baroni, C. 2002. Rates of evolution in ancient DNA from Adélie penguins. Science 295: 2270-2273.

McGaughran, A., Hogg, I.D. and Stevens, M.I. 2008. Patterns of population genetic structure for springtails and mites in southern Victoria Land, Antarctica. Molecular phylogenetics and evolution 46: 606-618.

McGaughran, A., Redding, G.P., Stevens, M.I. and Convey, P. 2009. Temporal metabolic rate variation in a continental Antarctica springtail. Journal of Insect Physiology 55: 130-135.

Nakagawa, S., Möstl, E. and Waas, J.R. 2003. Validation of an enzyme immunoassay to measure faecal glucocorticoid metabolites from Adelie penguins (*Pygoscelis adeliae*): a non-invasive tool for estimating stress? Polar biology 26: 491-493.

Peterson, A.J. 1971. Population studies on the Antarctic Collembolan *Gomphiocephalus hodgsonii* Carpenter. Pacific Insects Monograph 25: 75-98.

Ritchie, P.A., Millar, C.D., Gibb, G.C., Baroni, C., Lambert, D.M. 2004. Ancient DNA enables timing of the Pleistocene origin and Holocene expansion of two Adelie penguin lineages in Antarctica. Molecular biology and evolution 21(2): 240-248.

Roeder, A.D., Marshall, R.K., Mitchelson, A.J., Visagathilagar, T., Ritchie, P.A., Love, D.R., Pakai, T.J., McPartlan, H.C., Murray, N.D., Robinson, N.A., Kerry, K.R. and Lambert, D.M. 2001. Gene flow on the ice: genetic differentiation among Adélie penguin colonies around Antarctica. Molecular Ecology 10: 1645-1656.

Seppelt, R.D. and Green, T.G.A. 1998. A bryophyte flora for Southern Victoria Land, Antarctica. New Zealand Journal of Botany 36: 617-635.

Sinclair, B.J. 2000. The ecology and physiology of New Zealand Alpine and Antarctic arthropods. Unpublished PhD, University of Otago, New Zealand. (pg 231)

Sinclair, B. J. 2001. On the distribution of terrestrial invertebrates at Cape Bird, Ross Island, Antarctica. Polar Biology 24(6): 394-400.

Sinclair, B. J. and Sjursen, H. 2001. Cold tolerance of the Antarctic springtail *Gomphiocephalus hodgsonii* (Collembola, Hypogastruridae). Antarctic Science 13(3): 271-279.

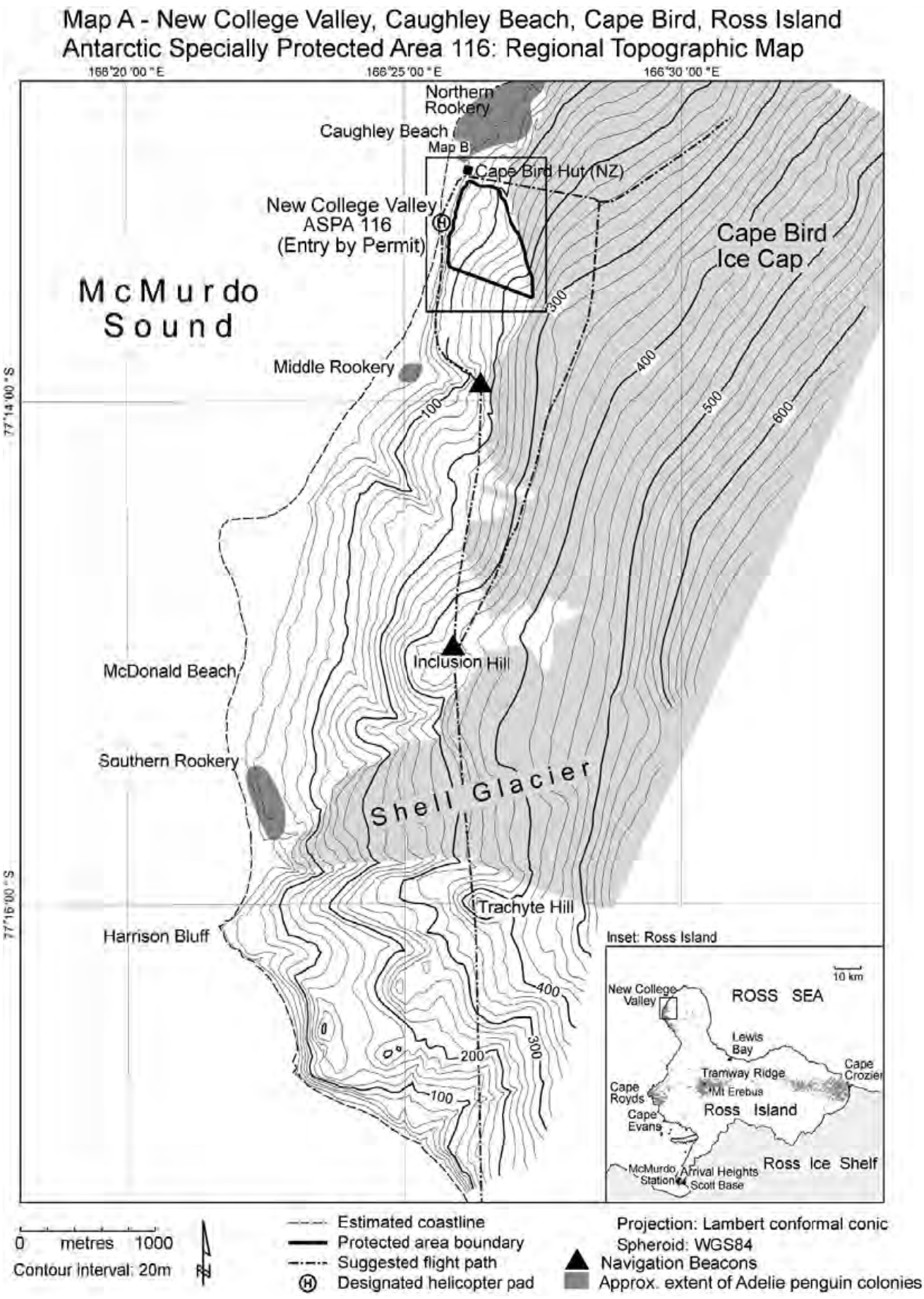
Sinclair, B.J. and Sjursen, H. 2001. Terrestrial invertebrate abundance across a habitat transect in Keble Valley, Ross Island, Antarctica. Pedobiologia 45: 134-145.

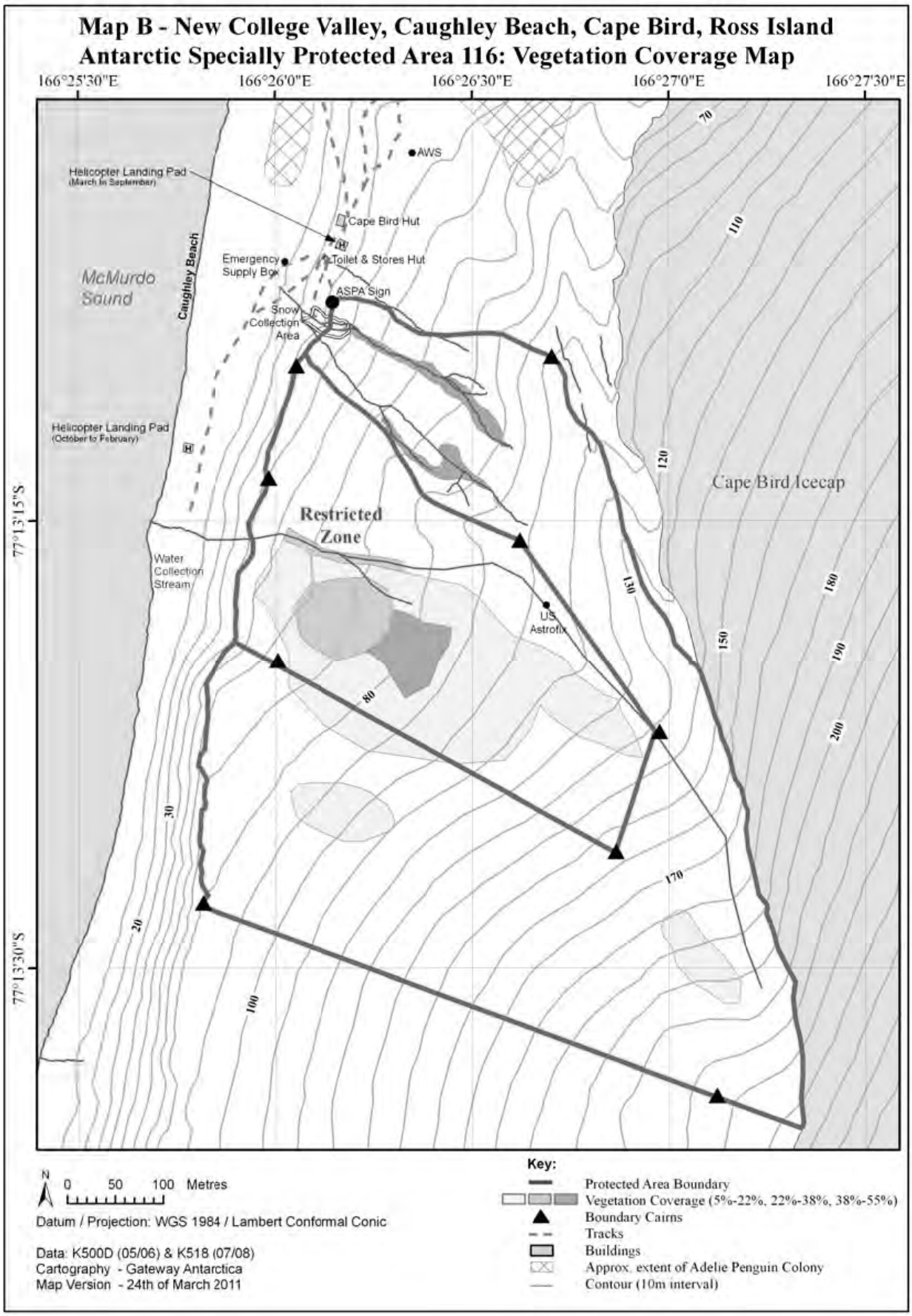
Smith, D.J. 1970. The ecology of *Gomphiocephalus hodgsonii* Carpenter (Collembola, Hypogastuidae) at Cape Bird, Antarctica. Unpublished MSc Thesis, University of Canterbury, Christchurch, New Zealand.

Stevens, M.I. and Hogg, I.D. 2003. Long-term isolation and recent expansion from glacial refugia revealed for the endemic springtail *Gomphiocephalus hodgsonii* from Victoria Land, Antarctica. Molecular ecology 12: 2357-2369.

Wilson, P.R., Ainley, D.G., Nur, N., Jacobs, S.S., Barton, K.J., Ballard, G. and Comisco, J.C. 2001. Adélie penguin population change in the Pacific sector of Antarctica: relation to sea-ice extent and the Antarctic Circumpolar Current. Marine ecology progress series 213: 301-309.

Wharton, D.A. and Brown, I.M. 1989. A survey of terrestrial nematodes from the McMurdo Sound region, Antarctica. New Zealand Journal of Zoology 16: 467-470.


Map A - New College Valley, Caughley Beach, Cape Bird, Ross Island
Antarctic Specially Protected Area 116: Regional Topographic Map
166°20 '00 " E
166°25 '00 " E
166°30 '00 " E
77°14 '00 " S
77°16 '00 " S
Northern Rookery
Caughley Beach
Map B
Cape Bird Hut (NZ)
New College Valley
ASPA 116
(Entry by Permit)
Cape Bird Ice Cap
McMurdo Sound
Middle Rookery
100
300
400
500
600
Inclusion Hill
McDonald Beach
Southern Rookery
Shell Glacier
Trachyte Hill
Harrison Bluff
0
100
200
300
400
Inset: Ross Island
10 km
New College Valley
ROSS SEA
Lewis Bay
Tramway Ridge
Cape Crozier
Mt Erebus
Cape Royds
Ross Island
Cape Evans
Ross Ice Shelf
McMurdo Station
Arrival Heights
Scott Base
0 metres 1000
Contour interval: 20m
Estimated coastline
Protected area boundary
Suggested flight path
Designated helicopter pad
Projection: Lambert conformal conic
Spheroid: WGS84
Navigation Beacons
Approx. extent of Adelie penguin colonies


Map B - New College Valley, Caughley Beach, Cape Bird, Ross Island
Antarctic Specially Protected Area 116: Vegetation Coverage Map
166°25'30"E
166°26'0"E
166°26'30"E
166°27'0"E
166°27'30"E
77°13'15"S
77°13'30"S
AWS
Helicopter Landing Pad
(March to September)
Cape Bird Hut
Emergency
Supply Box
Toilet & Stores Hut
ASPA Sign
Snow
Collection
Area
Caughley Beach
McMurdo
Sound
Helicopter Landing Pad
(October to February)
Restricted
Zone
Water
Collection
Stream
US
Astrofix
Cape Bird Icecap
70
110
120
130
150
180
190
200
170
80
30
20
100
N
0
50
100
Metres
Datum / Projection: WGS 1984 / Lambert Conformal Conic
Data: K500D (05/06) & K518 (07/08)
Cartography - Gateway Antarctica
Map Version - 24th of March 2011
Key:
Protected Area Boundary
Vegetation Coverage (5%-22%, 22%-38%, 38%-55%)
Boundary Cairns
Tracks
Buildings
Approx. extent of Adelie Penguin Colony
Contour (10m interval)

Antarctic Specially Protected Area No 120 (Pointe-Géologie Archipelago, Terre Adélie): 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 (1995), which designated Pointe-Géologie Archipelago as Specially Protected Area ("SPA") No 24 and annexed a Management Plan for the Area;
- Decision 1 (2002), which renamed and renumbered SPA 24 as ASPA 120;
- Measure 2 (2005), which adopted a revised Management Plan for ASPA 120;

Recalling that Measure 3 (1995) has not become effective;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 120;

Desiring to replace the existing Management Plan for ASPA 120 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 120 (Pointe-Géologie Archipelago, Terre Adélie), which is annexed to this Measure, be approved;
2. the Management Plan for ASPA 120 annexed to Measure 2 (2005) shall cease to be effective; and
3. Measure 3 (1995), which has not become effective, be withdrawn.

Management Plan for Antarctic Specially Protected Area No. 120

POINTE-GÉOLOGIE ARCHIPELAGO, TERRE ADÉLIE

Jean Rostand, Le Mauguen (former Alexis Carrel), Lamarck and Claude Bernard Islands, The Good Doctor's Nunatak and breeding site of Emperor Penguins

1. Description of values to be protected

In 1995, four islands, a nunatak and a breeding ground for emperor penguins were classified as an Antarctic Specially Protected Area (Measure 3 (1995), ATCM XIX, Seoul) because they were a representative example of terrestrial Antarctic ecosystems from a biological, geological and aesthetics perspective. A species of marine mammal, the Weddell seal *(Leptonychotes weddelli*) and various species of birds breed in the area: emperor penguin (*Aptenodytes forsteri*); Antarctic skua (*Catharacta maccormicki*); Adélie penguins (*Pygoscelis adeliae*); Wilson's petrel (*Oceanites oceanicus*); giant petrel (*Macronectes giganteus*); snow petrel (*Pagodrama nivea*), cape petrel (*Daption capense*).

Well-marked hills display asymmetrical transverse profiles with gently dipping northern slopes compared to the steeper southern ones. The terrain is affected by numerous cracks and fractures leading to very rough surfaces. The basement rocks consist mainly of sillimanite, cordierite and garnet-rich gneisses which are intruded by abundant dikes of pink anatexites. The lowest parts of the islands are covered by morainic boulders with a heterogeneous granulometry (from a few cm to more than a m across).

Long-term research and monitoring programs of birds and marine mammals have been going on for a long time already (since 1952 or 1964 according to the species), currently supported by the French Polar Institute Paul Émile Victor (IPEV) and the French National Centre for Scientific Research (CNRS). This has enabled the implementation of a population database which is particularly useful in view of the long timescale of the observations. It is maintained and used by the Centre d'Etudes Biologiques de Chize (CEBC-CNRS). Within this context, human scientific presence in the protected area is currently estimated at four people for a few hours, three times a month between the 1st November and the 15th February, and, inside the emperor penguin colony itself, at two people for a few hours between the 1st April and the 1st November.

Among the approximately thirty emperor penguin breeding sites on record, this is the only one located adjacent to a permanent station. It is therefore a providential spot to study this species and its environment.

2. Aims and objectives

Management of the Cape Géologie Archipelago Specially Protected Area aims at:

- preventing disturbance in the area due to the proximity of the Dumont d'Urville Station;
- avoiding any major changes to the structure and composition of flora and fauna and the association of different species of vertebrates harbored in the area, which is one of the most representative for both faunistic and scientific interest on Adélie Coast;
- permitting scientific research in the field of marine and terrestrial biology, i.e., ethology, ecology, physiology and biochemistry, demographic monitoring of marine birds and mammals, and environmental impact assessment of surrounding human activities;

- permitting scientific or technological research programmes in areas other than those previously mentioned (e.g. geology) or management programmes, with particular attention to the scheduling of visits in order to minimise the impacts on the flora and fauna.
- controlling the logistic operations related to the activities of the nearby Dumont d'Urville station, which may require temporary access to the ASPA.

3. Management activities

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

The present management plan is kept under periodical review to ensure that the values of the ASPA are monitored. Any activity carried out in the area undergoes an environmental impact assessment before being undertaken.

All members of staff staying at or in transit at the Dumont d'Urville base will be duly informed of the existence of the ASPA, of its geographical boundaries, of the entry restrictions in place and of the current management plan. To ensure this, a sign displaying a map of the area and listing the restrictions and relevant management measures shall be displayed prominently at the Dumont d'Urville station.

Copies of this management plan shall also be available in each of the four Treaty languages at the Dumont d'Urville station.

Information related to each incursion into the ASPA, namely a minima: activity undertaken or reason for presence, number of people involved, duration of stay, is recorded by the head of the Dumont d'Urville station.

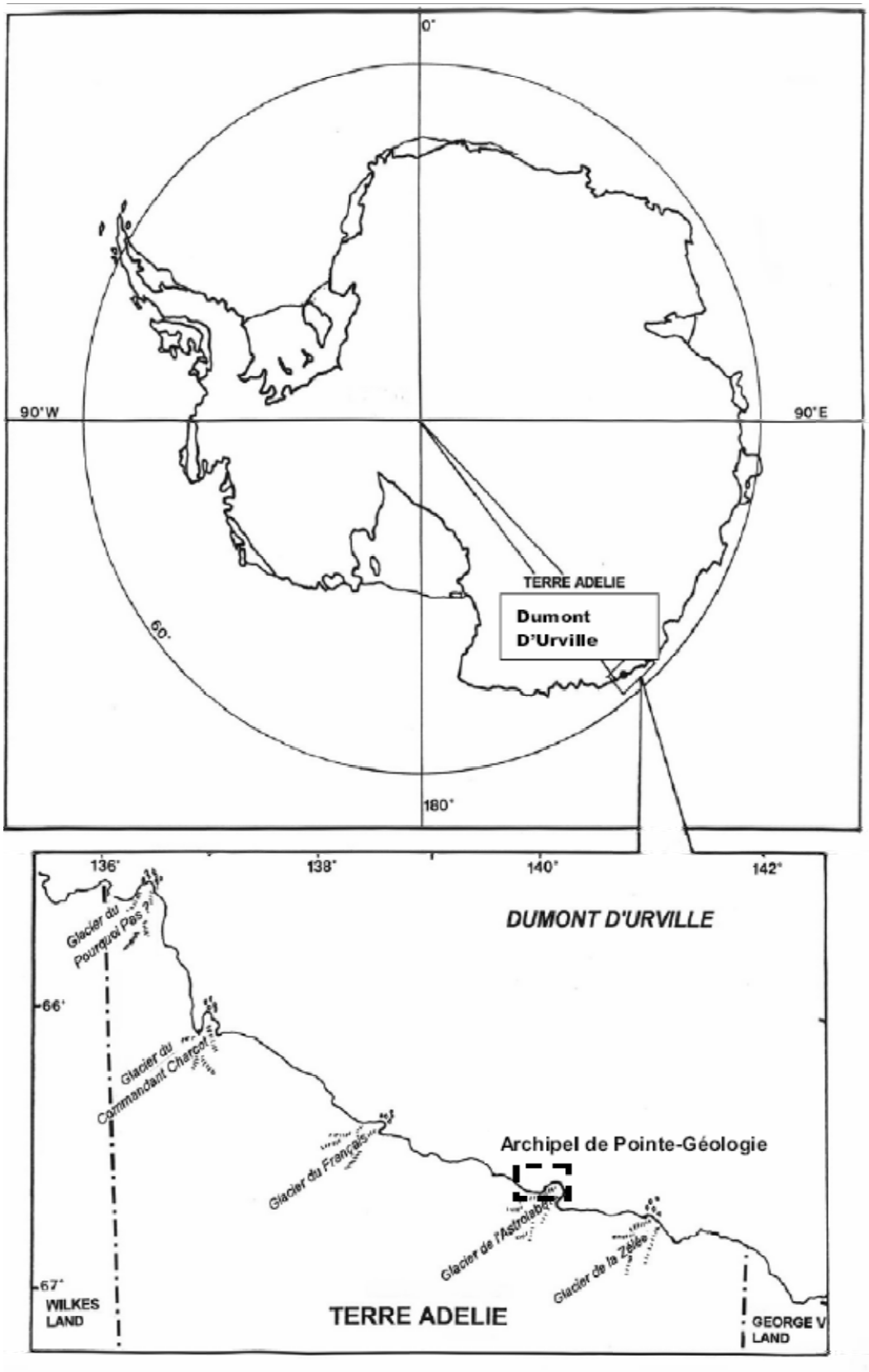
4. Period of Designation

The Area is designated as an Antarctic Specially Protected Area (ASPA) for an indefinite period.

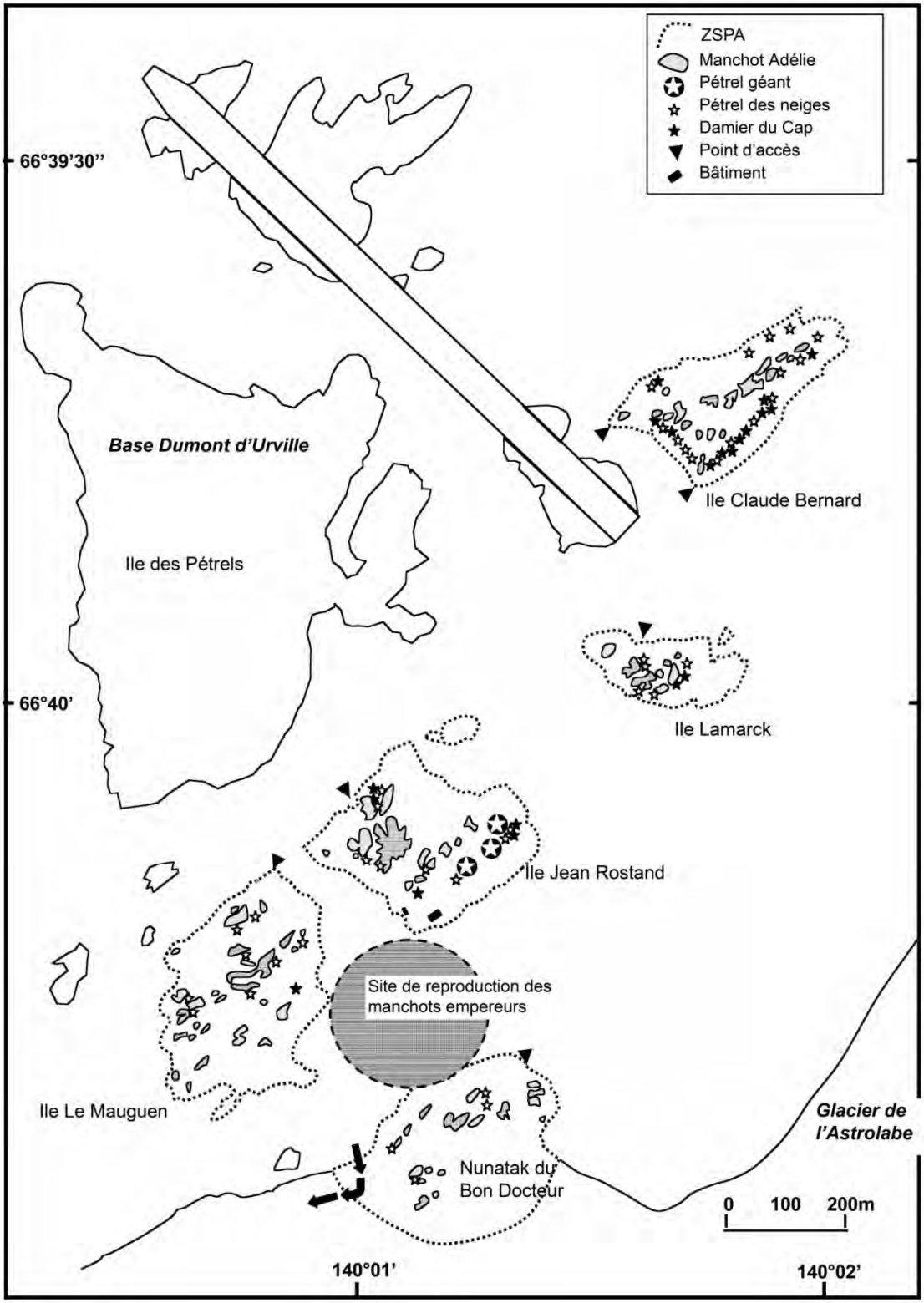
5. Maps

Map 1 shows the geographical location of Terre Adélie in the Antarctic and the location of the Cape Geology Archipelago on the Terre Adélie coast.

On Map 2 of the Cape Geology Archipelago, the dotted line indicates the boundary of the ASPA within the archipelago.



Map 1 - Location of the Cape Geology Archipelago, Terre Adélie (Antarctica).



Map 2 - Location of bird colonies (except skua territories and Wilson's petrels nests) within the Cape Geology Archipelago ASPA. The dotted lines show the ASPA boundary. Possible access of land vehicles to the continent via the Good Doctor's Nunatak is shown by means of arrows.

6. Description of the Area and Identification of Sectors

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

The ASPA 120 is located along the Terre Adélie coast, in the heart of the Cape Geology Archipelago, coastal area of Adélie Coast (140° - 140°02'E ; 66°39'30'' à 66°40'30'' S). It comprises the following territories:

- Jean Rostand Island,
- Le Mauguen (formerly Alexis Carrel) Island,
- Lamarck Island,
- Claude Bernard Island,
- the 'Bon Docteur' Nunatak,
- and the Emperor penguins breeding grounds, on the pack ice which surrounds the islands in winter.

As a whole, the surface of the rock outcrops does not exceed 2 km^2. The highest points are distributed along North-East-South-West ridges (C. Bernard Island: 47.6 m; J.Rostand Island 36.39 m; Le Mauguen (formerly Alexis Carrel) Island: 28.24 m Nunatak: 28.50 m).

During the summer, the pack ice between the islands disappears, and only the Southern flanks of the islands are still covered by firns. The area is then clearly limited by natural markers (island outlines and rocky outcrops).

No tracks or roads exist in the area.

6(ii) Identification of restricted or prohibited zones

Access to any part of the area is prohibited unless authorized by a permit.

Entry restrictions to different sites within the ASPA are determined according to the distribution of bird species (Table 1), the timing of their presence on breeding grounds (Table 2) and their specific sensitivity (Table 3). Location of breeding colonies is shown on the map. Birds are mainly present during the austral summer, except for the emperor penguins, which breed in winter.

Among the bird species present on the Cape Geology Archipelago, the emperor penguin and the southern giant petrel only breed inside the ASPA. Since the ASPA was established in 1995, the populations of those two species are now stable or slightly increasing (Table 3). However, long-term forecasts suggest that the high protection status should be maintained through the current management plan.

The case of Rostand Island

The establishment of the Dumont d'Urville station has resulted in a drastic decrease of the populations of emperor penguins and southern giant petrels in the Cape Geology Archipelago. The breeding colony on Petrel Island disappeared completely during the first years when the base was being set up in close proximity to this colony (building extensions, intensification of helicopter flights, installation and replacement of fuel storage tanks). Currently, 100% of the population breeds inside the ASPA, in the South-Eastern part of Rostand Island. The birds are present in an area defined by the NE-SW ridge going through the 33.10 metre and the 36.39 metre marks North West of the colony, marked on the floor with stakes. Access to this breeding area is strictly prohibited, except to ornithologists holding a Permit allowing access once a year when southern giant petrel chicks are being banded. Access to the rest of Rostand Island is authorised throughout the year to Permit Holders.

The case of the emperor penguin colony

The significant decrease of emperor penguins by the end of the 1970s seems to have been due to long weather anomalies between 1976 and 1982 causing a significant decrease in the surface area of the pack

ice. For the last fifteen years, the emperor penguin breeding population has been slightly increasing in parallel with an increase in pack ice surface area in the Terre Adélie sector. No one, except Permit Holders, is allowed to approach or to disturb the emperor penguin colony in any manner during the period when they are present at the breeding grounds, from March to mid-December when the chicks fledge. It is recommended that the minimum distance between authorised observers and the colony should be 20 m.

The emperor penguin colony is not always at the same site and moves about on the pack ice during winter. The protection zone for these animals is therefore defined by the sites where birds are present (colony or groups of individuals), with an additional 40 m buffer zone.

6(iii) Location of structures in the Area

Prévost hut and a shelter are located on Rostand Island. There are no other buildings anywhere else in the Area. There is no other protected area within 50 km of the Pointe-Géologie ASPA No. 120.

Table 1. Number of seabird breeding pairs within ASPA No. 120 (count done during the 2010/2011 breeding cycle). The population breeding within the ASPA compared to that of the Cape Geology
(PG) population as a whole is also mentioned (Source: unpublished data CEBC-CNRS on the breeding cycle 2010/2011 except for Wilson's storm petrels, data Micol & Jouventin 2001[1])

Site	Emperor penguin	Adélie penguin	South Polar skua	Snow petrel	Cape petrel	Wilson's storm petrel	Southern giant petrel
C. Bernard	--	3360	7	214	238	178	--
Lamarck	--	1160	1	38	36	45	--
J. Rostand	--	3994	7	61	46	35	15-18
Le Mauguen (formerly Alexis Carrel)	--	3478	15	21	2	72	
Nunatak	---	1831	1	5	--	41	--
Winter pack ice between islands	2838	--	--	--	--	--	--
ASPA TOTAL	2838	13823	31	369	322	371	15-18
PG TOTAL	2838	32746	67	1066	516	1200	15-18
% ASPA/PG	100	42	46	32	62	31	100

[1] Micol T. et Jouventin P 2001, Long-term population trends in seven Antarctic seabirds at Pointe Géologie (Terre Adélie) *Polar Biology* **24** :175-185.

Table 2. Presence of birds on breeding grounds

	Emperor penguin	Adelie penguin	South Polar skua	Snow petrel	Cape petrel	Wilson's storm petrel	Southern giant petrel
First arrival	March	October	October	September	October	November	July
First egg laying	May	November	November	November	November	December	October
Last departure	Mid-December	March	March	March	March	March	April

Table 3. Sensitivity to disturbance caused by human beings and changes in populations of the Cape Geology Archipelago (Sources : unpublished data CEBC-CNRS, Thomas 1986[2], and Micol & Jouventin 2001 for data on Wilson's storm petrel)

	Emperor penguin	Adelie penguin	South Polar skua	Snow petrel	Cape petrel	Wilson's storm petrel *	Southern giant petrel
Sensitivity [2]	High	Medium	Medium	Medium	High	High	High
Trend 1952-1984	Diminishing	Stable	Stable	?	?	?	Diminishing
Trend 1984-2000	Stable	Increasing	Increasing	Stable	Stable	?	Stable
Trend 2000-2011	Slightly increasing	Increasing	Increasing	Increasing	Stable	?	Stable
Trend 1952-2011	Diminishing	Increasing	Increasing	Stable	Stable	?	Diminishing

7. Permit Conditions

- Entry into the Area is subject to obtaining a Permit issued by an appropriate national authority.
- Permits may be granted to carry out various scientific research, site monitoring or inspection activities, or one-off logistical operations. For each single entry, permits will authorize the scope of the tasks to be undertaken, their time-span and the maximum number of people commissioned to enter the Area (Permit Holders and any accompanying persons who may be needed for professional or safety reasons).

7(i) Access to and movement within the Area

- No helicopters or terrestrial vehicles are authorized within the Area. No overflights over the Area, either by helicopters or other aircraft are authorized. Access to the Area is only permitted by foot or by light watercraft (in summer).
- The transit traffic of land vehicles between the Dumont d'Urville station, on Petrel Island, and the Cap Prudhomme station on the continent, will normally take place in winter, following a straight line across the pack ice. During the very rare occasions when sea-ice conditions do not allow these transits to be made safely, a route along the western edge of the Bon Docteur Nunatak can be permitted exceptionally, as indicated on Map 2. The vehicles will then follow the distance instructions regarding emperor penguins as mentioned in Section 6(ii).
- The movement of authorised persons within the Area shall, in any case, be limited, in order to avoid unnecessary disturbance to birds, and to ensure that breeding areas or their access are not damaged or endangered.

---

2 Thomas T., 1986 L'effectif des oiseaux nicheurs de l'archipel de Pointe Géologie (Terre Adélie) et son évolution au cours des trente dernières années. *L'oiseau RFO* **56** :349-368.

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

- Compelling scientific activities which cannot be conducted elsewhere.
- Essential management and logistical activities
- Educational and scientific outreach activities (filming, photography, sound recording...)

7(iii) Installation, modification or removal of structures

- No structures are to be erected or scientific equipment installed in the Area except for compelling scientific reasons or management activities as authorized by an appropriate national authority.
- The possible modification or dismantling of installations currently on Rostand Island can only proceed after authorisation.

7(iv) Location of field camps

Only safety tents should be erected when security reasons so require it provided all precautions have been taken in order to avoid damaging or disturbing the fauna.

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

- According to the provisions set forth in Annex II to the Madrid Protocol, no living animals or plant materials, poultry products, including dried eggs, shall be introduced into the Area.
- No chemicals shall be brought into the Area, except chemicals which may be introduced for a compelling scientific purpose as specified n the Permit. Any chemical introduced 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 compelling purposes connected with the activity for which the Permit has been granted. Such materials are to be removed when no longer required. Permanent storage is not permitted.

7(vi) The taking of or harmful interference with flora and fauna

- Taking of or harmful interference with native flora and fauna is prohibited except in accordance with a specific Permit. In the case of authorised taking or interference, the requirements of article
  3 of Annex II of the Protocol will be used as the minimum standard.

7 (vii) The collection or removal of anything not brought into the Area by the Permit Holder

- Collection or removal of anything not brought into the Area by a Permit Holder is prohibited unless specifically mentioned in the Permit.
- Debris of man-made origin may be removed from the Area and dead or pathological specimens of fauna or flora cannot be removed unless explicitly mentioned in the Permit.

7(viii) Disposal of waste

- All waste produced must be removed from the Area after each visit.

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

- Visits to the Area shall be restricted to scientific, logistic and management objectives only.

7(x) Requirements for reports of visits to the Area

Parties should ensure that the principal Holder of 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 the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas.

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 original or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be taken into consideration both when reviewing the Management Plan and when organizing the scientific manipulation of the Area.

Antarctic Specially Protected Area No 122 (Arrival Heights, Hut Point Peninsula, 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 VIII-4 (1975), which designated Arrival Heights, Hut Point Peninsula, Ross Island as Site of Special Scienti c Interest ("SSSI") No 2 and annexed a Management Plan for the site;
- Recommendation X-6 (1979), which extended the expiry date of SSSI 2 from 30 June 1981 to 30 June 1985;
- Recommendation XII-5 (1983), which extended the expiry date of SSSI 2 from 30 June 1985 to 31 December 1985;
- Recommendation XIII-7 (1985), which extended the expiry date of SSSI 2 from 31 December 1985 to 31 December 1987;
- Recommendation XIV-4 (1987), which extended the expiry date of SSSI 2 from 31 December 1987 to 31 December 1997;
- Resolution 3 (1996), which extended the expiry date of SSSI 2 from 31 December 1997 to 31 December 2000;
- Measure 2 (2000), which extended the expiry date of SSSI 2 from 31 December 2000 to 31 December 2005;
- Decision 1 (2002), which renamed and renumbered SSSI 2 as ASPA 122;
- Measure 2 (2004), which adopted a revised Management Plan for ASPA 122;

Recalling that Measure 2 (2000) was withdrawn by Measure 5 (2009);

Recalling that Recommendation VIII-4 (1975), Recommendation X-6 (1979), Recommendation XII-5 (1983), Recommendation XIII-7 (1985), Recommendation XIV-4 (1987), and Resolution 3 (1996) are designated as no longer current by Decision 1 (2011);

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 122;

Desiring to replace the existing Management Plan for ASPA 122 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 122 (Arrival Heights, Hut Point Peninsula, Ross Island), which is annexed to this Measure, be approved; and
2. the Management Plan for ASPA 122 annexed to Measure 2 (2004) shall cease to be effective.

Management Plan for Antarctic Specially Protected Area No. 122

ARRIVAL HEIGHTS, HUT POINT PENINSULA, ROSS ISLAND

Introduction

The Arrival Heights Antarctic Specially Protected Area (ASPA) is situated near the south-western extremity of Hut Point Peninsula, Ross Island, at 77° 49' 41.2" S, 166° 40' 2.8" E, with an approximate area 0.73 km^2. The primary reason for designation of the Area is its value as an electromagnetically 'quiet' site for the study of the upper atmosphere and its close proximity to logistical support. The Area is used for a number of other scientific studies, including trace gas monitoring, auroral and geomagnetic studies and air quality surveys. As an example, the longevity and quality of the numerous atmospheric datasets makes the Area of high scientific value. Since its designation in 1975, numerous projects have been located in or near the Area with a potential to degrade the electromagnetically quiet conditions at Arrival Heights. The interference generated by these activities appears to have an acceptably low impact on scientific experiments, although a detailed review of the level of interference is currently being undertaken. The continued use of the Area is favored by its geographical characteristics, its proximity to logistical support and high costs associated with relocation. The Area was proposed by the United States of America and adopted through Recommendation VIII-4 [1975, Site of Special Scientific Interest (SSSI) No. 2]; date of expiry was extended through Recommendations X-6 (1979), XII-5 (1983), XIII-7 (1985), and XIV-4 (1987) and Resolution 3 (1996). The Area was renamed and renumbered through Decision 1 (2002); a revised management plan was provided through Measure 2 (2004). The degradation of electromagnetically 'quiet' conditions within the Area was recognized by SCAR Recommendation XXIII-6 (1994). Minor corrections to the boundaries of the Area have been made to ensure consistency between the text and the updated and more accurate maps provided in the current management plan.

1. Description of values to be protected

An area at Arrival Heights was originally designated in Recommendation VIII-4 (1975, SSSI No. 2), after a proposal by the United States of America on the grounds that it was "an electromagnetic and natural 'quiet site' offering ideal conditions for the installation of sensitive instruments for recording minute signals associated with upper atmosphere programs." For example, electromagnetic recordings have been carried out at Arrival Heights as part of long term scientific studies, yielding data of outstanding quality because of the unique characteristics of the geographic location with respect to the geomagnetic field combined with relatively low levels of electromagnetic interference. The electromagnetically quiet conditions and the longevity of data collection at Arrival Heights make the data obtained of particularly high scientific value.

In recent years, however, increases in science and support operations associated with Scott Base and McMurdo Station have raised the levels of locally generated electromagnetic noise at Arrival Heights and it has been recognized that the electromagnetically 'quiet' conditions have to some degree been degraded by these activities, as identified in SCAR Recommendation XXIII-6 (1994).

Scientific research within the Area appears to operate within an acceptably low level of electromagnetic interference (EMI) from other activities in the vicinity and the aims and objectives set out in the management plan for Arrival Heights therefore remain relevant. However, recent site visits and deployment of new instruments have shown that there is some elevated very-low frequency (VLF) noise in the 50 Hz – 12 kHz range from sources located outside of the Area (most likely wind turbines installed ~1 km from the Area). There is also evidence of increased VLF noise in the 12 – 50 KHz frequency range, which probably arises inside of the Area from, for example, the electrical power grid configuration and grounding, and the proliferation of units such as uninterruptable power supplies (UPS). The US and NZ scientific communities that run projects at Arrival Heights are

currently undertaking a detailed analysis of the possible causes of EMI with the goal of providing practical recommendations for mitigating potential effects.

Notwithstanding these observations, the original geographical characteristics of the site, such as its elevated position and thus broad viewing horizon, the volcanic crater morphology, and the close proximity to the full logistic support of nearby McMurdo Station (US) 1.5 km south and Scott Base (NZ) 2.7 km SE, continue to render the Area valuable for upper atmospheric studies and boundary layer air sampling studies. Moreover, there are scientific, financial and practical constraints associated with any proposed relocation of the Area and the associated facilities. Thus, the current preferred option for management is to minimize sources of EMI to the maximum extent practicable, and to monitor these levels routinely so that any significant threat to the values of the site can be identified and addressed as appropriate.

Since original designation the site has been used for several other scientific programs that benefit from the restrictions on access in place within the Area. In particular, the broad viewing horizon and relative isolation from activities (e.g. vehicle movements, engine exhausts) has been valuable for measurement of trace gases, particularly ozone, spectroscopic and air particulate investigations, pollution surveys, and auroral and geomagnetic studies. In addition, the protected status of Arrival Heights has also had the effect of limiting the extent and magnitude of physical disturbance within the Area. As a result, soils and landscape features are much less disturbed than is the case in the surrounding areas of Hut Point where station developments have taken place. In particular, sand-wedge polygons are far more extensive than elsewhere in the Hut Point vicinity, covering an area of approximately 0.5 km^2. The relatively undisturbed nature of the environment at Arrival Heights makes the Area valuable for comparative studies of impacts associated with station developments, and valuable as a reference against which to consider changes. These additional values are also important reasons for special protection at Arrival Heights.

The Area continues to be of high scientific value for a variety of high quality and long-term atmospheric data sets that have been collected at this site. Despite the acknowledged potential for interference from local and surrounding sources, the long-term data series, the accessibility of the site for year-round observations, its geographical characteristics, and the high cost of relocation, warrant that the site receive ongoing and strengthened protection. The vulnerability of this research to disturbance through chemical and noise pollution, in particular electromagnetic interference, is such that this Area requires continued special protection.

2. Aims and objectives

Management at Arrival Heights 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 in the Area, in particular atmospheric research, while ensuring protection from incompatible uses and uncontrolled equipment installation that may jeopardize such research;
- minimize the possibility of generation of excessive electromagnetic noise interference within the Area through regulating the types, quantity and use of equipment that can be installed and operated in the Area;
- encourage the consideration of the values of the Area in the management of surrounding activities and land uses, in particular to monitor the levels, and encourage the minimization of sources of electromagnetic radiation that may potentially compromise the values of the Area;
- allow access for maintenance, upgrade and management of communications and scientific equipment located within the Area;
- allow visits for management purposes in support of the aims of the management plan; and
- allow visits for education or public awareness purposes associated with the scientific studies being conducted in the Area that cannot be fulfilled elsewhere.

3. Management activities

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

- Signs showing the location and boundaries of the Area with clear statements of entry restrictions shall be placed at appropriate locations at the boundaries of the Area to help avoid inadvertent entry.
- 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 principal research hut facilities within the Area and at McMurdo Station and Scott Base.
- Markers, signs or structures erected within or near the boundary of 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.
- Electromagnetic noise surveys shall be undertaken within the Area bi-annually to detect equipment faults and to monitor levels of interference that may have potential to compromise the values of the Area unacceptably, for the purposes of identification and mitigation of their sources.
- Potentially disruptive activities that are planned to be conducted outside of but close to the Area, such as blasting or drilling, or the operation of transmitters or other equipment with the potential to cause significant electromagnetic interference within the Area, should be notified in advance to the appropriate representative(s) of national
  authorities operating in the region, with a view to coordinating activities and / or undertaking mitigating actions in order to avoid or minimize disruption to scientific programs.
- National Antarctic Programs operating in the region shall appoint an Activity Coordinator who will be responsible for inter-program consultation regarding all activities within the Area.
- National Antarctic Programs operating in the region shall consult together with a view to ensuring the conditions in this management plan are implemented, and take appropriate measures to detect and enforce compliance where the conditions are not being followed.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

Map 1: Arrival Heights, ASPA No. 122 in relation to Hut Point Peninsula, showing the location of nearby stations (McMurdo Station, US; and Scott Base, NZ), installations (SuperDARN, satellite receptors and wind turbines) and routes (roads and recreational trails). Projection Lambert Conformal Conic: Standard parallels: 1st 77° 40' S; 2nd 78°
00' S; Central Meridian: 166° 45' E; Latitude of Origin: 77° 50' S; Spheroid WGS84; Datum McMurdo Sound Geodetic Control Network. Data sources: Topography: contours (10 m interval) derived from digital orthophoto and DEM from aerial imagery (Nov 1993); Permanent ice extent digitized from orthorectified Quickbird satellite image (15 Oct 05) (Imagery © 2005 Digital Globe, provided through the NGA Commercial Imagery Program); Infrastructure: station layout CAD data USAP (Feb 09 / Mar 11), ERA (Nov 09) and USAP (Jan 11) field survey; Recreational trails PGC field survey (Jan 09 / Jan 11).

***Inset 1*:** The location of Ross Island in the Ross Sea. ***Inset 2*:** The location of Map 1 on Ross Island and key topographic features.

Map 2: Arrival Heights, ASPA No. 122 topographic map, showing protected area boundaries, site facilities, nearby installations (SuperDARN, satellite receptors) and routes (access roads and recreational trails). Projection details and data sources are the same as for Map 1.

6. Description of the Area

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

Boundaries and coordinates

Arrival Heights (77° 49' 41.2" S, 166° 40' 2.8" E; Area: 0.73 km^2) is a small range of low hills located near the southwestern extremity of Hut Point Peninsula, Ross Island. Hut Point Peninsula is composed of a series of volcanic craters extending from Mount Erebus, two of which, namely First Crater and Second Crater, respectively form part of the southern and northern boundaries of the Area. The Area is predominantly ice-free and elevations range from 150 m to a maximum of 280 m at Second Crater. Arrival Heights is located approximately 1.5 km north of McMurdo Station and 2.7 km northwest of Scott Base. The Area has a broad viewing horizon and is comparatively isolated from activities at McMurdo Station and Scott Base, with the majority of McMurdo Station being hidden from view.

The southeastern boundary corner of the Area is defined by Trig T510 No.2, the center of which is located at 77° 50' 08.4" S, 166° 40' 16.4" E at an elevation of 157.3 m. Trig T510 No.2 replaced, and is 0.7 m from, the former boundary survey marker (T510) which no longer exists. The replacement T510 No.2 marker is an iron rod (painted orange) installed into the ground approximately 7.3 m west of the access road to Arrival Heights, and is surrounded by a small circle of rocks. The boundary of the Area extends from Trig T510 No.2 in a straight line 656.0 m northwest over First Crater to a point located at 77° 49' 53.8" S, 166° 39' 03.9" E at 150 m elevation. The boundary thence follows the 150 m contour northward for 1186 m to a point (77° 49' 18.6" S, 166° 39' 56.1" E) due west of the northern rim of Second Crater. The boundary thence extends 398 m due east to Second Crater, and around the crater rim to a US Hydrographic Survey marker (a stamped brass disk) which is installed near ground level at 77° 49' 23.4" S, 166° 40' 59.0" E and 282 m elevation, forming the northeastern boundary of the Area. The boundary thence extends from the US Hydrographic Survey marker southward for 1423 m in a straight line directly to Trig T510 No.2.

Geology, geomorphology and soils

Hut Point Peninsula is 20 km long and is formed by a line of craters that extend south from the flanks of Mt. Erebus (Kyle 1981). The basaltic rocks of Hut Point Peninsula constitute part of the Erebus volcanic province and the dominant rock types are alkali basanite lavas and pyroclastics, with small amounts of phonolite and occasional outcrops of intermediate lavas (Kyle 1981). Aeromagnetic data and magnetic models indicate that the magnetic volcanic rocks underlying Hut Point Peninsula are likely to be <2 km in thickness (Behrendt *et al*. 1996) and dating studies suggest that the majority of basaltic rocks are younger than ~ 750 ka (Tauxe *et al*. 2004).

The soils at Arrival Heights consist mostly of volcanic scoria deposited from the eruptions of Mount Erebus, with particle size ranging from silt to boulders. The thickness of surface deposits ranges from a few centimetres to tens of metres, with permafrost underlying the active layer (Stefano, 1992). Surface material at Arrival Heights also includes magma flows from Mount Erebus, which have been weathered and reworked over time. Sand-wedge polygons cover an area of approximately 0.5 km^2 at Arrival Heights and, because physical disturbance has been limited by the protected status of the Area, are far more extensive than elsewhere in the southern Hut Point Peninsula vicinity (Klein *et al*.
2004).

Climate

Arrival Heights is exposed to frequent strong winds and conditions are generally colder and windier than at nearby McMurdo Station and Scott Base (Mazzera *et al.* 2001). During the period February 1999 to April 2009, the maximum temperature recorded within the Area was 7.1ºC (30 Dec 2001) and the minimum was -49.8ºC (21 July 2004). During this period, December was the warmest

month, with mean monthly air temperatures of -5.1ºC, and August was the coolest month, averaging –28.8ºC (data sourced from National Institute of Water and Atmospheric Research, New Zealand, http://www.niwa.cri.nz, 21 May 2009).

The mean annual wind speed recorded at Arrival Heights between 1999 and 2009 was 6.96 ms-1, with June and September being the windiest months (data sourced from National Institute of Water and Atmospheric Research, New Zealand, http://www.niwa.cri.nz, 21 May 2009). The highest recorded gust at Arrival Heights between 1999-2011 was 51 m/s (~184 km/h) on 16 May 2004. The prevailing wind direction at Arrival Heights is north-easterly, as southern air masses are deflected by the surrounding topography (Sinclair 1988). Hut Point Peninsula lies at the confluence of three dissimilar air masses, predisposing the area to rapid onset of severe weather (Monaghan *et al*. 2005).

Scientific research

Numerous long-term scientific investigations are conducted at Arrival Heights, with the majority of research focusing on the earth's atmosphere and magnetosphere. Research areas include extremely low and very low radio frequencies, auroral events, geomagnetic storms, meteorological phenomena and variations in trace gas levels, particularly ozone. The Area has good access and logistical support from nearby McMurdo Station and Scott Base, which helps to facilitate research within the Area.

The extremely-low-frequency and very-low-frequency (ELF/VLF) data have been continuously collected at Arrival Heights since the austral summer of 1984-1985 (Fraser-Smith *et al*. 1991). The ELF/VLF noise data are unique in both length and continuity for the Antarctic and were recorded concurrently with ELF/VLF data at Stanford University, allowing for comparison between polar and mid-latitude time series. The lack of electromagnetic interference and remote location of Arrival Heights allow researchers to measure background ELF/VLF noise spectra and weak ELF signals, such as Schumann resonances, which are associated changes in the magnetosphere and ionosphere (Füllekrug & Fraser-Smith 1996). ELF/VLF and Schumann resonance data collected within the Area have been studied in relation to fluctuations in sun spots, solar particle precipitation events, and planetary-scale meteorological phenomenon (Anyamba *et al*. 2000; Schlegel & Füllekrug 1999; Fraser-Smith & Turtle 1993). Furthermore, ELF data have been used as a proxy measure of global cloud-to-ground lightning activity and thunderstorm activity (Füllekrug *et al*. 1999) and VLF data provide input to global networks which monitor lightning activity and conditions in the ionosphere (Clilverd *et al.* 2009; Rodger *et al*. 2009). High quality electromagnetic data from Arrival Heights has enabled determination of an upper limit for the photon rest mass of ~10^{-52} kg (Füllerkrug 2004) based on detection of minute global ionospheric reflection height measurements (Füllerkrug *et al.* 2002), and it has also provided a critical link between lightning at mid- and tropical latitudes and surface temperature variations in moderate and tropical climates (Füllerkrug & Fraser-Smith 1997). Recent research has developed novel measurement technologies with a sensitivity of μV/m over the broad frequency range from ~4 Hz to ~400 kHz (Füllerkrug 2010), which has promising scientific potential requiring conditions of electromagnetic quiescence such as are present at Arrival Heights.

The southerly location of Arrival Heights results in several weeks of total darkness during the austral winter, allowing low intensity auroral events and dayside emissions to be observed (Wright *et al*. 1998). Data recorded at Arrival Heights have been used to track the motion of polar cap arcs, a form of polar aurora, and results have been related to solar wind and interplanetary magnetic field conditions. Auroral observations made at Arrival Heights by researchers for the University of Washington have also been used to calculate the velocity and temperature of high altitude winds by analyzing the Doppler shift of auroral light emissions. In addition to auroral research, optical data collected within the Area have been used to monitor the response of the thermosphere to geomagnetic storms (Hernandez & Roble 2003) and medium frequency radar has been used to measure middle atmospheric (70-100 km) wind velocities (McDonald *et al*. 2007).

A range of trace gas species are measured at Arrival Heights, including ozone, bromine, methane, nitrogen oxides, hydrogen chloride and carbon monoxide, with records commencing as early as 1982 (Connor *et al*. 2005). Arrival Heights represents a key site in the Network of the Detection of Atmospheric Composition (NDACC), with data being used to monitor changes in the stratosphere, including long-term evolution of the ozone layer and changes in overall atmospheric composition. Ozone levels have been recorded at Arrival Heights since 1988 and are used to monitor both long-term and seasonal variations in ozone (Oltmans *et al*. 2008; Nichol *et al*. 1991), as well as in estimations of Antarctic ozone loss (Kuttippurath *et al*. 2010). In addition to longer-term trends, sudden and substantial ozone depletion events have been recorded during spring-time at Arrival Heights, which occur over a period of hours and thought to result from the release of bromine compounds from sea salt (Riedel *et al*. 2006; Hay *et al*. 2007).

Tropospheric bromine levels have been continuously recorded since 1995 within the Area and have been studied in relation to ozone depletion, stratospheric warming and changes in the polar vortex, as well as being used in validation of satellite measurements (Schofield *et al*. 2006). Nitrogen oxide (NO_2) data collected at Arrival Heights have also been used to investigate variations in ozone levels and results show substantial variations in NO_2 at daily to interannual timescales, potentially resulting from changes in atmospheric circulation, temperature and chemical forcing (Struthers *et* al. 2004, Wood et al., 2004). In addition, ground-based Fourier transform spectroscopy has been used at Arrival Heights to monitor atmospheric carbonyl sulfide levels and to record HCL fluxes from Mount Erebus (Deutscher *et al*. 2006; Keys *et al*. 1998).

Vegetation

Lichens at Arrival Heights were surveyed in 1957 by C.W. Dodge and G.E. Baker, with species recorded including: *Buellia alboradians, B. frigida, B. grisea, B. pernigra, Caloplaca citrine, Candelariella flava, Lecanora expectans, L. fuscobrunnea, Lecidella siplei, Parmelia griseola, P. leucoblephara* and *Physcia caesia*. Moss species recorded at Arrival Heights include *Sarconeurum glaciale* and *Syntrichia sarconeurum* (BAS Plant Database, 2009), with *S. glaciale* documented within drainage channels and disused vehicle tracks (Skotnicki *et al*. 1999).

Human activities and impact

The Arrival Heights facilities are used year-round by personnel from McMurdo Station (US) and Scott Base (NZ). In addition to two laboratory buildings, numerous antenna arrays, aerials, communications equipment, and scientific instruments are located throughout the Area, along with associated cabling.

The scientific instruments used for atmospheric research in the Area are sensitive to electromagnetic noise and interference, with potential local noise sources including VLF radio transmissions, powerlines, vehicle emission systems and also laboratory equipment. Noise sources generated outside of the Area that may also affect electromagnetic conditions at Arrival Heights include radio communications, entertainment broadcast systems, ship, aircraft, or satellite radio transmissions, or aircraft surveillance radars. A site visit report from 2006 suggested that levels of interference at that time were acceptably low, despite activities operating out of McMurdo Station and Scott Base. In order to provide some degree of protection from local radio transmissions and station noise, some of the VLF antennas at Arrival Heights are located within Second Crater.

Unauthorised access to the Area, both by vehicle and on foot, is thought to have resulted in damage to cabling and scientific instruments, although the extent of damage and impact upon scientific results is unknown. A camera was installed at the USAP building in early 2010 to monitor traffic entering the Area via the road leading to the laboratories.

Recent installations within and close to the Area include an FE-Boltzmann LiDAR in the New Zealand Arrival Heights Research Laboratory in 2010, the Super Dual Auroral RADAR Network (SuperDARN) Antenna Array (2009-10) and two satellite earth station receptors (Map 2). The SuperDARN Antenna Array transmits at low frequencies (8 – 20 MHz), with the main transmission

direction to the southwest of the Area, and its location was selected in part to minimize interference with experiments at Arrival Heights. Two satellite earth station receptors (Joint Polar Satellite System (JPSS) and MG2) are located nearby. One of the receptors has the ability to transmit (frequency range 2025 – 2120 Hz) and measures have been taken to ensure that any irradiation of the Area is minimal.

Three wind turbines were constructed approximately 1.5 km east of the Area and close to Crater Hill during austral summer 2009-10 (Map 1). EMI emissions from the turbines should comply with accepted standards for electrical machinery and utilities. However, EMI originating from the new wind turbines has been detected in very low frequency datasets at Arrival Heights, with potential sources of EMI including turbine transformers, generators and power lines.

A detailed analysis of EMI is currently being carried out, with particular attention being paid to determining possible impacts arising from operation of the nearby wind turbines and the LiDAR and power systems installed in laboratories within the Area. Results are anticipated in late 2011.

Air quality monitoring has been regularly carried out at Arrival Heights since 1992 and recent studies suggest that air quality has been reduced, most likely due to emissions originating from McMurdo or Scott Base (Mazzera *et al*. 2001), for example from construction and vehicle operations. Investigations found that air quality samples contained higher concentrations of pollution derived species (EC, SO2, Pb, Zn) and PM10 (particles with aerodynamic diameters less than 10 μm) aerosols than other coastal and Antarctic sites.

6(ii) Access to the Area

Access to the Area may be made over land by vehicle or on foot. The access road to the Area enters at the south-east and extends to the research laboratories. Several vehicle trails are present within the Area and run from the Satellite Earth Station in First Crater to the foot of Second Crater. Pedestrian access may be made from the access road.

Access by air and overflight of the Area are prohibited, except when specifically authorized by permit, in which case the appropriate authority supporting research programs within the Area must be notified prior to entry.

6(iii) Restricted and managed zones within the Area

None.

6(iv) Structures within and near the Area

Both the New Zealand and United States programs have research and living facilities within the Area. New Zealand opened a new research laboratory at Arrival Heights on 20 January 2007, replacing an old building which has been removed from the Area. The US maintains one laboratory within the Area. A range of antenna arrays and aerials designed to meet scientific needs are located throughout the Area (Map 2), and a new VLF antenna was installed at Arrival Heights during December 2008. A Satellite Earth Station (SES) is located several meters inside the boundary of the Area on First Crater (Map 2).

The SuperDARN Antenna Array is located approximately 270 m SW of the Area, while two satellite earth station receptors are installed approximately 150 m SW of the Area (Map 2).

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

The nearest protected areas to Arrival Heights are on Ross Island: Cape Evans (ASPA No. 155) is the closest at 22 km north; Backdoor Bay (ASPA No. 157) is 32 km north, Cape Royds (ASPA No. 121) is 35 km NNW; Tramway Ridge (ASPA No. 130) near the summit of Mt. Erebus is 40 km north; Lewis Bay (ASPA No. 156) the site of the 1979 DC-10 passenger aircraft crash is 50 km NE; New College Valley (ASPA No. 116) is 65 km north at Cape Bird; and Cape Crozier (ASPA No. 124) is 70 km to the NE. NW White Island (ASPA No. 137) is 35 km to the south across the Ross

Ice Shelf. Antarctic Specially Managed Area No. 2 McMurdo Dry Valleys is located approximately 50 km to the west of the Area.

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 atmosphere and magnetosphere, or for other scientific purposes that cannot be served elsewhere; or
- it is issued for operation, management and maintenance of science support facilities (including safe operations), on the condition that movement within the Area be restricted to that necessary to access those facilities; or
- it is issued for educational or public awareness activities that cannot be fulfilled elsewhere and which are associated with the scientific studies being conducted in the Area, on the condition that visitors are accompanied by permitted personnel responsible for the facilities visited; or
- it is issued for essential management purposes consistent with plan objectives such as inspection or review;
- the actions permitted will not jeopardize the scientific or educational 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 or authorities named in the Permit;
- permits shall be valid for a stated period.

7(i) Access to and movement within the Area

Access to the Area is permitted by vehicle and on foot. Landing of aircraft and overflight within the Area is prohibited unless specifically authorized by permit. Prior written notification must be given to the appropriate authority or authorities supporting scientific research being conducted in the Area at the time of the proposed aircraft activity. The location and timing of the aircraft activity should be coordinated as appropriate in order to avoid or minimize disruption to scientific programs.

Vehicle and pedestrian traffic should be kept to the minimum necessary to fulfil the objectives of permitted activities and every reasonable effort should be made to minimize potential impacts on scientific research: e.g. personnel entering the Area by vehicle should coordinate travel so vehicle use is kept to a minimum.

Vehicles shall keep to the established vehicle tracks as shown on Map 2, unless specifically authorized by permit otherwise. Pedestrians should also keep to established tracks wherever possible. Care should be taken to avoid cables and other instruments when moving around the Area, as they are susceptible to damage from both foot and vehicle traffic. During hours of darkness, vehicle headlights should be switched off when approaching the facilities, in order to prevent damage to light-sensitive instruments within the Area.

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 scientific values of the Area;
- essential management activities, including the installation of new facilities to support scientific research;
- Activities with educational aims (such as documentary reporting (photographic, audio or written) or the production of educational resources or services) that cannot be served elsewhere;

- use of hand-held and vehicle radios by visitors entering the Area is allowed; however, their use should be minimized and shall be restricted to communications for scientific, management or safety purposes;
- surveys of electromagnetic noise to help ensure that scientific research is not significantly compromised.

7(iii) Installation, modification or removal of structures

- No structures are to be erected within the Area except as specified in a permit.
- All structures, scientific equipment or markers installed within the Area, outside of research hut facilities, must be authorized by permit and clearly identified by country, name of the principal investigator and year of installation. Removal of such structures, equipment or markers upon expiration of the permit shall be the responsibility of the authority which granted the original permit, and shall be a condition of the permit.
- Installation (including site selection), maintenance, modification or removal of structures shall be undertaken in a manner that minimizes environmental disturbance and installations should not jeopardize the values of the Area, particularly the electromagnetically 'quiet' conditions. Installations should be made of materials that pose minimal risk of environmental contamination of the Area. The time period for removal of equipment shall be specified in the permit.
- No new Radio Frequency (RF) transmitting equipment other than low power transceivers for essential local communications may be installed within the Area. Electromagnetic radiation produced by equipment introduced to the Area shall not have significant adverse effects on any on-going investigations unless specifically authorized. Precautions shall be taken to ensure that electrical equipment used within the Area is adequately shielded to keep electromagnetic noise to a minimum.
- Installation or modification of structures or equipment within the Area is subject to an assessment of the likely impacts of the proposed installations or modifications on the values of the Area, as required according to national procedures. Details of proposals and the accompanying assessment of impacts shall, in addition to any other procedures that may be required by appropriate authorities, be submitted by investigators to the activity coordinator for their national program, who will exchange documents received with other activity coordinators for the Area. Activity coordinators will assess the proposals in consultation with national program managers and relevant investigators for the potential impacts on the scientific or natural environmental values of the Area. Activity coordinators shall confer with each other and make recommendations (to proceed as proposed, to proceed with revisions, to trial for further assessment, or not to proceed) to their national program within 60 days of receiving a proposal. National programs shall be responsible for notifying investigators whether or not they may proceed with their proposals and under what conditions.
- The planning, installation or modification of nearby structures or equipment outside the Area that emit EMR should take into account their potential to affect the values of the Area.

7(iv) Location of field camps

Camping within the Area is prohibited. Overnight visits are permitted in buildings equipped for such purposes.

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

There are no specific restrictions on materials and organisms that can be brought into the Area.

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 by the appropriate national authority specifically for that purpose under Article 3 of Annex II to the Protocol.

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.
- The appropriate national authority should be notified of any items removed from the Area that were not introduced by the permit holder.

7(viii) Disposal of waste

All wastes, including 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

1) Permits may be granted to enter the Area to carry out scientific monitoring and site inspection activities, which may involve the collection of data for analysis or review, or for protective measures.
2) Any specific sites of long-term monitoring shall be appropriately marked.
3) Electromagnetic bands of particular scientific interest and that warrant special protection from interference should be identified by parties active within the Area. As far as practically possible, the generation of electromagnetic noise should be limited to frequencies outside of these bands.
4) The intentional generation of electromagnetic noise within the Area is prohibited, apart from within agreed frequency bands and power levels or in accordance with a permit.

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 the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas.
- 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 for 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. All spills shall be reported to the appropriate authority.

References

Anyamba, E., Williams, E., Susskind, J., Fraser-Smith, A. & Fullerkrug, M. 2000. The Manifestation of the Madden- Julian Oscillation in Global Deep Convection and in the Schumann Resonance Intensity. *American Meteorology Society* **57**(8): 1029–44.

Behrendt, J. C., Saltus, R., Damaske, D., McCafferty, A., Finn, C., Blankenship, D. D. & Bell, R. E. 1996. Patterns of Late Cenozoic volcanic tectonic activity in the West Antarctic rift system revealed by aeromagnetic surveys. *Tectonics* **15**: 660–76.

Clilverd, M. A., C. J. Rodger, N. R. Thomson, J. B. Brundell, Th. Ulich, J. Lichtenberger, N. Cobbett, A. B. Collier, F.

W. Menk, A. Seppl, P. T. Verronen, and E. Turunen. 2009. Remote sensing space weather events: the AARDDVARK network. *Space Weather* **7** (S04001). DOI: 10.1029/2008SW000412.

Connor, B. J., Bodeker, G., Johnston, P. V., Kreher, K., Liley, J. B., Matthews, W. A., McKenzie, R. L., Struthers, H. & Wood, S. W. 2005. Overview of long-term stratospheric measurements at Lauder, New Zealand, and Arrival Heights, Antartica. *American Geophysical Union, Spring Meeting 2005.*

Deutscher, N. M., Jones, N. B., Griffith, D. W. T., Wood, S. W. and Murcray, F. J. 2006. Atmospheric carbonyl sulfide (OCS) variation from 1992-2004 by ground-based solar FTIR spectrometry. *Atmospheric Chemistry and Physics Discussions* **6**: 1619–36.

Fraser-Smith, A. C., McGill, P. R., Bernardi, A., Helliwell, R. A. & Ladd, M. E. 1991. Global Measurements of Low- Frequency Radio Noise *in* Environmental and Space Electromagnetics (Ed. H. Kikuchi). Springer-Verlad, Tokyo.

Fraser-Smith, A. C. & Turtle, J. P.1993. ELF/VLF Radio Noise Measurements at High Latitudes during Solar Particle Events. Paper presented at the 51st AGARD-EPP Specialists meeting on *ELF/VLF/LF Radio Propagation and Systems Aspects.* Brussels, Belgium; 28 Sep – 2 Oct, 1992.

M. Füllekrug, M. 2004. Probing the speed of light with radio waves at extremely low frequencies. *Physical Review*
Letters **93**(4), 043901: 1-3.

Füllekrug, M. 2010. Wideband digital low-frequency radio receiver. *Measurement Science and Technology*, **21**,
015901: 1-9. doi:10.1088/0957-0233/21/1/015901.

Füllekrug , M. & Fraser-Smith, A. C.1996. Further evidence for a global correlation of the Earth-ionosphere cavity resonances. *General Assembly of the International Union of Geodesy and Geophysics No. 21, Boulder, Colorado, USA.*

Füllekrug, M. & Fraser-Smith, A.C. 1997. Global lightning and climate variability inferred from ELF magnetic field variations. *Geophysical Research Letters* **24**(19), 2411

Füllekrug, M., Fraser-Smith, A. C., Bering, E. A. & Few, A. A. 1999. On the hourly contribution of global cloud-to- ground lightning activity to the atmospheric electric field in the Antarctic during December 1992. *Journal of Atmospheric and Solar-Terrestrial Physics* **61**: 745-50.

Füllekrug, M., Fraser-Smith, A.C. & Schlegel, K. 2002. Global ionospheric D-layer height monitoring. *Europhysics*
Letters **59**(4): 626.

Hay, T., Kreher, K., Riedel, K., Johnston, P., Thomas, A. & McDonald, A. 2007. Investigation of Bromine Explosion
Events in McMurdo Sound, Antarctica. *Geophysical Research Abstracts.* Vol. 7.

Hernandez, G. & Roble, R. G. 2003. Simultaneous thermospheric observations during the geomagnetic storm of April
2002 from South Pole and Arrival Heights, Antarctica. *Geophysical Research Letters* **30** (10): 1511.

Keys, J. G., Wood, S. W., Jones, N. B. & Murcray. 1998. Spectral Measurements of HCl in the Plume of the Antarctic
Volcano Mount Erebus. *Geophysical Research Letters* **25** (13): 2421–24.

Klein, A. G., Kennicutt, M. C., Wolff, G. A., Sweet, S. T., Gielstra, D. A. & Bloxom, T. 2004. Disruption of Sand- Wedge Polygons at McMurdo Station Antarctica: An Indication of Physical Disturbance. *61st Eastern Snow Conference*, Portland, Maine, USA.

Kyle, P. 1981. Mineralogy and Geochemistry of a Basanite to Phonolite Sequence at Hut Point Peninsula, Antarctica, based on Core from Dry Valley Drilling Project Drillholes 1,2 and 3. *Journal of Petrology.* **22** (4): 451 – 500.

Kuttippurath, J., Goutail, F., Pommereau, J.-P., Lefèvre, F., Roscoe, H. K., Pazmi˜no A., Feng, W., Chipperfield, M. P.,
& Godin-Beekmann, S. 2010. Estimation of Antarctic ozone loss from ground-based total column measurements. *Atmospheric Chemistry and Physics* **10**: 6569–81.

Mazzera, D. M., Lowenthal, D. H., Chow, J, C. & Watson, J. G. 2001. Sources of PM_{10} and sulfate aerosol at McMurdo station, Antarctica. *Chemosphere* **45**: 347–56.

McDonald, A. J., Baumgaertner, A. J. G., Fraser, G. J., George, S. E. & Marsh, S. 2007. Empirical Mode
Decomposition of the atmospheric wave field. *Annals of Geophysics* **25**: 375–84.

Monaghan, A. J. & Bromwich, D. H. 2005. The Climate of the McMurdo, Antarctica, Region as Represented by One
Year Forecasts from the Antarctic Mesoscale Prediction System. *Journal of Climate.* 18, pp. 1174–89.

Nichol, S. E., Coulmann, S. & Clarkson, T. S. 1991. Relationship of springtime ozone depletion at Arrival Heights, Antarctica, to the 70 HPA temperatures. *Geophysical Research Letters* **18** (10): 1865–68.

Oltmans, S. J., Johnson, B. J. & Helmig, D. 2008. Episodes of high surface-ozone amounts at South Pole during summer and their impact on the long-term surface-ozone variation. *Atmospheric Environment* **42**: 2804–16.

Riedel, K., Kreher, K., Nichol, S. & Oltmans, S. J. 2006. Air mass origin during tropospheric ozone depletion events at
Arrival Heights, Antarctica. *Geophysical Research Abstracts* **8**.

Rodger, C. J., J. B. Brundell, R. H. Holzworth, and E. H. Lay. 2009. Growing detection efficiency of the World Wide Lightning Location
Network. American Institute of Physics Conference Proceedings **1118**: 15-20.

DOI:10.1063/1.3137706.
Schlegel, K. & Fullekrug, M. 1999. Schumann resonance parameter changes during high-energy particle precipitation. *Journal of Geophysical Research* **104** (A5): 10111-18.

Schofield, R., Johnston, P. V., Thomas, A., Kreher, K., Connor, B. J., Wood, S., Shooter, D., Chipperfield, M. P., Richter, A., von Glasow, R. & Rodgers, C. D. 2006. Tropospheric and stratospheric BrO columns over Arrival Heights, Antarctica, 2002. *Journal of Geophysical Research* **111**: 1–14.

Sinclair, M. R. 1988. Local topographic influence on low-level wind at Scott Base, Antarctica. *New Zealand Journal of*
Geology and Geophysics. **31**: 237–45.

Skotnicki, M. L., Ninham, J. A. & Selkirk P. M. 1999. Genetic diversity and dispersal of the moss Sarconeurum glaciale on Ross Island, East Antarctica. *Molecular Ecology* **8**: 753-62.

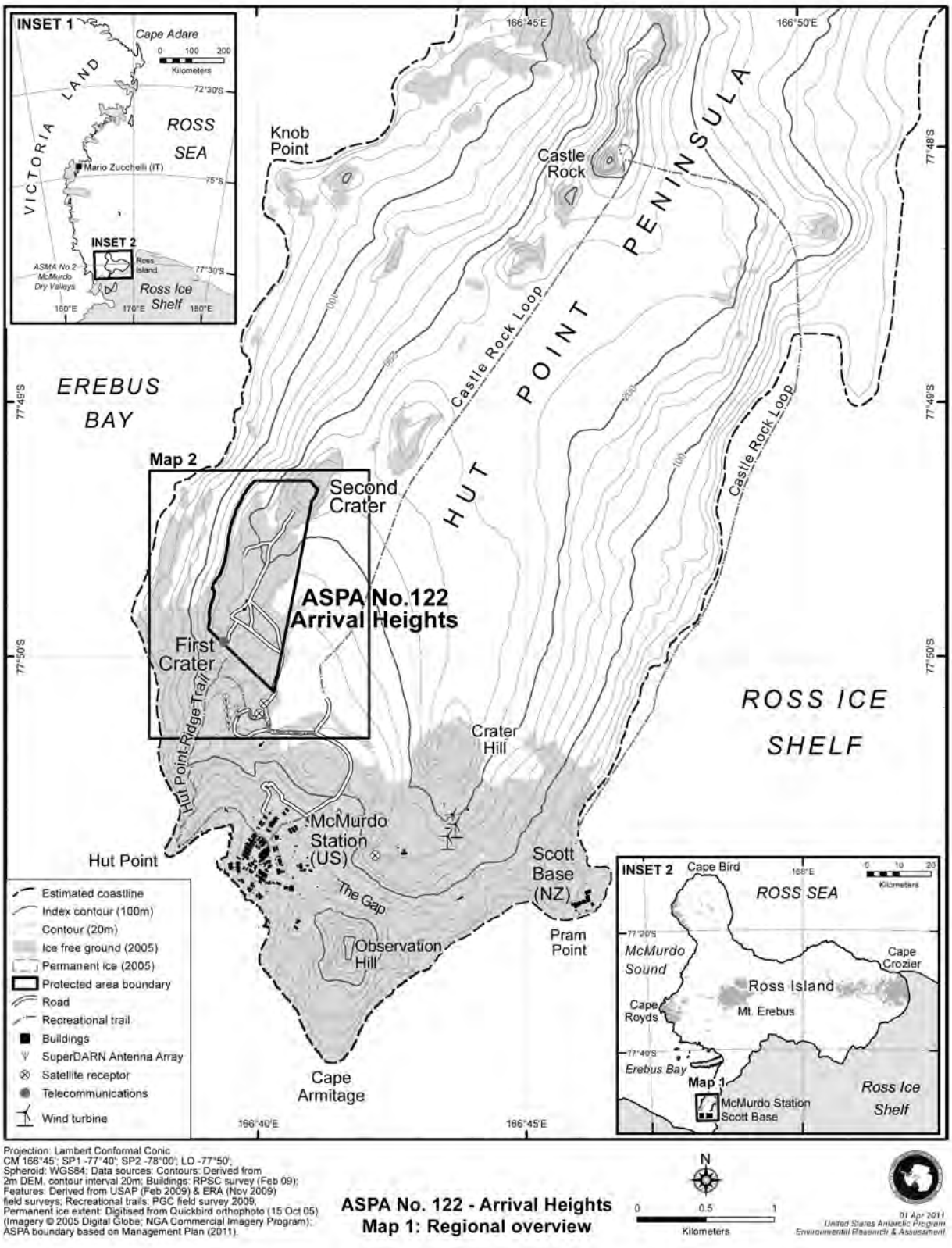
Stefano, J. E. 1992. Application of Ground-Penetrating Radar at McMurdo Station, Antarctica. Presented at the
Hazardous Materials Control Research Institute federal environment restoration conference, Vienna, USA, 15-17
April 1992.

Struthers, H., Kreher, K., Austin, J., Schofield, R., Bodeker, G., Johnston, P., Shiona, H. & Thomas, A. 2004. Past and future simulations of NO_2 from a coupled chemistry-climate model in comparison with observations. *Atmospheric Chemistry and Physics Discussions* **4**: 4545–79.

Tauxe, L., Gans, P. B. & Mankinen, E. A. 2004. Paleomagnetic and 40Ar/39Ar ages from Matuyama/Brunhes aged volcanics near McMurdo Sound, Antarctica. *Geochemical Geophysical Geosystems* **5** (10): 1029.

Wood, S. W., Batchelor, R. L., Goldman, A., Rinsland, C. P., Connor, B. J., Murcray, F. J., Stephan, T. M. & Heuff, D.
N. 2004. Ground-based nitric acid measurements at Arrival Heights, Antarctica, using solar and lunar Fourier transform infrared observations. *Journal of Geophysical Research* **109**: D18307.

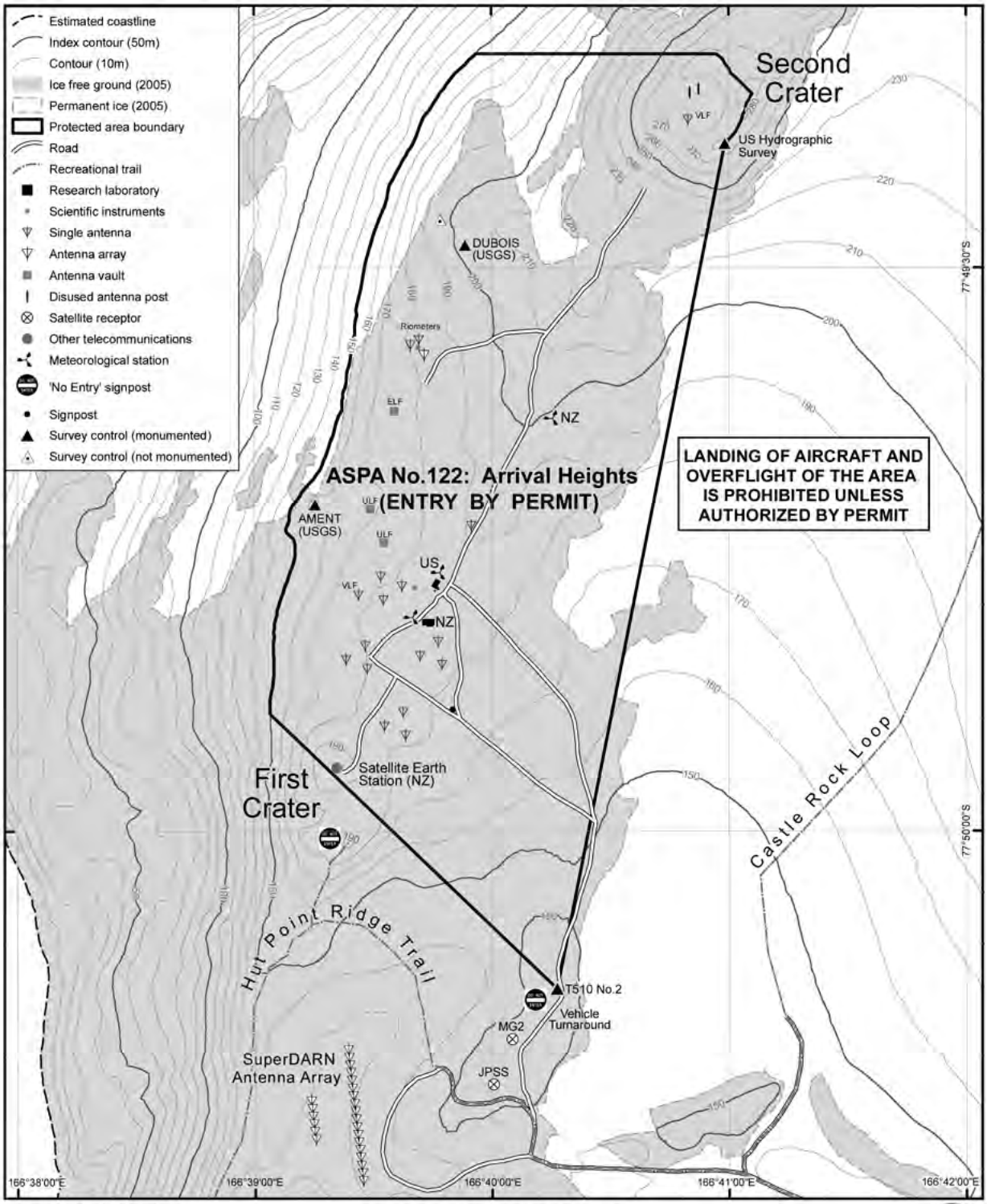
Wright, I. M., Fraser, B. J., & Menk F.W. 1998. Observations of polar cap arc drift motion from Scott Base S-RAMP Proceedings of the AIP Congress, Perth, September 1998.



Projection: Lambert Conformal Conic
CM 166°45'; SP1 -77°40'; SP2 -78°00'; LO -77°50';
Spheroid: WGS84; Data sources: Contours: Derived from 2m DEM, contour interval 20m; Buildings: RPSC survey (Feb 09); Features: Derived from USAP (Feb 2009) & ERA (Nov 2009) field surveys; Recreational trails: PGC field survey 2009. Permanent ice extent: Digitised from Quickbird orthophoto (15 Oct 05) (Imagery © 2005 Digital Globe; NGA Commercial Imagery Program); ASPA boundary based on Management Plan (2011).

ASPA No. 122 - Arrival Heights
Map 1: Regional overview

01 Apr 2011
United States Antarctic Program Environmental Research & Assessment



Projection: Lambert Conformal Conic
CM 166°45'; SP1 -77°40'; SP2 -78°00'; LO -77°50';
Spheroid: WGS84; Data sources: Contours: Derived from 2m DEM, contour interval 10m; Features: Derived from USAP (Feb 2009) & ERA (Nov 2009) field surveys;
Recreational trails: PGC field survey 2009; Permanent ice digitised from orthorectified Quickbird image (15 Oct 05) (Imagery © Digital Globe; NGA Commercial Imagery Program);
ASPA boundary based on Management Plan (2011).

ASPA No. 122 - Arrival Heights
Map 2: ASPA Boundary & topography

Note: Overground cables are present throughout Arrival Heights and are not shown on this map. Care should be taken to avoid disturbing these cables.

N

0 100 200
Meters

07 Apr 2011
United States Antarctic Program
Environmental Research & Assessment

Antarctic Specially Protected Area No 126 (Byers Peninsula, Livingston Island, South Shetland Islands): 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-10 (1966), which designated Byers Peninsula, Livingston Island, South Shetland Islands as Specially Protected Area ("SPA") No 10;
- Recommendation VIII-2 (1975), which terminated SPA 10, and Recommendation VIII-4 (1975), which redesignated the area as Site of Special Scientific Interest ("SSSI") No 6 and annexed the first Management Plan for the site;
- Recommendation X-6 (1979), which extended the expiry date of SSSI 6 from 30 June 1981 to 30 June 1985;
- Recommendation XII-5 (1983), which extended the expiry date of SSSI 6 from 30 June 1985 to 31 December 1985;
- Recommendation XIII-7 (1985), which extended the expiry date of SSSI 6 from 31 December 1985 to 31 December 1995;
- Recommendation XVI-5 (1991), which adopted a revised Management Plan for SSSI 6;
- Measure 3 (2001), which extended the expiry date of SSSI 6 from 31 December 1995 to 31 December 2005;
- Decision 1 (2002) which renamed and renumbered SSSI 6 as ASPA 126;
- Measure 1 (2002), which adopted a revised Management Plan for SSSI 6;

Recalling that Recommendation XVI-5 (1991) and Measure 3 (2001) have not become effective;

Recalling that Recommendation VIII-2 (1975), Recommendation X-6 (1979), Recommendation XII-5 (1983), Recommendation XIII-7 (1985) and Recommendation XVI-5 (1991) are designated as no longer current by Decision 1 (2011);

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 122;

Desiring to replace the existing Management Plan for ASPA 126 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 126 (Byers Peninsula, Livingston Island, South Shetland Islands), which is annexed to this Measure, be approved;
2. the prior Management Plans for ASPA 126, including the one annexed to Measure 1 (2002), shall cease to be effective; and
3. Recommendation XVI-5 (1991) and Measure 3 (2001), which have not become effective, be withdrawn.

Management Plan for Antarctic Specially Protected Area No. 126 BYERS PENINSULA, LIVINGSTON ISLAND, SOUTH SHETLAND ISLANDS

Introduction

The primary reason for the designation of Byers Peninsula (latitude 62°34'35" S, longitude 61°13'07" W), Livingston Island, South Shetland Islands, as an Antarctic Specially Protected Area (ASPA) is to protect the terrestrial and lacustrine habitats within the Area.

Byers Peninsula was originally designated as Specially Protected Area (SPA) No. 10 through Recommendation IV-10 in 1966. This area included the ice-free ground west of the western margin of the permanent ice sheet on Livingston Island, below Rotch Dome, as well as Window Island about 500 m off the northwest coast and five small ice-free areas on the south coast immediately to the east of Byers Peninsula. Values protected under the original designation included the diversity of plant and animal life, many invertebrates, a substantial population of southern elephant seals (*Mirounga leonina*), small colonies of Antarctic fur seals (*Arctocephalus gazella*), and the outstanding scientific values associated with such a large variety of plants and animals within a relatively small area.

Designation as an SPA was terminated through Recommendation VIII-2 and redesignation as a Site of Special Scientific Interest (SSSI) was made through Recommendation VIII-4 (1975, SSSI No. 6). The new designation as an SSSI more specifically sought to protect four smaller ice-free sites on the peninsula of Jurassic and Cretaceous sedimentary and fossiliferous strata, considered of outstanding scientific value for study of the former link between Antarctica and other southern continents. Following a proposal by Chile and the United Kingdom, the SSSI was subsequently extended through Recommendation XVI-5 (1991) to include boundaries similar to those of the original SPA: i.e. the entire ice-free ground of Byers Peninsula west of the margin of the permanent Livingston Island ice sheet, including the littoral zone, but excluding Window Island and the five southern coastal sites originally included, as well as excluding all offshore islets and rocks. Recommendation XVI-5 noted that in addition to the special geological value, the Area was also of considerable biological and archaeological importance.

While the particular status of designation and boundaries have changed from time to time, Byers Peninsula has in effect been under special protection for most of the modern era of scientific activity in the region. Recent activities within the Area have been almost exclusively for scientific research. Most visits and sampling within the Area, since original designation in 1966, have been subject to Permit conditions, and some areas (e.g. Ray Promontory) have been rarely visited. During the International Polar Year, Byers Peninsula was established as an 'International Antarctic Reference Site for Terrestrial, Freshwater and Coastal Ecosystems' (Quesada et al 2009). During this period baseline data relating to terrestrial, limnetic and coastal ecosystems was established, including permafrost characteristics, geomorphology, vegetation extent, limnetic diversity and functioning, marine mammal and bird diversity, microbiology, and coastal marine invertebrate diversity. The archaeological values of Byers Peninsula have been described as unique in possessing the greatest concentration of historical sites in Antarctica, namely the remains of refuges, together with contemporary artefacts and shipwrecks of early nineteenth century sealing expeditions (see Map 2).

Byers Peninsula makes a substantial contribution to the Antarctic protected areas system as it (a) contains a particularly wide diversity of species, (b) is distinct from other areas due to its numerous lakes, freshwater ponds and streams, (c) is of great ecological importance and represents the most significant limnological site in the region, (d) is vulnerable to human interference, in particular, due to the oligotrophic nature of the lakes which are highly sensitive to pollution and (e) is of great scientific interest across a range of disciplines. While some of these quality criteria are represented in other ASPAs in the region, Byers Peninsula is unique in possessing a high number of different criteria within one area. While Byers Peninsula is protected primarily for its outstanding environmental values (specifically its biological diversity and terrestrial and lake ecosystems) the Area contains a combination of other values including scientific (i.e. for terrestrial biology, limnology, ornithology, palaeolimnology, geomorphology and geology), historic (artefacts and refuge remains of early sealers), wilderness (e.g. Ray Promontory) and on-going scientific values that may benefit from the Area's protection.

The ice-free ground of Byers Peninsula is surrounded on three sides by ocean and the Rotch Dome glacier to the east. The Area has been designated to protect values found within the ice-free ground on Byers Peninsula. To fulfil this objective a portion of Rotch Dome has been included within the ASPA to ensure newly exposed ice-free ground, (resulting from any retreat of Rotch Dome), will be within the boundaries of the ASPA. In addition, the northwestern Rotch Dome including adjacent de-glaciated ground and Ray Promontory have been designated as restricted zones to allow microbiological studies that required higher quarantine standards than considered necessary within the rest of the Area. The Area (84.7 km^2) is considered to be of sufficient size to provide adequate protection of the values described below.

1. Description of values to be protected

The Management Plan attached to Measure 1 (2002) noted values considered important as reasons for special protection of the Area. The values recorded in the original Management Plans are reaffirmed. These values are set out as follows:

- The described terrestrial flora and fauna is of exceptional diversity, with one of the broadest representations of species known in the maritime Antarctic. For example, sparse but diverse flora of calcicolous and calcifuge plants and cyanobacteria are associated with the lavas and basalts, respectively, and several rare cryptogams and the two native vascular plants (*Deschampsia antarctica* and *Colobanthus quitensis*) occur at several sites.
- With over 60 lakes, numerous freshwater pools and a great variety of often extensive streams, it is the most significant limnological site in the South Shetland Islands – and perhaps the Antarctica Peninsula region – and also one which has not been subjected to significant levels of human disturbance.
- *Parochlus steinenii* (the only native winged insect in Antarctica) is of limited distribution in the South Shetland Islands. The only other native dipteral, the wingless midge *Belgica antarctica,* has a very restricted distribution on the Antarctic Peninsula. Both species are abundant at several of the lakes and pools on Byers Peninsula.
- Unusually extensive cyanobacterial mats dominated by *Phormidium* sp.and other species, particularly on the upper levels of the central Byers Peninsula plateau, are the best examples so far described in the maritime Antarctic.
- The breeding avifauna within the Area is diverse, including two species of penguin [chinstrap (*Pygoscelis antarctica)* and gentoo (*P. papua*)], Antarctic tern (*Sterna vittata*), Wilson's storm petrels (*Oceanites oceanicus*), cape petrels (*Daption capense*), kelp gulls (*Larus dominicanus*), southern giant petrels (*Macronectes giganteus*), black-bellied storm petrels (*Fregetta tropica*), blue-eyed cormorants (*Phalacrocorax atriceps*), brown skuas (*Catharacta loennbergi*), and sheathbills (*Chionis alba*).

- The lakes and their sediments constitute one of the most important archives for study of the Holocene palaeoenvironment in the Antarctic Peninsula region, as well as for establishing a regional Holocene tephrachronology.
- Well-preserved sub-fossil whale bones are present in raised beaches, which are important for radiocarbon dating of beach deposits.
- The ice-free sites on the peninsula with exposed Jurassic and Cretaceous sedimentary and fossiliferous strata, are considered of outstanding scientific value for study of the former link between Antarctica and other southern continents.

2. Aims and objectives

Management at Byers Peninsula aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance;
- allow scientific research on the terrestrial and lacustrine ecosystems, marine mammals, avifauna, coastal ecosystems and geology;
- allow other scientific research within the Area provided it is for compelling reasons which cannot be served elsewhere;
- allow archaeological research and measures for artefact protection, while protecting historic artefacts present within the Area from unnecessary destruction, disturbance, or removal;
- prevent or minimise the introduction to the Area of alien plants, animals and microbes;
- minimise the possibility of the introduction of pathogens which may cause disease in fauna within the Area; and
- allow visits for management purposes in support of the aims of the management plan.

3. Management activities

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

- A map showing the location of the Area and stating the special restrictions that apply, shall be displayed prominently at Base Juan Carlos I (Spain) and St. Kliment Ochridski Station (Bulgaria) on Hurd Peninsula, where copies of this management plan shall be made available.
- Markers, signs, fences or other structures erected within the Area for scientific or management purposes shall be secured and maintained in 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.

Byers Peninsula has been described as extremely sensitive to human impact (Tejedo et al 2009). The Area was designated as an ASPA to protect a diverse range of values present within the Area. As a result, it attracts scientists (representing a diverse range of disciplines) and archaeologists from a number of Treaty nations. The high number of people present in the Area at peak times (mid-summer) means there is potential for the environmental values of the area to be negatively impacted upon by human activities, for example by potentially increasing (i) the size and number of camping location, (ii) the trampling of vegetation, (iii) the disturbance of native wildlife (iv) the generation of waste and (v) the need for fuel storage. Consequently, when making plans for field work within the Area, Parties are **strongly encouraged** to liaise with other nations likely to be operating in the Area that season and co-ordinate activities to keep environmental impacts, including cumulative impacts, to an absolute minimum (e.g. fewer than c. 12 people in the International Field Camp at any one time).

All Parties are strongly encouraged to use the established International Field Camp (located on South Beaches, 62º39'49.7" S, 61º05'59.8' W), to reduce the creation of new camping sites that would increase levels of human impacts within the Area. Two melon huts are found within the camp (one set up for scientific research, the other for domestic activities; both huts are managed by Spain). The

melon huts are available to all Treaty Parties, should they wish to use them. Parties should liaise with Spain to co-ordinate access to the melon huts.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

Map 1: Byers Peninsula ASPA No. 126 in relation to the South Shetland Islands, showing the location of Base Juan Carlos I (Spain) and St. Kliment Ochridski Station (Bulgaria), and showing the location of protected areas within 75 km of the Area. Inset: the location of Livingston Island along the Antarctica Peninsula.

Map 2: Byers Peninsula ASPA No. 126 topographic map. Map specifications: Projection UTM Zone 20S; Spheroid: WGS 1984; Datum: Mean Sea Level. Horizontal accuracy of control: ±0.05 m. Vertical contour interval 50 m.

6. Description of the Area

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

BOUNDARIES

The Area encompasses:

- Byers Peninsula and all ice-free ground and ice sheet west of longitude 60°53'45'' W, including Clark Nunatak and Rowe Point;
- the near-shore marine environment extending 10 m offshore from the low tide water line and;
- Demon Island and Sprite Island, adjacent to the southern shoreline of Devils Point, but excluding all other offshore islets, including Rugged Island, and rocks (Map 2).

The linear eastern boundary follows longitude 60°53'45'' W to ensure newly exposed ice-free ground resulting from the retreat of Rotch Dome, which may contain scientifically useful opportunities and new habitats for colonization studies, will be within the boundaries of the ASPA.

No boundary markers are in place.

GENERAL DESCRIPTION

Byers Peninsula (between latitudes 62°34'35" and 62°40'35" S and longitudes 60°53'45''" and 61°13'07" W, 84.7 km^2) is situated at the west end of Livingston Island, the second-largest of the South Shetland Islands (Map 1). The ice-free area on the peninsula has a central west-east extent of about 9 km and a NW-SE extent of 18.2 km, and is the largest ice-free area in the South Shetland Islands. The peninsula is generally of low, gently rolling relief, although there are a number of prominent hills ranging in altitude between 80 –265 m (Map 2). The interior is dominated by a series of extensive

platforms at altitudes of up to 105 m, interrupted by isolated volcanic plugs such as Chester Cone (188 m) and Negro Hill (143 m) (Thomson and López-Martínez 1996). There is an abundance of rounded, flat landforms resulting from marine, glacial and periglacial erosional processes. The most rugged terrain occurs on Ray Promontory, a ridge forming the northwest-trending axis of the roughly 'Y'-shaped peninsula. Precipitous cliffs surround the coastline at the northern end of Ray Promontory with Start Hill (265 m) at the NW extremity being the highest point on the peninsula.

The coast of Byers Peninsula has a total length of 71 km (Map 2). Although of generally low relief, the coast is irregular and often rugged, with numerous headlands, cliffs, offshore islets, rocks and shoals. Byers Peninsula is also notable for its broad beaches, prominent features on all three coasts (Robbery Beaches in the north, President Beaches in the west, and South Beaches). The South Beaches are the most extensive; extending 12 km along the coast and up to almost 0.9 km in width, these are the largest in the South Shetland Islands (Thomson and López-Martínez 1996). For a detailed description of the geology and biology of the Area see Annex 1.

Resolution 3 (2008) recommended that the "Environmental Domains Analysis for the Antarctic Continent", be used as a dynamic model for the identification of Antarctic Specially Protected Areas within the systematic environmental-geographical framework referred to in Article 3(2) of Annex V of the Protocol. Using this model, Byers Peninsula is predominantly Environment Domain G (Antarctic Peninsula off-shore islands geologic), which is described as "*a very small terrestrial environment focused around the Antarctic Peninsula and associated offshore islands such as Deception Island. At 966 km^2 it is by far the smallest environment within the classification. The environment consists entirely of ice-free land cover and contains a combination of three geological units - sedimentary (2%), intrusive (24%), and volcanic (28%). Climatically the environment is the warmest in the classification with an average air temperature of only -3.29°C, has the smallest seasonal range at -8.82°C, and receives the highest level of solar radiation at 10.64 MJ/m2/day. The average wind speed within the environment is moderate, at 13.86 m/sec. The environment is moderately sloping with an average slope of 13.41°. Well-known locations the environment covers include parts of ice free areas on South Shetland Islands such as Fildes Peninsula on King George Island, and small points on the Antarctic Peninsula along Davis Coast'.* The scarcity of Environment G, relative to the other environmental domain areas, means that substantial efforts have been made to conserve the values found within this environment type elsewhere: other protected areas containing Domain G include ASPAs 109, 111, 112, 114, 125, 128, 140, 145, 149, 150, and 152 and ASMAs 1 and 4.

The permanent ice of Rotch Dome comes under Environment Domain E, which is described as "*a moderately sized ice sheet environment focussed around the Antarctic Peninsula as far south as latitude 73^{o}S. The size of the environment (173,130 km^2) is moderate when compared with other environments. The environment consists entirely of ice sheet and contains no mapped geology. Climatically the environment is warm when compared across the continent and is the warmest of the environments that contain only ice sheet. Environment E is ranked ninth warmest in average air temperature (-14.06 ^{o}C), fourth smallest in seasonal range (-15.04 ^{o}C), and seventh in the amount of solar radiation (9.85 MJ/m^2/day). The average wind speed within the environment is low ranking, 17th out of 21 environments (10.28 m/s). The environment is a moderately sloping environment with an average slope of 15.01^o. Well-known locations the environment covers include the glacierised parts of South Orkney, South Shetland (including Deception), Snow Hill, Brabant, Anvers, Adelaide and Alexander Islands as well as the Antarctic Peninsula north of 73^{o}S*". Other protected areas containing Domain E include ASPAs 113, 114, 117, 126, 128, 129, 133, 134, 139, 147, 149, 152 and ASMAs 1 and 4.

6(ii) Access to the Area

- Access shall be by helicopter or small boat.
- There are no special restrictions on boat landings from the sea, or that apply to the sea routes

used to move to and from the Area. Due to the large extent of accessible beach around the Area, landing is possible at many locations. Nevertheless, if possible, landing of cargo and scientific equipment should be close to the International Field Camp located at Southern Beaches (62º39'49.7" S, 61º05'59.8' W; see 6(*iii*) for further details).

- A designated helicopter landing site is located at 62º39'36.4" S, 61º05'48.5' W, to the east of the International Field Camp.
- Under exceptional circumstances necessary for purposes consistent with the objectives of the Management Plan, helicopters may land elsewhere within the Area, although landings should, where practicable, be made on ridge and raised beach crests.
- No helicopter lands shall be made within the restricted zones [see section 6(*v*)].
- Helicopters should avoid sites where there are concentrations of birds (e.g. Devils Point, Lair Point and Robbery Beaches) or well-developed vegetation (e.g. large stands of mosses near President and South Beaches).
- To avoid disturbance of wildlife, aircraft should avoid landing within an over-flight restriction zone extending ¼ nautical mile (c. 460 m) inland from the coast during the period 1 October – 30 April inclusive (see Map 2). The only exception to this is the designated helicopter landing site at 62º39'36.4" S, 61º05'48.5'W.
- Within the over-flight restriction zone the operation of aircraft should be carried out, as a minimum requirement, in compliance with the 'Guidelines for the Operation of Aircraft near Concentrations of Birds' contained in Resolution 2 (2004). In particular, aircraft should maintain a vertical height of 2000 ft (~ 610 m) AGL and cross the coastline at right angles where possible. When conditions require aircraft to fly at lower elevations than recommended in the guidelines, aircraft should maintain the maximum elevation possible and minimise the time taken to transit the coastal zone.
- Use of helicopter smoke grenades is prohibited within the Area unless absolutely necessary for safety. If used all smoke grenades should be retrieved.

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

An International Field Camp is located at South Beaches, at 62º39'49.7" S, 61º05'59.8' W. It is comprised of two fibreglass 'melon huts'. It is maintained by the Spanish Polar Programme and is available for use by all Parties. The locations of 19th Century sealers remains, including refuges and caves used for shelter are given in Smith and Simpson (1987) (see Map 2). Several cairns marking sites used for topographical survey are also present within the Area, predominantly on high points.

The nearest scientific research stations are 30 km east at Hurd Peninsula, Livingston Island [Base Juan Carlos I (Spain) and St Kliment Ochridski (Bulgaria)].

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

The nearest protected areas to Byers Peninsula are: Cape Shirreff (ASPA No. 149) which lies about 20 km to the northeast, Deception Island (ASMA No. 4), Port Foster and other parts of Deception Island (ASPAs No. 140, 145) which are approximately 40 km SSE and 'Chile Bay' (Discovery Bay) (ASPA No. 144), which is about 70 km to the east at Greenwich Island (Map 1).

6(v) Restricted and managed zones within the Area

Some zones on Byers Peninsula are thought to have been visited only very rarely, or never. New metagenomic techniques are predicted to allow future identification of microbial biodiversity (bacteria, fungi and viruses) to an unprecedented level, allowing many fundamental questions regarding microbial dispersal and distribution to be answered. Restricted zones have been designated that are of scientific importance to Antarctic microbiology and greater restriction is placed on access with the aim of preventing microbial or other contamination by human activity:

- In keeping with this aim, within the restricted zones sterile protective over-clothing shall be worn. The protective clothing shall be put on immediately prior to entering the restricted zones. Spare boots, previously cleaned using a biocide then sealed in plastic bags, shall be unwrapped and put on just before entering the restricted zones. If accessing the restricted zones by boat, protective clothing shall be put on immediately upon landing.

- To the greatest extent possible, all sampling equipment, scientific apparatus and markers brought into the restricted zones 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®).

- 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. To the maximum extent practicable, all equipment used or brought into the restricted zones 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 restricted zones, preferably by sealing in sterile plastic bags or other clean containers.

- Scientists from disciplines other than microbiology are permitted to enter the restricted areas, but shall adhere to the quarantine measures detailed above.

- Camping within the restricted zones is not permitted.

- Helicopter landings within the restricted zones are not permitted.

- If access to the restricted zones is required for research or for emergency reasons, a detailed record of where visitation occurred (preferably using GPS technology) and the specific activities, should be submitted to the appropriate national authority and included in the Exchange of Information Annual Report, preferably through the Electronic Information Exchange System (EIES).

The restricted zones are:

1. North-western Rotch Dome and adjacent deglaciated ground. The restricted zone includes all land and ice sheet within an area bordered to the east by longitude 60º53'45"W, to the west by longitude 60^{O}58'48" W, to the south by latitude 62^{O}38'30"S, and the northern boundary follows the coastline (see Map 2).

2. Ray Promontory. The restricted zone includes all land and permanent ice northwest of a straight line crossing the Promontory from 62º37'S, 61º08'W (marked by a small coastal lake) to 62º36'S, 61º06'W. Within the Ray Promontory restricted zone, access to

archaeological remains located on the coast is permitted without the need for quarantine precautions required elsewhere within the restricted zone. Access to inland areas beyond the coastal archaeological remains is not permitted without quarantine measures, detailed in this section, in place. Preferably, access to the archaeological remains shall be from the sea using small boats. Access to the archaeological remains on foot is also permitted without the need for the additional quarantine measures, by following the coastline from the unrestricted area of the Byers Peninsula ASPA to the southeast. Access to the archaeological remains shall be solely for archaeological investigations, authorised by the appropriate national authority.

7. Terms and conditions for entry permits

Entry into the Area is prohibited except in accordance with a Permit issued by an appropriate national authority.

7(i) General permit conditions

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

- it is issued only for scientific study of the ecosystem, geology, palaeontology or archaeology of the Area, or for compelling scientific reasons that cannot be served elsewhere; or
- it is issued for essential management purposes consistent with management plan objectives such as inspection, maintenance or review;
- the actions permitted will not jeopardise the ecological, geological, historical or scientific values of the Area;
- the sampling proposed will not take, remove or damage such quantities of soil, rock, native flora or fauna that their distribution or abundance on Byers Peninsula would be significantly affected;
- 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 within the Area;
- a visit report shall be supplied to the authority named in the Permit;
- permits shall be issued for a stated period; and
- the appropriate authority should be notified of any activities/measures undertaken that were not included in the authorised Permit.

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

- Land vehicles are prohibited within the Area.
- Movement within the Area shall be on foot unless under exceptional circumstances when helicopter may be used.
- All movement shall be undertaken carefully so as to minimise disturbance to archaeological remains, animals, soils, geomorphological features and vegetated surfaces, walking on rocky terrain or ridges if practical to avoid damage to sensitive plants, patterned ground and waterlogged soils.
- Pedestrian traffic should be kept to the minimum consistent with the objectives of any permitted activities and every reasonable effort should be made to minimise trampling effects. Where possible, existing tracks should be used to transit the area (Map 2). If no track exists, care should be taken to avoid creation of new tracks. Research has shown that vegetation on Byers Peninsula can recover if fewer than 200 transits are made over it in a single season (Tejedo et al 2009). Pedestrian routes over vegetated ground should therefore be chosen depending on the forecasted number of transits (i.e.

number of people × transits per day × number of days). When the number of transits on the same track is expected to be less than 200 in the same season, the track should be clearly identified and transits always made along the track. When the number is expected to be larger than 200 in a season, then the route should not be fixed along a single track, but transits should be done across a wide belt (i.e. multiple tracks, each with fewer than 200 transits), to diffuse the impact and allow quicker recovery of trampled vegetation.

- Conditions for use of helicopters within the Area are described in section 6(*ii*)
- Pilots, air and boat crew, or other people on aircraft or boats, are prohibited from moving on foot beyond the immediate vicinity of their landing site unless specifically authorised by Permit.
- Restrictions on access and movement within the restricted zones are described in section 6(*v*)

7(iii) Activities which may be conducted in the Area

- Compelling scientific research which cannot be undertaken elsewhere and that will not jeopardise the ecosystem or values of the Area or interfere with existing scientific studies.
- Archaeological research.
- Essential management activities, including monitoring.

7(iv) Installation, modification or removal of structures

No new structures are to be erected within the Area, or scientific equipment installed, except for compelling scientific or management reasons and for a pre-established period, as specified in a permit. Installation (including site selection), maintenance, modification or removal of structures and equipment shall be undertaken in a manner that minimises disturbance to the values of the Area. All 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 free of organisms, propagules (e.g. seeds, eggs) and non-sterile soil, and be made of materials that can withstand the environmental conditions and pose minimal risk of contamination of the Area. Removal of specific structures or equipment for which the Permit has expired shall be a condition of the Permit. Permanent structures or installations are prohibited.

7(v) Location of field camps

In order to minimise the area of ground within the ASPA impacted by camping activities, camps should be within the immediate vicinity of the International Field Camp (62º39'49.7" S, 61º05'59.8" W). When necessary for purposes specified in the Permit, temporary camping beyond the International Field Camp is allowed within the Area. Camps should be located on non-vegetated sites, such as on the drier parts of the raised beaches, or on thick (>0.5 m) snow-cover when practicable, and should avoid concentrations of breeding birds or mammals. Camping within 50 m of any sealers' refuge or shelter is prohibited. Previously used campsites should be re-used where practical, unless the guidance above suggests that they were inappropriately located. Camping within the restricted zones is not permitted.

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

The deliberate introduction of animals, plant material, microorganisms and non-sterile soil into the Area shall not be permitted. Precautions shall be taken to prevent the accidental introduction of animals, plant material, micro-organisms and non-sterile soil from other biologically distinct regions (within or beyond the Antarctic Treaty area). In view of the presence of breeding bird colonies on Byers Peninsula, no poultry products, including wastes from such products and products containing uncooked dried eggs, shall be released into the Area or into the adjacent sea.

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. Release of radio-nuclides or stable isotopes directly into the environment in a way that renders them unrecoverable should be avoided. Fuel or other chemicals shall not be stored in the Area unless specifically authorised by Permit condition. They shall be stored and handled in a way that minimises the risk of their accidental introduction into the environment. Materials introduced into the Area shall be for a stated period only and shall be removed by the end 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 anything released and not removed that was not included in the authorised Permit.

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

Taking of 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 of 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(viii) The collection or removal of materials not brought into the Area by the Permit holder

Collection or removal of anything not brought into the Area by the permit holder shall only be in accordance with a Permit and should be limited to the minimum necessary to meet scientific, archaeological or management needs.

Unless specifically authorized by permit, visitors to the Area are prohibited from interfering with or from handling, taking or damaging any historic anthropogenic material meeting the criteria in Resolution 5 (2001). Similarly, relocation or removal of artefacts for the purposes of preservation, protection or to re- establish historical accuracy is allowable only by permit. The appropriate national authority shall be informed of the location and nature of any newly identified anthropogenic materials.

Other 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 the Area unless the environmental impact of the removal is likely to be greater than leaving the material in situ; if this is the case the appropriate Authority must be notified and approval obtained.

7(ix) Disposal of waste

As a minimum standard all waste shall be disposed of in accordance with Annex III to the Protocol on Environmental Protection to the Antarctic Treaty. In addition, all wastes, including all solid human waste, shall be removed from the Area. Liquid human wastes may be disposed of into the sea. Solid human waste should not be disposed of to the sea as the near-shore reefs will prevent dispersal, but shall be removed from the Area. No human waste shall be disposed of inland as the oligotrophic characteristics of the lakes and other water-bodies on the plateau can be compromised by even a small quantity of human waste, including urine.

7(x) 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 monitoring and site inspection activities, which may involve the collection of data and/or a small number of samples for analysis or review;

- erect or maintain signposts, structures or scientific equipment; or
- carry out protective measures.

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

To help maintain the ecological and scientific values of the Area, visitors shall take special precautions against introductions. Of particular concern are microbial, animal or vegetation introductions sourced from soils from other Antarctic sites, including stations, or from regions outside Antarctica. To the maximum extent practicable, visitors shall ensure that footwear, clothing and any equipment – particularly camping and sampling equipment – is thoroughly cleaned before entering the Area. Poultry products and other introduced avian products, which may be a vector of avian diseases, shall not be released into the Area.

7(xi) Requirements for reports

The principal permit holder for each visit to the Area shall submit a report to the appropriate national authority as soon as practicable, and no later than six months after the visit has been completed. Such reports should include, as appropriate, the information identified in the visit report form contained in the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas. If appropriate, the national authority should also forward a copy of the visit report to the Party that proposed the Management Plan, to assist in managing the Area and reviewing the Management Plan. Wherever possible, Parties should deposit the original or copies of the original visit 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.

8. Supporting documentation

Bañón, M., Justel M. A., Quesada, A. 2006. Análisis del microclima de la península Byers, isla Livingston, Antártida, en el marco del proyecto LIMNOPOLAR. In: *Aplicaciones meteorológicas*. Asociación Meteorológica Española.

Birnie, R.V., Gordon, J.E. 1980. Drainage systems associated with snow melt, South Shetland Islands, Antarctica. *Geografiska Annaler* **62A**: 57-62.

Björck, S., Hakansson, H, Zale, R., Karlén, W., Jönsson, B.L. 1991. A late Holocene lake sediment sequence from Livingston Island, South Shetland Islands, with palaeoclimatic implications. *Antarctic Science* **3**: 61-72.

Björck, S., Sandgren, P., Zale, R. 1991. Late Holocene tephrochronology of the Northern Antarctic Peninsula. *Quaternary Research* **36**: 322-28.

Björck, S., Hjort, C, Ingólfsson, O., Skog, G. 1991. Radiocarbon dates from the Antarctic Peninsula - problems and potential. In: Lowe, J.J. (ed.), *Radiocarbon dating: recent applications and future potential. Quaternary Proceedings* 1, Quaternary Research Association, Cambridge. pp 55-65.

Björck, S., Håkansson, H., Olsson, S., Barnekow, L., Janssens, J. 1993. Palaeoclimatic studies in South Shetland Islands, Antarctica, based on numerous stratigraphic variables in lake sediments. *Journal of Paleolimnology* **8**: 233-72.

Björck, S., Zale, R. 1996. Late Holocene tephrochronology and palaeoclimate, based on lake sediment studies. In: López-Martínez, J., Thomson, M. R. A., Thomson, J.W. (eds.) *Geomorphological map of Byers Peninsula, Livingston Island*. BAS GEOMAP Series Sheet 5-A, 43-48. British Antarctic Survey, Cambridge.

Björck, S., Hjort, C., Ingólfsson, O., Zale, R., Ising, J. 1996. Holocene deglaciation chronology from lake sediments. In: López-Martínez, J., Thomson, M. R. A., Thomson, J.W. (eds.) *Geomorphological map of Byers Peninsula, Livingston Island*. BAS GEOMAP Series Sheet 5-A, 49-51. British Antarctic Survey, Cambridge.

Block, W., Starý, J. 1996. Oribatid mites (Acari: Oribatida) of the maritime Antarctic and Antarctic Peninsula. *Journal of Natural History* **30**: 1059-67.

Bonner, W.N., Smith, R.I.L. (Eds) 1985. *Conservation areas in the Antarctic.* SCAR, Cambridge: 147-56. Booth, R.G., Edwards, M., Usher, M.B. 1985. Mites of the genus Eupodes (Acari, Prostigmata) from maritime Antarctica: a biometrical and taxonomic study. *Journal of the Zoological Society of London(A)* **207**: 381-406.

Carlini, A.R., Coria, N.R., Santos, M.M., Negrete, J., Juares, M.A., Daneri, G.A. 2009. Responses of *Pygoscelis adeliae* and *P. papua* populations to environmental changes at Isla 25 de Mayo (King George Island). *Polar Biology* **32**: 1427-1433.

Convey, P., Greenslade, P. Richard, K.J., Block, W. 1996. The terrestrial arthropod fauna of the Byers Peninsula, Livingston Island, South Shetland Islands - Collembola. *Polar Biology* **16**: 257-59.
Covacevich, V.C. 1976. Fauna valanginiana de Peninsula Byers, Isla Livingston, Antartica. *Revista Geologica de Chile* **3**: 25-56.

Crame, J.A. 1984. Preliminary bivalve zonation of the Jurassic-Cretaceous boundary in Antarctica. In: Perrilliat, M. de C. (Ed.) *Memoria, III Congreso Latinamerico de Paleontologia, Mexico, 1984. Mexico City*, Universidad Nacional Autonoma de Mexico, Instituto de Geologia. pp 242-54.

Crame, J.A. 1985. New Late Jurassic Oxytomid bivalves from the Antarctic Peninsula region. *British Antarctic Survey Bulletin* **69**: 35-55.

Crame, J.A. 1995. Occurrence of the bivalve genus Manticula in the Early Cretaceous of Antarctica. *Palaeontology* **38** Pt. 2: 299-312.

Crame, J.A. 1995. A new Oxytomid bivalve from the Upper Jurassic–Lower Cretaceous of Antarctica. *Palaeontology* **39** Pt. 3: 615-28.

Crame, J.A. 1996. Early Cretaceous bivalves from the South Shetland Islands, Antarctica. *Mitt. Geol- Palaont. Inst. Univ. Hamburg* **77**: 125-127.

Crame, J.A., Kelly, S.R.A. 1995. Composition and distribution of the Inoceramid bivalve genus *Anopaea*. *Palaeontology* **38** Pt. 1: 87-103.

Crame, J.A., Pirrie, D., Crampton, J.S., Duane, A.M. 1993. Stratigraphy and regional significance of the Upper Jurassic - Lower Cretaceous Byers Group, Livingston Island, Antarctica. *Journal of the Geological Society* **150** Pt. 6: 1075-87.

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

Davey, M.C. 1993. Carbon and nitrogen dynamics in a maritime Antarctic stream. *Freshwater Biology* **30**: 319-30.

Davey, M.C. 1993. Carbon and nitrogen dynamics in a small pond in the maritime Antarctic. *Hydrobiologia* **257**: 165-75.

Duane, A.M. 1994. Preliminary palynological investigation of the Byers Group (Late Jurassic-Early Cretaceous), Livingston Island, Antarctic Peninsula. *Review of Palaeobotany and Palynology* **84**: 113-120.

Duane, A.M. 1996. Palynology of the Byers Group (Late Jurassic-Early Cretaceous) Livingston and Snow Islands, Antarctic Peninsula: its biostratigraphical and palaeoenvironmental significance. *Review of Palaeobotany and Palynology* **91**: 241-81.

Duane, A.M. 1997. Taxonomic investigations of Palynomorphs from the Byers Group (Upper Jurassic- Lower Cretaceous), Livingston and Snow Islands, Antarctic Peninsula. *Palynology* **21**: 123-144.

Ellis-Evans, J.C. 1996. Biological and chemical features of lakes and streams. In: López-Martínez, J., Thomson, M. R. A., Thomson, J.W. (eds.) *Geomorphological map of Byers Peninsula, Livingston Island*. BAS GEOMAP Series Sheet 5-A, 20-22. British Antarctic Survey, Cambridge.

Fernández-Valiente, E., Camacho, A., Rochera, C., Rico, E., Vincent, W. F., Quesada, A. 2007 Community structure and physiological characterization of microbial mats in Byers Peninsula, Livingston Island (South Shetland islands, Antarctica). *FEMS Microbiology Ecology* **59**: 377- 385

Gil-Delgado, J.A., Villaescusa, J.A., Diazmacip, M.E., Velazquez, D., Rico, E., Toro, M., Quesada, A., Camacho, A. Is the southern elephant seal *mirounga leonina* population on the Byers Peninsula (Livingston Island, South Shetland Islands) increasing? *Polar Biology* (submitted)

Gil-Delgado, J.A., González-Solis, J., Barbosa, A. 2010. Breeding birds populations in Byers Peninsula (Livingston Is., South Shetlands Islands. 18th International Conference of the European Bird Census Council. 22-26 March. Caceres. Spain.

González-Ferrán, O., Katsui, Y., Tavera, J. 1970. Contribución al conocimiento geológico de la Península

Byers, Isla Livingston, Islas Shetland del Sur, Antártica. *Publ. INACH Serie. Cientifica* **1**: 41-54.

Gray, N.F., Smith, R.I. L. 1984. The distribution of nematophagous fungi in the maritime Antarctic. *Mycopathologia* **85**: 81-92.

Harris, C.M. 2001. *Revision of management plans for Antarctic protected areas originally proposed by the United States of America and the United Kingdom: Field visit report.* Internal report for the National Science Foundation, US, and the Foreign and Commonwealth Office, UK. Environmental Research and Assessment, Cambridge.

Hansom, J.D. 1979. Radiocarbon dating of a raised beach at 10 m in the South Shetland Islands. *British Antarctic Survey Bulletin* **49**: 287-288.

Hathway, B. 1997. Non-marine sedimentation in an Early Cretaceous extensional continental-margin arc, Byers Peninsula, Livingston Island, South Shetland Islands. *Journal of Sedimentary Research* **67**: 686-697.

Hathway, B., Lomas, S.A. 1998. The Upper Jurassic-Lower cretaceous Byers Group, South Shetland Islands, Antarctica: revised stratigraphy and regional correlations. *Cretaceous Research* **19**: 43-67.

Hernandez, P.J., Azcarate, V. 1971. Estudio paleobotanico preliminar sobre restos de una tafoflora de la Peninsula Byers (Cerro Negro), Isla Livingston, Islas Shetland del Sur, Antartica. *Publ. INACH Serie. Cientifica* **2**: 15-50.

Hjort, C., Ingólfsson, O., Björck, S. 1992. The last major deglaciation in the Antarctic Peninsula region - a review of recent Swedish Quaternary research. In: Y. Yoshida *et al*. (eds.) *Recent Progress in Antarctic Science*. Terra Scientific Publishing Company (TERRAPUB), Tokyo: 741-743.

Hjort, C., Björck, S., Ingólfsson, Ó., Möller, P. 1998. Holocene deglaciation and climate history of the northern Antarctic Peninsula region: a discussion of correlations between the Southern and Northern Hemispheres. *Annals of Glaciology* **27**: 110-112.

Hodgson, D.A., Dyson, C.L., Jones, V.J., Smellie, J.L. 1998. Tephra analysis of sediments from Midge Lake (South Shetland Islands) and Sombre Lake (South Orkney Islands), Antarctica. *Antarctic Science* **10**:13-20.

John, B.S., Sugden, D.E. 1971. Raised marine features and phases of glaciation in the South Shetland Islands. *British Antarctic Survey Bulletin* **24**: 45-111.

Jones, V.J., Juggins, S., Ellis-Evans, J.C. 1993. The relationship between water chemistry and surface sediment diatom assemblages in maritime Antarctic lakes. *Antarctic Science* **5**: 339-48.

Kelly, S.R.A. 1995. New Trigonioid bivalves from the Early Jurassic to Earliest Cretaceous of the Antarctic Peninsula region: systematics and austral paleobiogeography. *Journal of Paleontology* **69**: 66-84. Lindsay, D.C. 1971. Vegetation of the South Shetland Islands. *British Antarctic Survey Bulletin*

25: 59-83. López-Bueno, A., Tamames, J. Velazquez, D., Moya, A., Quesada, A., Alcami, A. 2009. Viral Metagenome of an Antarctic lake: high diversity and seasonal variations. *Science* **326**: 858-861.

Lopez-Martinez, J., Serrano, E., Martinez de Pison, E. 1996. Geomorphological features of the drainage system. In: López-Martínez, J., Thomson, M. R. A., Thomson, J.W. (eds.) *Geomorphological map of Byers Peninsula, Livingston Island*. BAS GEOMAP Series Sheet 5-A, 15-19. British Antarctic Survey, Cambridge.

Lopez-Martínez, J., Martínez de Pisón, E., Serrano, E., Arche, A. 1996 *Geomorphological map of Byers Peninsula, Livingston Island*. BAS GEOMAP Series, Sheet 5-A, Scale 1:25 000. Cambridge, British Antarctic Survey.

Martínez De Pisón, E., Serrano, E., Arche, A., Lopez-Martínez, J. 1996. Glacial geomorphology. In: López- Martínez, J., Thomson, M. R. A., Thomson, J.W. (eds.) *Geomorphological map of Byers Peninsula, Livingston Island*. BAS GEOMAP Series Sheet 5-A, 23-27. British Antarctic Survey, Cambridge.

Pankhurst, R.J., Weaver, S.D., Brook, M., Saunders, A.D. 1979. K-Ar chronology of Byers Peninsula, Livingston Island, South Shetland Islands. *British Antarctic Survey Bulletin* **49**: 277-282.

Petz, W., Valbonesi, A., Schiftner, U., Quesada, A., Ellis-Evans, C.J. 2007. Ciliate biogeography in Antarctic and Arctic freshwater ecosystems: endemism or global distribution of species? *FEMS Microbiology Ecology* **59**: 396-408.

Quesada, A., Fernández Valiente, E., Hawes, I., Howard.Williams, C. 2008. Benthic primary production in polar lakes and rivers. In: Vincent, W., Leybourn-Parry J. (eds). *Polar Lakes and Rivers – Arctic and Antarctic Aquatic Ecosystems.* Springer. pp 179-196.

Quesada, A., Camacho, A. Rochera, C., Velazquez, D. 2009. Byers Peninsula: a reference site for coastal, terrestrial and limnetic ecosystems studies in maritime Antarctica. *Polar Science* **3**: 181-187.

Richard, K.J., Convey, P., Block, W. 1994. The terrestrial arthropod fauna of the Byers Peninsula, Livingston Island, South Shetland Islands. *Polar Biology* **14**: 371-79.

Rodríguez, P., Rico, E. 2008. A new freshwater oligochaete species (Clitellata: Enchytraeidae) from Livingston Island, Antarctica. *Polar Biology* **31**: 1267-1279.

SGE, WAM and BAS. 1993. *Byers Peninsula, Livingston Island*. Topographic map, Scale 1:25 000. Cartografia Antartica. Madrid, Servicio Geografia del Ejercito.

Serrano, E., Martínez De Pisón, E., Lopez-Martínez, J. 1996. Periglacial and nival landforms and deposits. In: López-Martínez, J., Thomson, M. R. A., Thomson, J.W. (eds.) *Geomorphological map of Byers Peninsula, Livingston Island*. BAS GEOMAP Series Sheet 5-A, 28-34. British Antarctic Survey, Cambridge.

Smellie J.L., Davies, R.E.S., Thomson, M.R.A. 1980. Geology of a Mesozoic intra-arc sequence on Byers Peninsula, Livingston Island, South Shetland Islands. *British Antarctic Survey Bulletin* **50**: 55-76.

Smith, R.I.L., Simpson, H.W. 1987. Early Nineteeth Century sealers' refuges on Livingston Island, South Shetland Islands. *British Antarctic Survey Bulletin* **74**: 49-72.

Starý, J., Block, W. 1998. Distribution and biogeography of oribatid mites (Acari: Oribatida) in Antarctica, the sub-Antarctic and nearby land areas. *Journal of Natural History* **32**: 861-94.

Sugden, D.E., John, B.S. 1973. The ages of glacier fluctuations in the South Shetland Islands, Antarctica. In: van Zinderen Bakker, E.M. (ed.) *Paleoecology of Africa and of the surrounding islands and Antarctica* . Balkema, Cape Town, pp. 141-159.

Tejedo, P., Justel, A., Benayas, J., Rico, E., Convey, P., Quesada, A. 2009. Soil trampling in an Antarctic Specially Protected Area: tools to assess levels of human impact. *Antarctic Science* **21**: 229-236. Thom, G. 1978. Disruption of bedrock by the growth and collapse of ice lenses. *Journal of Glaciology* **20**: 571-75.

Thomson, M.R.A., López-Martínez, J. 1996. Introduction. In: López-Martínez, J., Thomson, M. R. A., Thomson, J.W. (eds.) *Geomorphological map of Byers Peninsula, Livingston Island*. BAS GEOMAP Series Sheet 5-A, 1-4. British Antarctic Survey, Cambridge.

Toro, M., Camacho, A., Rochera, C., Rico, E., Bañón, M., Fernández, E., Marco, E., Avendaño, C., Ariosa, Y., Quesada, A. 2007. Limnology of freshwater ecosystems of Byers Peninsula (Livingston Island, South Shetland Islands, Antarctica. *Polar Biology* **30**: 635-649.

Torres, D., Cattan, P., Yanez, J. 1981. Post-breeding preferences of the Southern Elephant seal *Mirounga leonina* in Livingston Island (South Shetlands). *Publ. INACH Serie. Cientifica* **27**: 13-18.

Torres, D., Jorquera, D. 1994. Marine debris analysis collected at cape Shirreff, Livingston Island, South Shetland, Antarctica. *Ser. Cient. INACH* **44**: 81-86.

Usher, M.B., Edwards, M. 1986. The selection of conservation areas in Antarctica: an example using the arthropod fauna of Antarctic islands. *Environmental Conservation* **13**: 115-22.

Van der Vijver, J., Agius, T., Gibson, J., Quesada, A. 2009. An unusual spine-bearing Pinnularia species from the Antarctic Livingston Island. *Diatom Research* **24**: 431-441.

White, M.G. Preliminary report on field studies in the South Shetland Islands 1965/66. Unpublished field report in BAS Archives AD6/2H1966/N6.

Woehler, E.J. (Ed.) 1993. *The distribution and abundance of Antarctic and sub-Antarctic penguins*. SCAR, Cambridge.

Zidarova, E., Van de Vijver, B., Quesada, A., de Haan, M. 2010. Revision of the genus Hantzschia (Bacillariophyceae) on Livingston Island (South Shetland Islands, Southern Atlantic Ocean). *Plant Ecology and Evolution*. In press.

Annex 1

Supporting information

CLIMATE

No extended meteorological records are available for Byers Peninsula before 2001, but the climate is expected to be similar to that at Base Juan Carlos I, Hurd Peninsula (recorded since 1988). Conditions there indicate a mean annual temperature of below 0 ºC, with temperatures less than 0 ºC for at least several months each summer and a relatively high precipitation rate estimated at about 800 mm yr^{-1}, much of which falls as rain in summer (Ellis-Evans 1996). The peninsula is snow-covered for much of the year, but is usually completely snow-free by the end of the summer. The peninsula is exposed to weather from the Drake Passage in the north and northwest, the directions from which winds prevail, and Bransfield Strait to the south. The climate is polar maritime, with a permanently high relative humidity (about 90%), cloud covered skies for most of the time, frequent fogs and regular precipitation events. Mean temperature in summer is 1.1 º C, but occasionally can be higher than 5 ºC. Exceptionally summer temperature has reached 9 ºC. Minimum average temperature is close to 0 ºC. In winter, temperatures can be lower than -26 ºC, although the average value is -6 ºC and maximum temperatures in winter can be close to 0 ºC. Mean radiation in summer is 14,000 KJ m^{-2}, reaching 30,000 KJ m^{-2} on sunny days close to the solstice. Winds are high and average speed is 24 km h^{-1}, with frequent storms with winds over 140 Km h^{-1}. The predominant winds are from SW and NE.

GEOLOGY

The bedrock of Byers Peninsula is composed of Upper Jurassic to Lower Cretaceous marine sedimentary, volcanic and volcaniclastic rocks, intruded by igneous bodies (see Smellie *et al* 1980; Crame *et al* 1993, Hathway and Lomas 1998). The rocks represent part of a Mesozoic-Cenozoic magmatic arc complex which is exposed throughout the whole of the Antarctic Peninsula region, although most extensively on the Byers Peninsula (Hathway and Lomas 1998). The elevated interior region of the eastern half of the peninsula – surrounded to the north and south by Holocene beach deposits – is dominated by Lower Cretaceous non- marine tuffs, volcanic breccias, conglomerates, sandstones and minor mudstones, with intrusions in several places by volcanic plugs and sills. The western half of the peninsula, and extending NW half-way along Ray Promontory, is predominantly Upper Jurassic-Lower Cretaceous marine mudstones, with sandstones and conglomerates, with frequent intrusions of volcanic sills, plugs and other igneous bodies. The NW half of Ray Promontory comprises mainly volcanic breccias of the same age. Mudstones, sandstones, conglomerates and pyroclastic rocks are the most common lithologies found on the peninsula. Expanses of Holocene beach gravels and alluvium are found in coastal areas, particularly on South Beaches and the eastern half of Robbery Beaches, with less-extensive deposits on President Beaches.

The Area is of high geological value because "the sedimentary and igneous rocks exposed at Byers Peninsula constitute the most complete record of the Jurassic-Early Cretaceous period in the northern part of the Pacific flank of the magmatic arc complex, and they have proved a key succession for the study of marine molluscan faunas (e.g. Crame 1984, 1995, Crame and Kelly 1995) and non-marine floras (e.g. Hernandez and Azcárte 1971, Philippe *et al* 1995)" (Hathway and Lomas 1998).

GEOMORPHOLOGY AND SOILS

Much of the terrain consists of lithosols, essentially a layer of shattered rock, with permafrost widespread below an active layer of 30-70 cm depth (Thom 1978, Ellis-Evans 1996, Serrano *et al* 1996). Stone fields (consisting of silty fines with dispersed boulders and surficial clasts),

gelifluction lobes, polygonal ground (both in flooded and dry areas), stone stripes and circles and other periglacial landforms dominate the surface morphology of the upper platforms where bedrock outcrop is absent (Serrano at al 1996). Debris and mud-flows are observed in several localities. Beneath some of the moss and grass communities there is a 10-20 cm deep layer of organic matter although, because vegetation is sparse over most of Byers Peninsula, there are no deep accumulations of peat (Bonner and Smith 1985). Ornithogenic soils are present especially in the Devils Point vicinity and on a number of knolls along President Beaches (Ellis-Evans 1996).

Parts of the interior of the peninsula have been shaped by coastal processes with a series of raised beaches ranging from 3 to 54 m in altitude, some of which are over 1 km wide. A radiocarbon date for the highest beach deposits suggests that Byers Peninsula was largely free of permanent ice by 9700 yr B.P., while the lowest beach deposits are dated at 300 yr B.P (John and Sugden 1971, Sugden and John 1973). Lake sediment analyses, however, suggest a more recent general deglaciation of central Byers Peninsula of around 4000-5000 yr B.P. and radiocarbon dates in the locality need to be interpreted cautiously (Björck *et al* 1991a, b). In several places sub-fossil whalebones are embedded in the raised beaches, occasionally as almost entire skeletons. Radiocarbon dates of skeletal material from about 10 m a.s.l. on South Beaches suggest an age of between 2000 and 2400 yr B.P. (Hansom 1979). Pre-Holocene surfaces of Byers Peninsula exhibit clear evidence of a glacial landscape, despite the gentle landforms. Today only three small residual glaciers (comprising less then 0.5 km^2) remain on Ray Promontory. The pre-existing glacially modified landforms, have been subsequently overprinted by fluvial and periglacial processes, and moraines and other glacial deposits are scarce (Martinez de Pison *et al* 1996).

STREAMS AND LAKES

Byers Peninsula is perhaps the most significant limnological site in the South Shetland Islands/Antarctic Peninsula region, with over 60 lakes, numerous freshwater pools (differentiated from lakes in that they freeze to the bottom in winter) and a dense and varied stream network. The gentle terrain favours water retention and waterlogged soils are common in the summer. The water capacity of the thin soils is limited, however, and many of the channels are frequently dry, with flow often intermittent except during periods of substantial snow melt or where they drain glaciers (Lopez-Martinez *et al* 1996). Most of the streams drain seasonal snowfields and are often no more than 5-10 cm in depth (Ellis-Evans 1996) although snow accumulation in some narrow gorges can reach over 2 m height, and result in ice dams blocking the lake outlet. The larger streams are up to 4.5 km in length, up to 20 m in width and 30-50 cm in depth in the lower reaches during periods of flow. Streams that drain to the west often have sizeable gorges (Lopez-Martinez *et al* 1996) and gullies up to 30 m in depth have been cut into the uppermost, and largest, of the raised marine platforms (Ellis-Evans 1996). Above the Holocene raised beaches the valleys are gentle, with widths of up to several hundred metres.

Lakes are especially abundant on the higher platforms (i.e. at the heads of basins) and on the Holocene raised beaches near the coast. Midge Lake is the largest at 587 × 112 m, and deepest with a maximum depth of 9.0 m. The inland lakes are all nutrient-poor and highly transparent, with extensive sediments in deeper water overlain by a dense aquatic moss carpet [*Drepanocladus longifolius (=D. aduncus*)]. In some lakes, such as Chester Cone Lake about 500 m to the south of Midge Lake, or Limnopolar lake, stands of aquatic moss are found growing at one to several metres in depth and cover most of the lake bottom, which is the habitat for *Parochlus* larvae (Bonner and Smith 1985). Large masses of this moss are sometimes washed up along parts of the shoreline. The lakes are generally frozen to a depth of 1.0 - 1.5 m for 9 - 11 months of the year and overlain by snow, although surfaces of some of the higher lakes remain frozen year-round (Ellis- Evans 1996, Lopez-Martinez *et al* 1996). On the upper levels of the central plateau many small, shallow, slow-flowing streams flow between lakes and drain onto large flat areas of saturated lithosol covered with

thick cyanobacterial mats of *Phormidium* sp. These mats are more extensive than in any other maritime Antarctic site thus far described and reflect the unique geomorphology and relatively high annual precipitation of the Area. With spring melt there is considerable flush through most lakes, but outflow from many lakes may cease late in the season as seasonal snowmelt decreases. Most lakes contain some crustaceans such as the copepods *Boeckella poppei* and the fairy shrimp *Branchinecta gainii*. Some of the streams also contain substantial growths of cyanobacterial and green filamentous algae, along with diatoms and copepods. A number of relatively saline lakes of lagoonal origin occur close to the shore, particularly on President Beaches. Where these are used as southern elephant seal (*Mirounga leonina*) wallows these lakes have been highly organically enriched. Those coastal shallow lakes and pools located behind the first raised beach often have abundant algal mats and crustaceans, including the copepods *B. poppei* and *Parabroteas sorsi*, and occasionally the fairy shrimp *Br. gainii*. Some of these water bodies have high biological diversity, with newly described species of diatoms (van der Vijver 2010), oligochaete (Rodriguez and Rico, 2009) and ciliate protozoa (Petz et al 2008).

VEGETATION

Although much of Byers Peninsula lacks abundant vegetation, especially inland (see Lindsay 1971), the sparse communities contain a diverse flora, with at least 56 lichen species, 29 mosses, 5 hepatics and 2 phanerogams having been identified as present within the Area. Numerous unidentified lichens and mosses have also been collected. This suggests the Area contains one of the most diverse representations of terrestrial flora known in the maritime Antarctic. A number of the species are rare in this part of the maritime Antarctic. For example, of the bryophytes, *Anthelia juratzkana*, *Brachythecium austroglareosum*, *Chorisodontium aciphyllum*, *Ditrichum hyalinum*, *Herzogobryum teres*, *Hypnum revolutum*, *Notoligotrichum trichodon*, *Pachyglossa dissitifolia*, *Platydictya jungermannioides*, *Sanionia* cf. *plicata*, *Schistidium occultum*, *Syntrichia filaris* and *Syntrichia saxicola* are considered rare. For *A. juratzkana*, *D. hyalinum*, *N. trichodon* and *S. plicata*, their furthest-south record is on Byers Peninsula. Of the lichen flora, *Himantormia lugubris*, *Ochrolechia parella*, *Peltigera didactyla* and *Pleopsidium chlorophanum* are considered rare.

Vegetation development is much greater on the south coast than on the north. Commonly found on the higher, drier raised beaches in the south is an open community dominated by abundant *Polytrichastrum alpinum* (=*Polytrichum alpinum*), *Polytrichum piliferum* (=*Polytrichum antarcticum*), *P. juniperinum*, *Ceratodon purpureus*, and the moss *Pohlia nutans* and several crustose lichens are frequent. Some large stands of mosses occur near President and South Beaches, where extensive snowdrifts often accumulate at the base of slopes rising behind the raised beaches, providing an ample source of melt water in the summer. These moss stands are dominated mainly by *Sanionia uncinata* (=*Drepanocladus uncinatus*), which locally forms continuous carpets of several hectares. The vegetation composition is more diverse than on the higher, drier areas. Inland, wet valley floors have stands of *Brachythecium austro-salebrosum*, *Campylium polygamum, Sanionia uncinata*, *Warnstorfia laculosa* (=*Calliergidium austro-stramineum*), and *W. sarmentosa* (=*Calliergon sarmentosum*). In contrast, moss carpets are almost non-existent within 250 m of the northern coast, replaced by scant growth of *Sanionia* in hollows between raised beaches of up to 12 m in altitude. Lichens, principally of the genera *Acarospora, Buellia, Caloplaca, Verrucaria* and *Xanthoria*, are present on the lower (2-5 m) raised beach crests, with *Sphaerophorus, Stereocaulon* and *Usnea* becoming the more dominant lichens with increasing altitude (Lindsay 1971).

On better drained ash slopes *Bryum* spp., *Dicranoweisia* spp., *Ditrichum* spp., *Pohlia* spp., *Schistidium* spp., and *Tortula* spp. are common as isolated cushions and turves with various liverworts, lichens (notably the pink *Placopsis contortuplicata* and black foliose *Leptogium puberulum*), and the cyanobacterium *Nostoc commune*. *P. contortuplicata* occurs in inland and

upland habitats lacking in nitrogen, and is typical of substrata with some degree of disturbance such as solifluction; it is often the only plant to colonise the small rock fragments of stone stripes and frost-heave polygons (Lindsay 1971). It is usually found growing alone, though rarely with species of *Andreaea* and *Usnea*. *N. commune* covers extensive saturated areas on level or gently sloping, gravelly boulder clay from altitudes of between 60-150 m, forming discrete rosettes of about 5 cm in diameter 10-20 cm apart (Lindsay 1971). Scattered, almost spherical, cushions of*Andreaea, Dicranoweisia,* and *Ditrichum* are found on the driest soils. In wet, bird- and seal-influenced areas the green foliose alga *Prasiola crispa* is sometimes abundant.

Rock surfaces on Byers Peninsula are mostly friable, but locally colonised by lichens, especially near the coast. Volcanic plugs are composed of harder, more stable rock and are densely covered by lichens and occasional mosses. Usnea Plug is remarkable for its luxuriant growth of *Himantormia lugubris* and *Usnea aurantiaco-atra* (=*U. fasciata*). More generally, *H. lugubris* and *U. aurantiaco-atra* are the dominant lichen species on inland exposed montane surfaces, growing with the moss *Andreaea gainii* over much of the exposed rock with up to 80% cover of the substratum (Lindsay 1971). In sheltered pockets harbouring small accumulations of mineral soil, the liverworts *Barbilophozia hatcheri* and *Cephaloziella varians* (= *C. exiliflora*) are often found, but more frequently intermixed with cushions of *Bryum, Ceratodon, Dicranoweisia, Pohlia, Sanionia*, *Schistidium*, and *Tortula. Sanionia* and *Warnstorfia* form small stands, possibly correlated with the absence of large snow patches and associated melt streams. *Polytrichastrum alpinum* forms small inconspicuous cushions in hollows, but it may merge with *Andreaea gainii* cushions in favourable situations (Lindsay 1971).

Crustose lichens are mainly species of *Buellia, Lecanora, Lecedella, Lecidea, Placopsis* and *Rhizocarpon* growing on rock, with species of *Cladonia* and *Stereocaulon* growing on mosses, particularly *Andreaea* (Lindsay 1971). On the south coast moss carpets are commonly colonised by epiphytic lichens, such as *Leptogium puberulum, Peltigera rufescens*, *Psoroma* spp., together with *Coclocaulon aculeata* and *C. epiphorella*. On sea cliffs *Caloplaca* and *Verrucaria* spp. dominate on lower surfaces exposed to salt spray up to about 5 m, with nitrophilous species, such as *Caloplaca regalis, Haematomma erythromma,*and *Xanthoria elegans* often dominant at higher altitudes where seabirds are frequently nesting. Elsewhere on dry cliff surfaces a *Ramalina terebrata* - crustose lichen community is common. A variety of ornithocoprophilous lichens, such as *Catillaria corymbosa*, *Lecania brialmontii*, and species of *Buellia, Haematomma, Lecanora,* and *Physcia* occur on rocks near concentrations of breeding birds, along with the foliose lichens *Mastodia tessellata, Xanthoria elegans* and *X. candelaria* which are usually dominant on dry boulders.

Antarctic hairgrass (*Deschampsia antarctica*) is common in several localities, mainly on the south coast, and occasionally forms closed swards (e.g. at Sealer Hill); Antarctic pearlwort (*Colobanthus quitensis*) is sometimes associated. Both plants are quite abundant in southern gullies with a steep north-facing slope, forming large, occasionally pure stands with thick carpets of *Brachythecium* and *Sanionia*, although they are rarely found above 50 m in altitude (Lindsay 1971). An open community of predominantly *Deschampsia* and *Polytrichum piliferum* extends for several kilometres on the sandy, dry, flat raised beaches on South Beaches. A unique growth-form of the grass, forming isolated mounds 25 cm high and up to 2 m across, occurs on the beach near Sealer Hill. *Deschampsia* has been reported at only one locality on the north coast (Lair Point), where it forms small stunted tufts (Lindsay 1971).

INVERTEBRATES

The microinvertebrate fauna on Byers Peninsula thus far described comprises 25 taxa (Usher and Edwards 1986, Richard *et al* 1994, Block and Stary 1996, Convey *et al* 1996, Rodriguez and Rico, 2008): six Collembola (*Cryptopygus antarcticus*, *Cryptopygus badasa, Friesea grisea, Friesea woyciechowskii, Isotoma* (*Folsomotoma*) *octooculata* (*=Parisotoma octooculata*) and *Tullbergia mixta*; one mesostigmatid mite (*Gamasellus racovitzai*), five cryptostigmatid mites (*Alaskozetes antarcticus*, *Edwardzetes dentifer, Globoppia loxolineata* (*=Oppia loxolineata*), *Halozetes belgicae* and *Magellozetes antarcticus*); nine prostigmatid mites (*Bakerdania antarcticus, Ereynetes macquariensis*, *Eupodes minutus, Eupodes parvus grahamensis, Nanorchestes berryi, Nanorchestes nivalis, Pretriophtydeus tilbrooki*, *Rhagidia gerlachei, Rhagidia leechi,* and *Stereotydeus villosus*); two Dipterans (*Belgica antarctica* and *Parochlus steinenii*), and two oligochaetes (*Lumbricillus healyae* and *Lumbricillus sp*.).

Larvae of the wingless midge *Belgica antarctica* occur in limited numbers in moist moss, especially carpets of *Sanionia*, although it is of very restricted distribution on Byers Peninsula (found especially near Cerro Negro) and may be near its northern geographical limit. The winged midge *Parochlus steinenii* and its larvae inhabit the margins of inland lakes and pools, notably Midge Lake and another near Usnea Plug, and are also found amongst the stones of many stream beds (Bonner and Smith 1985, Richard *et al* 1994, Ellis- Evans pers comm 1999). During warm calm weather, swarms of adults may be seen above lake margins.

The diversity of the arthropod community described at Byers Peninsula is greater than at any other documented Antarctic site (Convey *et al* 1996). Various studies (Usher and Edwards 1986, Richard *et al* 1994, Convey *et al* 1996) have demonstrated that the arthropod population composition on Byers Peninsula varies significantly with habitat over a small area. *Tullbergia mixta* has been observed in relatively large numbers; it appears to be limited in Antarctic distribution to the South Shetland Islands (Usher and Edwards 1986). Locally, the greatest diversity is likely to be observed in communities dominated by moss cushions such as *Andreaea* spp. (Usher and Edwards 1986). Further sampling is required to establish populations and diversities with greater reliability. While further sampling at other sites may yet reveal the communities described at Byers Peninsula to be typical of similar habitats in the region, available data on the microfauna confirm the biological importance of the Area.

MICROORGANISMS

An analysis of soil samples collected from Byers Peninsula yielded several nematophagous fungi: in soil colonised by *Deschampsia* were found *Acrostalagmus goniodes*, *A. obovatus, Cephalosporium balanoides* and *Dactylaria gracilis,* while in *Colobanthus*-dominated soil was found *Cephalosporium balanoides* and *Dactylella gephyropaga* (Gray and Smith 1984). The basidiomycete *Omphalina antarctica* is often abundant on moist stands of the moss *Sanionia uncinata* (Bonner and Smith 1985). Some of the water bodies have high microbial biodiversity including the largest viral genetic diversity found in Antarctic lakes (López-Bueno et al 2009)

BREEDING BIRDS

The avifauna of Byers Peninsula is diverse, although breeding colonies are generally not large. Two species of penguin, the chinstrap (*Pygoscelis antarctica*) and the gentoo (*P. papua*), breed in the Area. Adélie penguins (*P. adeliae*) have not been observed to breed on Byers Peninsula or its offshore islets. In the South Shetlands Islands, Adélie penguins only breeds on King George Island where the populations are declining (Carlini et al. 2009).

The principal chinstrap penguin colony is at Devils Point, where a rough estimate of about 3000 pairs was made in 1987; a more accurate count made in 1965 indicated about 5300 pairs in four discrete colonies, of which almost 95% were nesting on Demon Island, 100 m to the south of Devils Point (Croxall and Kirkwood 1979; Woehler 1993). Two colonies of about 25 chinstrap penguin pairs surrounded by a colony of gentoo penguins can be found on the President Beaches close to Devils Point. Small chinstrap penguin colonies have been reported on the northern coast, e.g. on Robbery Beaches (50 pairs in 1958; Woehler 1993), but no breeding pairs were reported there in a 1987 survey. In other locations, Lair Point contained 156 pairs in 1966, declining to 25 pairs in 1987 (Woehler 1993). In a recent visit to the area (January 2009) 20 pairs were counted (Barbosa pers.com).

Gentoo penguins breed at several colonies on Devils Point, with approximately 750 pairs recorded in 1965 (Croxall and Kirkwood 1979, Woehler 1993). Currently three colonies of about 3000 pairs in total can be found (Barbosa pers.com). On the northern coast, a rookery of three colonies with 900 pairs in total is located in Robbery Beaches (Woehler 1993). In a visit to Lair Point in January 2009, about 1200 pairs were counted. Woehler (1993) gives no data on gentoo penguins at this location.

Recent estimations of population size for some species of flying birds were obtained from a survey conducted in December 2008 and January 2009 (Gil-Delgado et al. 2010). The Antarctic tern (*Sterna vittata*) population was estimated at 1873 breeding pairs. Two hundred and thirty eight pairs of southern giant petrels *(Macronectes giganticus)* and 15 pairs of brown skua (*Catharacta lonnbergi*) nest locally. A detailed survey of other breeding birds was conducted in 1965 (White 1965). The most populous breeding species recorded then, with approximately 1760 pairs, was the Antarctic tern (*Sterna vittata*), followed by 1315 pairs of Wilson's storm petrels (*Oceanites oceanicus*), approximately 570 pairs of cape petrels (*Daption capense*), 449 pairs of kelp gulls (*Larus dominicanus*), 216 pairs of southern giant petrels, 95 pairs of black-bellied storm petrels (*Fregetta tropica*), 47 pairs of blue-eyed cormorants (*Phalacrocorax atriceps*) (including those on nearshore islets), 39 pairs of brown skuas, and 3 pairs of sheathbills (*Chionis alba*). In addition, prions (*Pachytilla* sp.) and snow petrels (*Pagodroma nivea*) have been seen on the peninsula but their breeding presence has not been confirmed. The census of burrowing and scree-nesting birds is considered an underestimate (White pers. comm. 1999). The majority of the birds nest in close proximity to the coast, principally in the west and south.

Recently some vagrant waders, probably white-rumped sandpipers (*Calidris fuscicollis*) have been seen frequently foraging in some streams in the southern beaches (Quesada pers. comm. 2009).

BREEDING MAMMALS

Large groups of southern elephant seals (*Mirounga leonina*) breed on the Byers Peninsula coast, with a total of over 2500 individuals reported on South Beaches (Torres *et al*. 1981), which is one of the largest populations of this species recorded in the South Shetland Islands. A estimation made in 2008-2009 showed a population ranging from 4700 to 6300 individuals (Gil-Delgado et al. 2010). Large numbers haul out in wallows and along beaches in summer. Weddell (*Leptonychotes weddellii*), crabeater (*Lobodon carcinophagous*) and leopard (*Hydrurga leptonyx*) seals may be seen around the shorelines. Antarctic fur seals (*Arctocephalus gazella*) were once very abundant on Byers Peninsula (see below), but have not substantially recolonised the Area in high numbers in spite of the recent rapid population expansion in other parts of the maritime Antarctic.

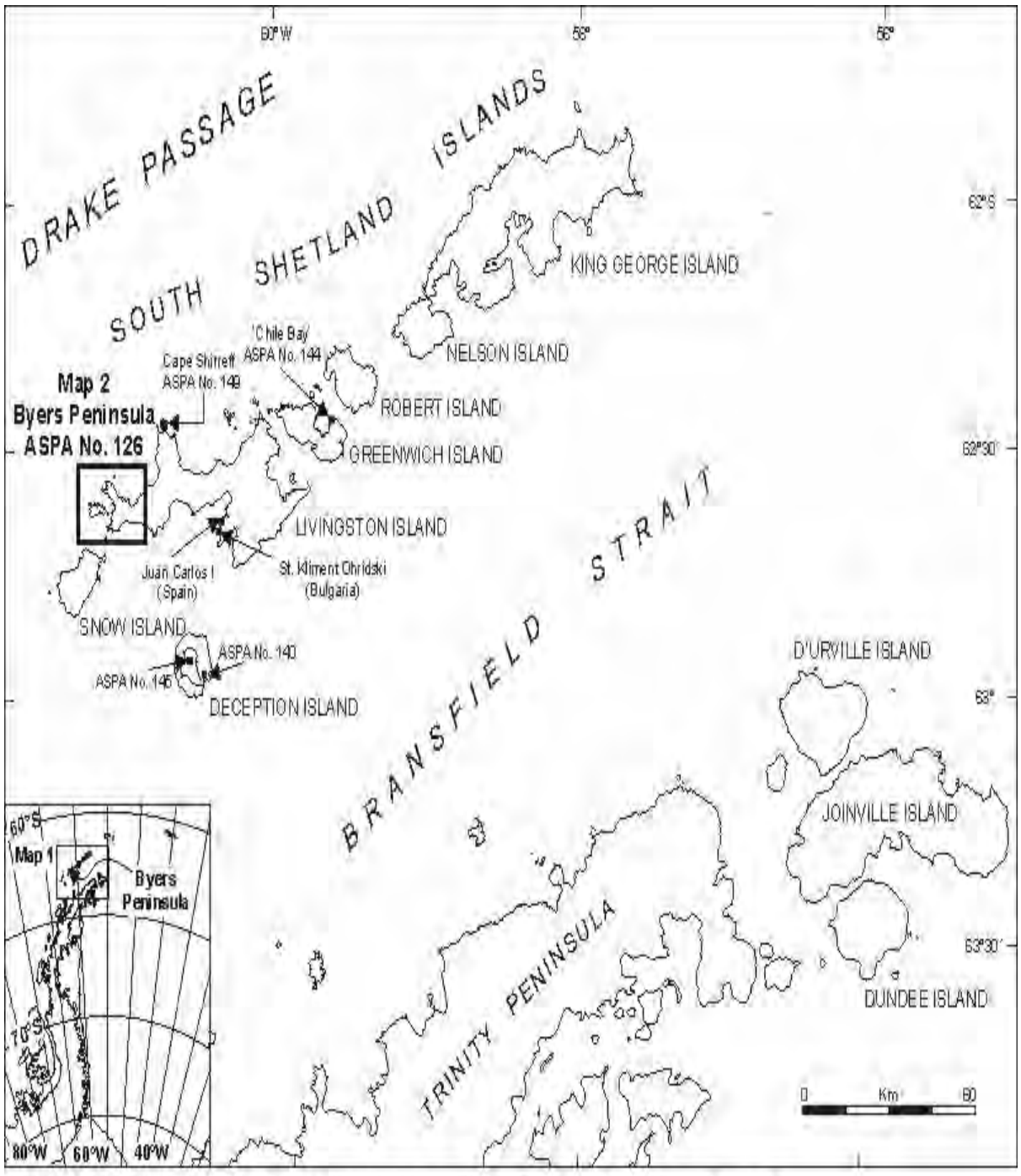
HISTORICAL FEATURES

Following discovery of the South Shetland Islands in 1819, intensive sealing at Byers Peninsula between 1820 and 1824 exterminated almost all local Antarctic fur seals and southern elephant seals

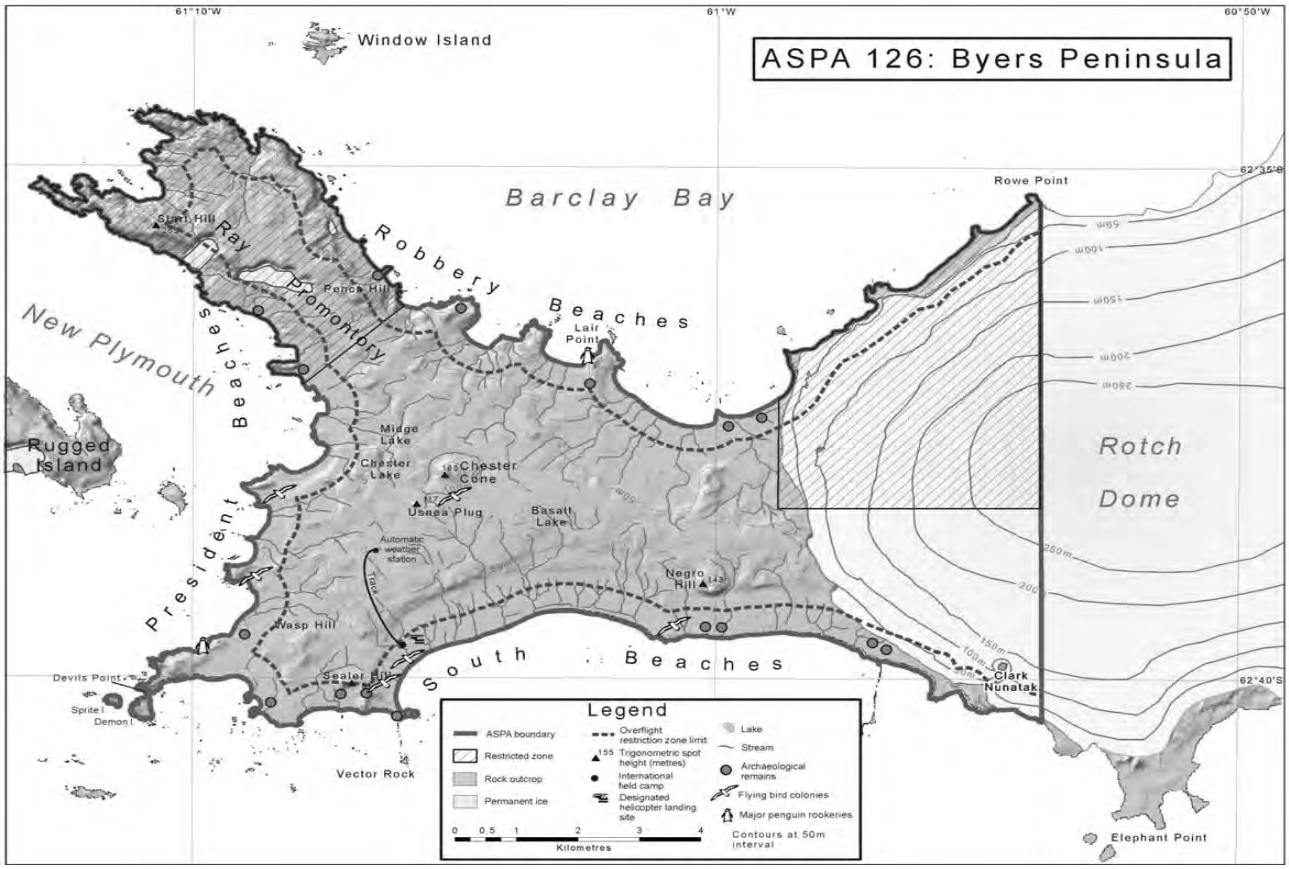
(Smith and Simpson 1987). During this period there was a summer population of up to 200 American and British sealers living ashore in dry-stone refuges and caves around Byers Peninsula (Smith and Simpson 1987). Evidence of their occupation remains in their many refuges, some of which still contain artefacts (clothing, implements, structural materials, etc.). Several sealing vessels were wrecked near Byers Peninsula and timbers from these ships may be found along the shores. Byers Peninsula has the greatest concentration of early 19th Century sealers' refuges and associated relics in the Antarctic and these are vulnerable to disturbance and/or removal. Elephant seal numbers, and to some extent fur seal numbers, recovered after 1860, but were again decimated by a second sealing cycle extending to the first decade of the twentieth century.

HUMAN ACTIVITIES/IMPACTS

The modern era of human activity at Byers Peninsula has been largely confined to science. The impacts of these activities have not been described, but are believed to be minor and limited to items such as campsites, footprints, markers of various kinds, sea-borne litter washed onto beaches (e.g. from fishing vessels) and from human wastes and scientific sampling. Several wooden stake markers and a plastic fishing float were observed in the southwest of the Area in a brief visit made in February 2001 (Harris 2001). In summer 2009- 2010, a beach litter survey was undertaken (Rodriguez-Pertierra pers. comm.). The highest proportion of litter on beaches (averaged over beach length) was found in Robbery Beach (64%) followed by President Beach (28%) and beaches to the southwest of the Area (8%). This is likely to be related to their exposure to the Drake Passage (Torres and Jorquera, 1994). The majority of the litter found on the three beaches was wood (78% by number of items) and plastic (19%) whereas metal, glass and cloth were found more rarely (less than 1%). Several pieces of timber were found, some of them quite large (several meters in length). The plastic items were highly diverse, with bottles, ropes and tape the most numerous items. Floats and glass bottles were also found on the beaches.



Map 1. Byers Peninsula, ASPA No. 126, Livingston Island, South Shetland Islands, location map. Inset: location of Byers Peninsula on the Antarctic Peninsula



Map 2. ASPA 126: Byers Peninsula topographic map.

Measure 5

Antarctic Specially Protected Area No 127 (Haswell 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 VIII-4 (1975), which designated Haswell Island as Site of Special Scientific Interest ("SSSI") No 7 and annexed a Management Plan for the site;
- Recommendation X-6 (1979), which extended the expiry date of SSSI 7 from 30 June 1981 to 30 June 1983;
- Recommendation XII-5 (1983), which extended the expiry date of SSSI 7 from 30 June 1983 to 31 December 1985;
- Recommendation XIII-7 (1985), which extended the expiry date of SSSI 7 from 31 December 1985 to 31 December 1991;
- Recommendation XVI-7 (1987), which extended the expiry date of SSSI 7 from 31 December 1991 to 31 December 2001;
- Measure 3 (2001), which extended the expiry date of SSSI 7 from 31 December 2001 to 31 December 2005;
- Decision 1 (2002), which renamed and renumbered SSSI 7 as ASPA 127;
- Measure 4 (2005), which extended the expiry date of the Management Plan of ASPA 127 from 31 December 2005 to 31 December 2010;
- Measure 1 (2006), which adopted a revised Management Plan for ASPA 127;

Recalling that Recommendation VIII-4 (1975), Recommendation X-6 (1979), Recommendation XII-5 (1983), Recommendation XIII-7 (1985) and Recommendation XVI-7 (1987) are designated as no longer current by Decision 1 (2011);

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 127;

Desiring to replace the existing Management Plan for ASPA 127 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 127 (Haswell Island), which is annexed to this Measure, be approved; and
2. the prior Management Plans for ASPA 127, namely those annexed to Recommendation VIII-4 (1975) and Measure 1 (2006), shall cease to be effective.

Management Plan for Antarctic SpeciallyProtectedArea No. 127 HASWELL ISLAND (Haswell Island and Adjacent Emperor Penguin Rookery on Fast Ice)

Revised Management Plan

1. Description of values to be protected

Haswell Island is a unique breeding site for almost all breeding bird species in East Antarctica including the: Antarctic petrel (*Talassoica antarctica*), Antarctic fulmar (*Fulmarus glacioloides*), Cape petrel (*Daption capense*), Snow petrel (*Pagodroma nivea*), Wilson's storm petrel (*Oceanites oceanicus*), South polar skua (*Catharacta maccormicki*), and Adelie penguin (*Pygoscelis adeliae*). The Area supports five species of pinnipeds, including the Ross seal (*Ommatophoca rossii*) which is a protected species.

South-east of the island, there is a large colony of Emperor penguins (*Aptenodytes forsteri*) on fast ice.

The Area consists of Haswell Island (66º31'S, 93º00'E), about 1 km² in area, the largest of a group of islands lying close to Mirny station, together with its littoral zone and the area of fast ice, when present. ATCM VIII (Oslo, 1975) approved its designation as SSSI 7 on the aforementioned grounds after a proposal by the
USSR. Map 1 shows the location of the Haswell Islands (except Vkhodnoy Island), Mirny station, and logistic activity sites. It was renamed and renumbered as ASPA No. 127 by Measure 1 (2002).

Currently it is proposed to detail the boundaries of the Antarctic Specially Protected Area, Haswell Island (66º31'S, 93º00'E), about 1 km2 in area and the adjacent section of Davis Sea fast ice of approximately 5 km2 (when present), that supports a colony of Emperor penguins (Map 2). It is one of a few Emperor penguin colonies in the vicinity of a permanent Antarctic station, and therefore it has advantages for the study of the species and its habitat.

Described by biologists during the first Soviet expeditions, the Area was studied in the 1970s and recent years, providing valuable materials for comparative analyses and monitoring of the long-term long environmental impact of a large Antarctic station.

2. Aims and Objectives

Research in the ASPA is conducted to provide a better understanding of how natural and anthropogenic environmental changes affect the status and dynamics of local populations of flora and fauna, and how these changes affect the interaction between key species of the Antarctic ecosystem.

Management at Haswell Island aims to:

- Avoid direct impact of logistic activities on the Area;
- Regulate access to the Area;
- Avoid anthropogenic changes in the structure and abundance of local populations of flora and fauna;
- Allow scientific research, provided it is for compelling scientific reasons that cannot be served elsewhere;

- Facilitate scientific research on the environment in the context of monitoring and assessment of human impact on populations:
- Encourage environmental education and awareness.

3. Management Activities

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

- When the vessel is approaching Mirny station and upon arrival at the station, all persons arriving shall be informed of the existence and location of the ASPA and the relevant provisions of the Management Plan.

- Copies of the Management Plan and maps of the Area showing its location shall be available at all units engaged in logistic and scientific activities on the Haswell Islands.

- A sign showing directions of the Area boundaries, with clear statements of entry restrictions ("No entry! Antarctic Specially Protected Area"), shall be placed at the crossing point of lines Gorev Island – Fulmar Island and Cape Mabus – eastern extremity of Haswell Island to help avoid inadvertent entry into the Area following the formation of fast ice which is safe for pedestrian and vehicle traffic. Information signs shall be installed at the top of Cape Mabus slope, and at station activity sites in the direct vicinity of the Area.

- Markers and signs erected within the Area shall be secured, maintained in good condition, and have no impact on the environment.

- Overflight shall only be allowed under those conditions as set out under *7. Permit Conditions*

The Management Plan shall be revised periodically to ensure that the values of the Antarctic Specially Protected Area are adequately protected. Any activity in the Area shall be preceded by the environmental impact assessment.

4. Period of Designation

Designated for an indefinite period.

5. Maps

Map 1: Location of the Haswell Islands, Mirny Station, and logistic activity sites.
Map 2: Boundaries of Antarctic Specially Protected Area 127, Haswell Island.
Map 3: Location of breeding seabird colonies.
Map 4: Topographic map of Haswell Island.

6. Description of the Area

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

The Area occupies a territory inside polygon ABFEDC (66º 31'10" S, 92º 59'20" E; 66º 31'10" S, 93º 03' E; 66º 32'30" S, 93º 03' E; 66º 32'30" S, 93º 01'E; 66º 31'45" S, 93º 01'E; 66º 31'45" S, 92º 59'20'' E) (Map 2). The marked section of fast ice in the Davis Sea encompasses the most likely routes taken by Emperor penguins during the breeding season.

Topography

The Area boundaries on fast ice closer to the station can be broadly (visually) identified on site as directions EF (Vkhodnoy Island – Fulmar Island) and ED (Cape Mabus – eastern extremity of

Haswell Island). A sign showing the directions of the Area boundaries, with clear statements of entry restrictions ("No entry! Antarctic Specially Protected Area"), shall be placed in point E. Information signs showing distance to the Area boundary shall be installed at station activity sites in the direct vicinity of the Area (at the top of Cape Mabus slope, and on Buromsky, Zykov, Fulmar, and Tokarev Islands).

It is highly unlikely that the outlying marine boundaries of the Area will be crossed inadvertently, as there is presently no activity this far away from the station. These boundaries have no visual features and shall be identified by the map.

There are no paths or roads within the Area.

Ice conditions

The Area comprises Haswell Island (the largest island in the archipelago), its littoral zone, and the adjacent section of fast ice in the Davis Sea. Russia's Mirny Observatory on Mirny Peninsula located in coastal nunataks south of the ASPA has been operational since 1956.

For the larger part of the year, the sea within the Area is covered with fast ice, whose width reaches 30-40 km by the end of winter. Fast ice breaks up between December 17 and March 9 (February 3, on average) and freezes between March 18 and May 5 (April 6, on average). The probability that the ice-free period off Mirny will last more than 1 month is 85%, more than 2 months 45%, and more than 3 months 25%. The Area is always full of icebergs frozen in the ice. In summer, when fast ice disappears, icebergs drift westward along the coast. Seawater temperature is always below zero. The tide has an irregular daily pattern.

Environmental domains analysis

Based on the Environmental Domains Analysis for Antarctica (Resolution 3(2008)) Haswell Island is located within Environment L *Continental coastal-zone ice sheet*.

Biological Features

Coastal waters support a rich benthic fauna. Fish fauna in the Area is dominated by various icefish species, while Antarctic toothfish (*Dissostichus mawsoni*) and Antarctic silverfish (*Pleuragramma antarcticum*) are less abundant. An ample forage base and the availability of suitable nesting sites create a favorable environment for numerous seabirds. According to records, there are 12 bird species in the vicinity of Mirny (Table 1).

The coastal fauna is mainly represented by pinnipeds, among which Weddell seals (*Leptonychotes weddelli*) are most abundant. Other Antarctic seal species can be seen occasionally in very small numbers. Minke whales (*Balaenoptera acutorostrata*) and killer whales (*Orcinus orca*) have frequently been observed near Mirny.

Table 1: The avifauna of the Haswell Islands (ASPA 127).

1	Emperor penguin (*Aptenodytes forsteri*)	B, M
2	Adelie penguin (*Pygoscelis adeliae)*	B, M
3	Chinstrap penguin (*Pygoscelis antarctica*)	V
4	Macaroni penguin (*Eudyptes chrysolophus*)	V
5	Southern fulmar (*Fulmarus glacioloides*)	B
6	Antarctic petrel (*Thalassoica antarctica*)	B
7	Cape petrel (*Daption capense*)	B
8	Snow petrel (*Pagodroma nivea*)	B
9	Southern giant petrel (Macronectes giganteus)	V
10	Wilson's storm petrel (Oceanites oceanicus)	B
11	Pomarine skua (Stercorarius pomarinus)	V
12	South-polar skua (Catharacta maccormicki)	B

13	Lonnberg skua Catharacta (Antarctica lonnbergi)	V
14	Kelp gull (*Larus dominicanus*)	V

Notes: B – breeding species; M – molting sites in the vicinity of the station; V – vagrant species.

At present, seabirds nest on six out of seventeen archipelago islands. Seven species breed directly on the islands, and one species – the Emperor penguin (Aptenodytes forsteri) – on fast ice. A few vagrant species have also been observed in the Area. In general, core species composition of the aviafauna remains stable during past 60 years, and is characteristic of the East Antarctica coastal areas. Recent updates to the species list (Table 1., added Southern giant petrel Macronectes giganteus and Lonnberg skua Catharacta Antarctica lonnbergi) are explained by more extensive ornithological observations at the Mirny station during last decade. All new species are recorded as vagrants only. At the same time, the Southern giant petrel observed in 2006 for the first time at Mirny, seems to become rare but regular visitor to the Area.

Emperor penguin (*Aptenodytes forsteri*)

The Emperor penguin colony of the Haswell Islands is located on fast ice in the Davis Sea 2 to 3 km north- east of the Mirny Observatory and usually within 1 km of Haswell Island. The colony was discovered and described by the Western Party of the Australasian Antarctic Expedition on November 25, 1912. However, a detailed study of the colony was initiated only after the establishment of the Mirny Observatory. Since its foundation in 1956, the Observatory has been conducting periodic monitoring of the size of the breeding population. The first round-the-year observation of the colony was initiated by E.S. Korotkevich in 1956 (Korotkevich, 1958), continued until 1962 (Makushok, 1959; Korotkevich, 1960; Prior, 1968), and was then resumed by V.M. Kamenev in the late 1960s-early 1970s (Kamenev, 1977). After a long break, observations of the avifauna were resumed at the area in 1999-2011 (Gavrilo, Mizin, 2007, Gavrilo, Mizin, 2011, Neelov et al., 2007).

Table 2 shows a schedule of various phenological events in the Emperor penguin colony of the Haswell Islands.

Penguins arrive at the colony site	Last 10 days in March
Peak of the mating period	Late April – first ten days in May
Commencement of egg laying	First 5 days in May
Commencement of hatching	July 5–15
Chicks start leaving brood pouches	Last 10 days in August
Chicks start getting together in creches	First 10 days in September
Chicks start molting	Late October – early November
Adult birds start molting	Last 10 days in November – first 5 days in December
The colony starts disintegrating	Last 10 days in November – mid-December
Birds abandon the colony site	Last 5 days in December – first 10 days in January

Table 2: Dates of phenological events in the Emperor penguin colony, Haswell Islands.

The most recent data on the colony status were obtained during 2010-2011 when the colony initially consisted of two sub-colonies 400 m apart. Single adult birds and those with eggs and chicks migrated between the subcolonies. Later, the third subcolony separated. All subcolonies were located and moved within the same area as in previous years, i.e. east andsouth-east off the Haswell Island.

During last decade, the Haswell colony of the emperor penguins should be considered rather stable and even slightly increasing . Highest population numbers as observed during egg laying period in 2010/2011 season reached ca. 13,000 adults, which is the maximal counts for the last 12years (RAE, unpublished data). According to estimates and censuses conducted in 1956–1966, the total population varied from 14,000 to
20,000 birds (Korotkevich, 1958, Makushok, 1959, Prior, 1964, Kamenev, 1977). After that, during 1970-s -1980-s population declined at ca. 30%, but later, in 2000-s, a recovery process is observed.

Comparative analysis of the emperor penguin population dynamics in two colonies located in the same ecoregion (80°E - 140°E), i.e. Haswell and Pointe Géologie, revealed similar trends during past 60 years (Barbraud et al., 2011). Before 1970-s penguin population at Pointe-Geologie Archipelago,Terre Adelie (ASPA 120) was stable, and at Haswell it was also stable or slightly decreasing. Population growth rate notably decreased and population numbers declined in both colonies during climatic regime shift in 1970-1980. Magnitude of decline was similar as well, and the numbers of breeding pairs correlated. Given that, one could suggest common large-scale environmental/climatic changes and related ecosystem shifts observed widely over the Southern Ocean might affect penguin populations. The same string negative factor is likely to impact both populations. The ice cover, which is known to effect emperor penguin ecology, is suggested to be such a factor. In particular, decrease in iced cover and earlier onset of the fast-ice break-up dates negatively impacted penguin survival and further breeding population numbers via changes in food availability as shown previously Barbraud, Weimerskirch, 2001, Jenouvrier et al., 2009). During past 20 years both colonies demonstrated positive population dynamics under conditions of increasing extent of the ice cover and shift of fast-ice break-up onset to the later dates.

Table 3: Factors affecting the population of Emperor penguins on the Haswell Islands and relevant mitigation actions.

		Actions to mitigate the impact of anthropogenic factors
Anthropogenic factors	Disturbance by visitors	Visits to the colony should be strictly regulated
	Collection of eggs	The collection of eggs is prohibited, except in accordance with a permit for research issued by a national authority.
	Disturbance by flights	Flight route and height should be selected in accordance with this Management Plan
Natural factors	Climate changes and related changes in food resources. Ice conditions affect food availability and survival of adults and chicks. (Decrease in sea ice extent in April – June leads to decline in population growth rate and population numbers decline. An early break-up of fast ice increases chick mortality).	

Data on changes in the size of other populations are less complete (Table 4). Long-term changes may show a negative trend. However, it's not possible to make well-grounded conclusions based just on the three surveys with not full coverage of the populations and which are several decades apart.

Table 4: Long-term changes in the size of bird populations on the Haswell Islands. Trend: 0 = uncertain, -1= negative, ? = supposed.

Species	**1960s-1970s, adults in individuals**	**1999/2001**	**2009/10, adults in individuals**	**Trend**
Adelie penguin	41,000-44,500	Ca. 31,000 adults	Ca. 27,000	-1
Southern fulmar	9,500-10000	2300 nests with clutches	Ca. 5,000	-1
Antarctic petrel	900-1050	150-200 nests with clutches	Ca. 500	-1
Cape petrel	750	150 nests with clutches	Ca. 300	-1
Snow petrel	600-700	60-75 nests with clutches	No data	-1 ?
Wilson's storm-petrel	400-500	Min 30 occupied nests	Over 80	-1 ?
South-polar skua	48 (24 pairs)	Min. 38 (19 pairs)	134 (62 pairs)	1

The data from Haswell Island area show possible long-term negative trends in different seabird species including both penguins and flying birds. It is possible that large-scaled climate changes may be responsible for the negative population dynamics in the Haswell Island area, not only in emperor penguin populations but also in other seabird populations except for the south-polar skua.

More research and further monitoring are needed to reveal population trends in the birds of Haswell Island and to understand their causes.

6(ii) Definition of seasons; restricted and prohibited zones within the Area

Entry into any part of the Area is allowed only for holders of a Permit issued by an appropriate National Authority.

Activity in the Area shall be subject to special restrictions during the bird breeding season:

- From mid-April to December in the vicinity of the Emperor penguin colony; and
- From October to March in the vicinity of the nesting sites on Haswell Island.

The location of the breeding colonies is shown in Map 3. Emperor penguins, which are especially sensitive to disturbance, shall also be protected outside the designated breeding site as the breeding site may vary in location.

6(iii) Structures within the Area

A beacon – a metal pole whose base is secured by stones – is located on Haswell Island. There are no other structures on the island.

A heated shack containing an emergency food supply may be located on one of the neighboring islands (but not on Haswell Island).

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

HSM No 9 Cemetery on Buromskiy Island is located in 200 m to boundary of the Area.

7. Permit Conditions

7(i) Permit conditions

Entry into the Area is prohibited unless in accordance with a Permit issued by an appropriate national authority. Issue of a Permit to enter the Area must satisfy the following conditions:

- A Permit is issued only for purposes specified in para. 2 of the Management Plan;
- Permits shall be issued for a stated period;
- The actions permitted will not jeopardize the ecosystems of the Area or interfere with existing scientific research;
- Visits to the Area under a Permit shall be allowed to organized groups accompanied by a authorized person. Relevant information shall be entered in the Visit Logbook specifying the date and purpose of the visit and the number of visitors. The leader of the Mirny station keeps the Logbook. The authorized person is appointed in accordance with national procedure; and
- A visit report shall be supplied to the authority named in the Permit by the end of stated period or annually.

Permits shall be issued for scientific research, monitoring studies, or inspections that do not require collection of biological materials or fauna samples, or that require collecting in small quantities. A Permit for a visit to or stay in the Area shall specify the scope of tasks to be implemented, the implementation period, and the maximum number of staff allowed to visit the Area.

7(ii) Access to and movement within the Area

Vehicles other than skidoos are prohibited within the Area.

When approaching or moving within the Area, care shall be taken to avoid any disturbance to birds and seals, especially during the breeding season. Deterioration of the conditions of or approaches to the bird nesting sites, or seal haulouts shall be prohibited at all times.

Haswell Island. The western or south-western slopes are most suitable for access (Map 4). Movement shall only be on foot.

Fast ice section. During the formation of fast ice which provides pedestrian and vehicle safety, entry into the section shall be at any suitable place from the Mirny station. The use of any vehicles in the Area shall be prohibited during the nest sitting season (May-July). When using skidoos, visitors shall not approach the Emperor penguin colony closer than 500 m (irrespective of its location).

Overflight of the Area is prohibited during the most sensitive period of the Emperor penguin breeding cycle, from April 15 to August 31.

During the remainder of the year, overflight of the Area shall be conducted according to the following restrictions (Table 5). Direct overflights of the seabird breeding colonies should be avoided whenever it is possible.

Table 5: Minimum overflight heights within the Area according to aircraft type.

Aircraft type	**Number of engines**	**Minimum height above ground**	
		Feet	**Meters**
Helicopter	1	2,460	750
Helicopter	2	3,300	1,000
Fixed-wing	1 or 2	2,460	750
Fixed-wing	4	3,300	1,000

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

- Research on avifauna and other environmental studies that cannot be conducted elsewhere;
- Management activities, including monitoring.
- Education visits to the Emperor penguins colony except of the early nesting period (May – July)

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

Structures or scientific equipment may be installed in the Area only for compelling scientific or management purposes approved by an appropriate authority pursuant to the effective regulations.

7(v) Location of field camps

Camping shall be allowed only for safety reasons, and every precaution shall be taken to avoid damage to the local ecosystem and disturbance to the local fauna.

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

No living organisms or chemicals other than chemicals required for scientific purposes specified in the Permit shall be introduced into the Area (chemicals introduced for scientific purposes shall be removed from the Area before the Permit expiry).

Fuel is not to be stored in the Area unless it is required for essential needs relating to the permitted activity. Anything introduced shall be for a stated period only, handled so that the risk to the ecosystem is minimized, and removed at the conclusion of the stated period. No permanent storage facilities shall be established in the Area.

7(vii) Taking of or harmful interference with native flora or fauna

Taking of or harmful interference with native flora or fauna is prohibited, except by Permit. In the case the activity is determined to have less than a minor or transitory impact, it should be conducted in accordance with the *SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica,* to be used as a minimum standard.

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

Collection or removal of anything not brought into the Area by the Permit holder shall only be for scientific or management purposes specified in the Permit.

However, human waste may be removed from the Area, and dead or pathological samples of fauna and flora may be removed for laboratory analysis.

7(ix) Disposal of waste

All waste shall be removed from the Area.

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

Permits to enter the Area may be granted to carry out scientific observation, monitoring, and site inspection activities, which may involve limited collection of fauna samples, eggs, and other biological materials for scientific purposes. To help maintain the environmental and scientific values of the Area, visitors shall take every precaution against the introduction of alien materials and organisms.

Any long-term monitoring sites shall be appropriately marked on a map and on site. A map showing the boundary of the ASPA shall be displayed at Mirny station. A copy of the Management Plan shall be displayed at Mirny station. A copy of the Management Plan shall be freely available at Mirny station.

Visits to the Area shall be limited to scientific, management and educational purposes.

7(xi) Requirements for reports

Parties should ensure that the principal holder of 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 the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas. 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

Androsova, E.I.. Antarctic and Subantarctic bryozoans // Soviet Antarctic Expedition Newsletter.-1973.-No.87.-P.65-69. (in Russian)

Averintsev, V.G. Ecology of sublittoral polychaetes in the Davis Sea // Animal Morphology, Systematics and Evolution. –L., 1978. –P. 41042. (in Russian)

Averintsev, V.G. Seasonal variations of sublittoral polychaetes in the Davis Sea // Marine Fauna Studies.- L.,1982.-Vol.. 28(36).-P.4-70. (in Russian)

Barbroud C. & Weimerskirch H. 2001 Emperor Penguins and climate change. Nature, 411: 183 185. Barbroud C., Gavrilo M., Mizin Yu., Weimerskirch H. Comparison of emperor penguin declines between Pointe Géologie and Haswell Island over the past 50 years. Antarctic Science. 2011. (Accepted)

Budylenko, G.A., and Pervushin, A.S. The migration of finwhales, sei whales and Minke whales in the Southern Hemisphere // Marine Mammals: Proceedings of VI All-Union Meeting.-Kiev, 1975.-Part.1.-P.57-59. (in Russian)

Bushueva, I.V. A new Acanthonotozommella species in the Davis Sea (East Antarctica) // Zool. Zhurn.-1978.-Vol.57, issue 3.-P.450-453. (in Russian)

Bushueva, I.V. A new Pseudharpinia (Amphipoda) species in the Davis Sea (Antarctica) // Zool. Zhurn.-1982.-Vol.61, issue.8.-P.1262-1265.

Bushueva, I.V. Some peculiarities of off-shore amphipod (Gammaridea) distribution in the Davis Sea (East Antarctica) // Hydrobiology and Biogeography of Cold and Moderate World Ocean Waters in the Off-shore Zone: Report Abstracts. –L., 1974. –P. 48-49. (in Russian)

Bushueva, I.V. Some peculiarities of Paramola walkeri ecology in the Davis Sea (East Antarctica) // Off-shore Biology: Abstracts of Reports Presented at the All-Union Conference. – Vladivostok, 1975, -P.21-22 (in Russian)

Chernov, A., Mizin, Yu. 2001 Avifauna observations at Mirny Station during RAE 44 (1999-2000) — The State of the Antarctic Environment as Shown by Real-time Data from Russia's Antarctic Stations. — SPb: AARI. (in Russian)

Doroshenko, N.V. The distribution of Minke whales (Balaenoptera acutorostrata Lac) in the Southern Hemisphere // V All-Union Meeting on Marine Mammal Research: Report Abstracts. - Makhachkala, 1972.- Part1.-P.181-185. (in Russian)

Egorova, E.N. Biogeographic composition and possible development of gastropods and bivalves in the Davis Sea, // Soviet Antarctic Expedition Newsletter.-1972.-No. 83.-P.70-76. (in Russian)

Egorova, E.N. Mollusks of the Davis Sea (East Antarctica).- L.:Nauka, 1982.-144 pp. - (Marine Fauna Research; No. 26(34). (in Russian)

Egorova, E.N. Zoogeographic composition of the mollusk fauna in the Davis Sea (East Antarctica) // Mollusks. Major Results of the Study: VI All-Union Mollusk Research Meeting.- L.,1979.- Vol.6.-P..78-79. (in Russian)

Gavrilo, M.V., Chupin, I.I., Mizin, Yu.A., and Chernov A.S. 2002. Study of the Biological Diversity of Antarctic Seabirds and Mammals. – Report on Antarctic Studies and Research under the World Ocean Federal Targeted Program. SPb: AARI (unpublished). (in Russian)

Gavrilo M., Mizin Yu. 2007. Penguin population dynamics in Haswell Archipelago area, ASPA № 127, East Antarctica. – p. 92 in Wohler E.j. (ed.) 2007. Abstracts of oral and poster presentations, 6th International Penguin Conference. Hobart, Australia, 3-7 September 2007

Gavrilo M., Mizin I. Current zoological researches in the area of Mirny station.Russian Polar Researches. Iss. 3. AARI, 2011

Gruzov, E.N. Echinoderms in coastal biocenoses of the Davis Sea (Antarctica) // Systematics, Evolution, Biology, and Distribution of Modern and Extinct Echinoderms.-L.,1977.-P.21-23. (in Russian)

Kamenev, V.M. Adaptive peculiarities of the reproduction cycle of some Antarctic birds. - Body Adaptation to Far North Conditions: Abstracts of Reports Presented at the All-Union Meeting. Tallinn, 1984. P. 72-76. (in Russian)

Kamenev, V.M. Antarctic petrels of Haswell Island // Soviet Antarctic Expedition Newsletter.-1979.- No.99.-P.78-84. (in Russian)

Kamenev, V.M. Ecology of Adelie penguins of the Haswell Islands // Soviet Antarctic Expedition Newsletter. 1971. No. 82. P. 67-71. (in Russian)

Kamenev, V.M. Ecology of Cape and snow petrels. - Soviet Antarctic Expedition Newsletter. 1988. No. 110. P. 117-129. (in Russian)

Kamenev, V.M. Ecology of Emperor penguins of the Haswell Islands. – The Adaptation of Penguins. M., 1977. P. 141-156. (in Russian)

Kamenev, V.M. Ecology of Wilson's storm petrels (Oceanites oceanicus Kuhl) on the Haswell Islands // Soviet Antarctic Expedition Newsletter. 1977. No. 94. P. 49-57. (in Russian)

Kamenev, V.M. Protected Antarctica. – Lecturer's Aid. L.: Znanie RSFSR, 1986. P. 1-17. (in Russian) Kamenev, V.M. The Antarctic fulmar (Fulmarus glacialoides) of the Haswell Islands // Soviet Antarctic Expedition Newsletter. - 1978. No. 98. P. 76-82. (in Russian)

Korotkevish, E.P. 1959 The bids of East Antarctica. – Arctic and Antarctic Issues. – No. 1. (in Russian)

Korotkevish, E.P. 1960 By radio from Antarctica. — Soviet Antarctic Expedition Newsletter. - № 20-24. (in Russian)

Krylov, V.I., Medvedev, L.P. The distribution of the Ceteans in the Atlantic and South Oceans // Soviet Antarctic Expedition Newsletter.-1971.-No. 82.-P.64-66. (in Russian)

Makushok, V.M. 1959 Biological takings and observations at the Mirny Observatory in 1958. — Soviet Antarctic Expedition Newsletter. – No. 6. (in Russian)

Minichev, Yu.R. Opisthobranchia (Gastropoda, Opisthobranchia) of the Davis Sea // Marine Fauna Reasearch. –L., 1972. –Vol. 11(19). –P.358-382. (in Russian)

Mizin, Yu.V. 2004 Report on the Ecological and Environmental Research Program Conducted by RAE 48 at the Mirny Observatory – SPb: AARI, unpublished. (in Russian)

Neelov A.V., Smirnov I.S., Gavrilo M.V. 2007 50 years of the Russian studies of antarctic ecosystems. – Problemy Arktiki I Antarktiki. – № 76. – Pp. 113 – 130

Popov, L.A., Studenetskaya, I.R. Ice-based Antarctic seals // The Use of the World Ocean Resources for Fishery Needs. An overview by the Central Research Institute of Fishery Information and Technical Studies. Series. 1.- M., 1971. Issue 5.-P.3-42. (in Russian)

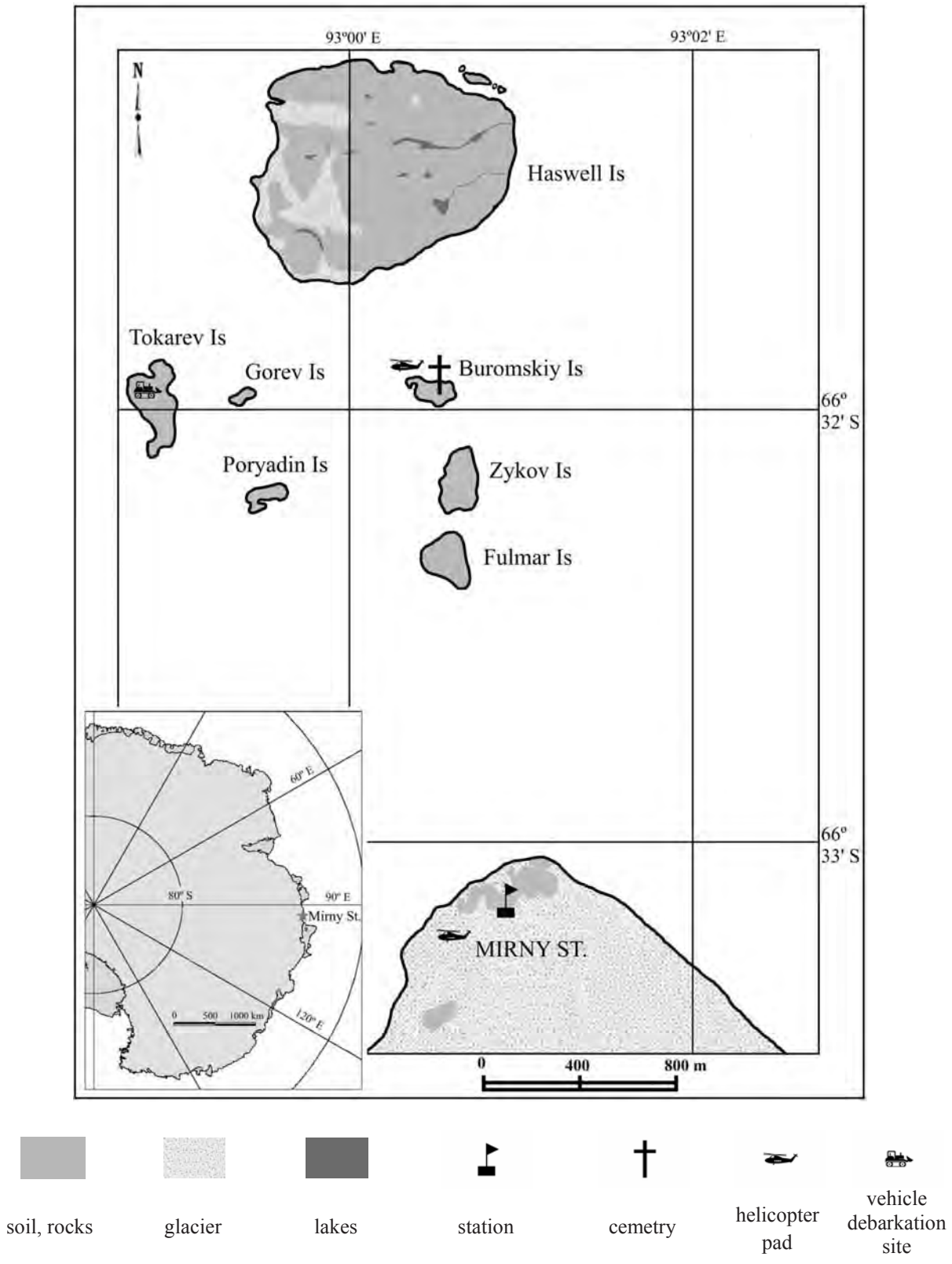
Prior, M.E. 1964 Observations of Emperor penguins (Aptenodytes forsteri Gray) in the Mirny area in 1962. Soviet Antarctic Expedition Newsletter. – No. 47. (in Russian)

Pushkin, A.F. Some ecological and zoogeographic peculiarities of the Pantopoda fauna in the Davis Sea // Hydrobiology and Biogeography of Cold and Moderate World Ocean Waters in the Off-shore Zone: Report Abstracts.- L.,1974.-P.43-45. (in Russian)

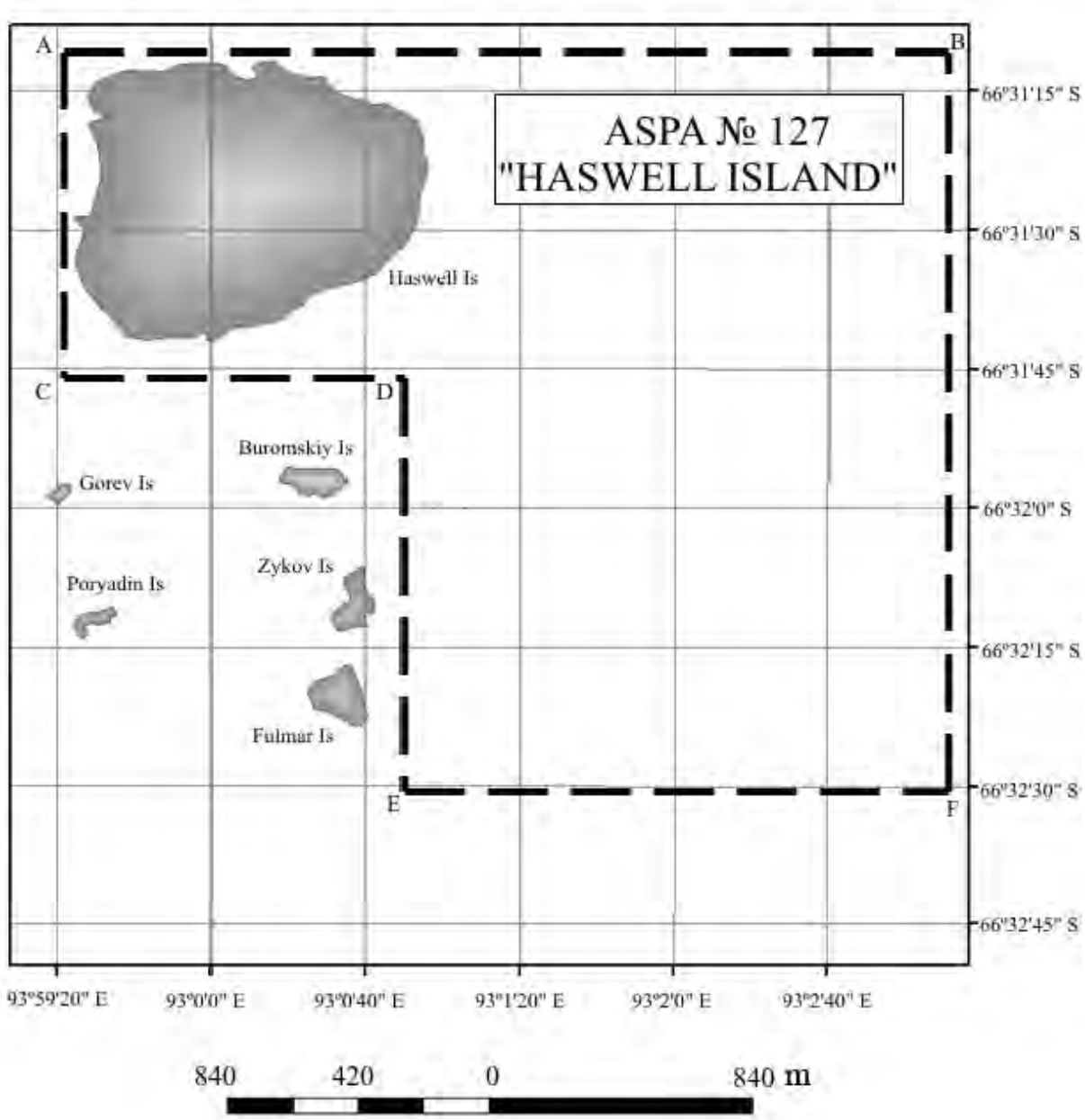
Splettstoesser J.F., Maria Gavrilo, Carmen Field, Conrad Field, Peter Harrison, M. Messicl, P. Oxford, F. Todd 2000 Notes on Antarctic wildlife: Ross seals *Ommatophoca rossii* and Emperor penguins *Aptenodytes forsteri*. New Zealand Journal of Zoology, 27: 137-142.

Stepaniants, R.D. Coastal hydrozoans of the Davis Sea (materials of the 11th Soviet Antarctic Expedition, 1965/66) // Marine Fauna Research.- L.,1972.-Vol.11(19).-P.56-79. (in Russian)
June 5, 1998). [Oslo, Royal Ministry of Foreign Affairs], P. – 93 – 130. (in Russian).

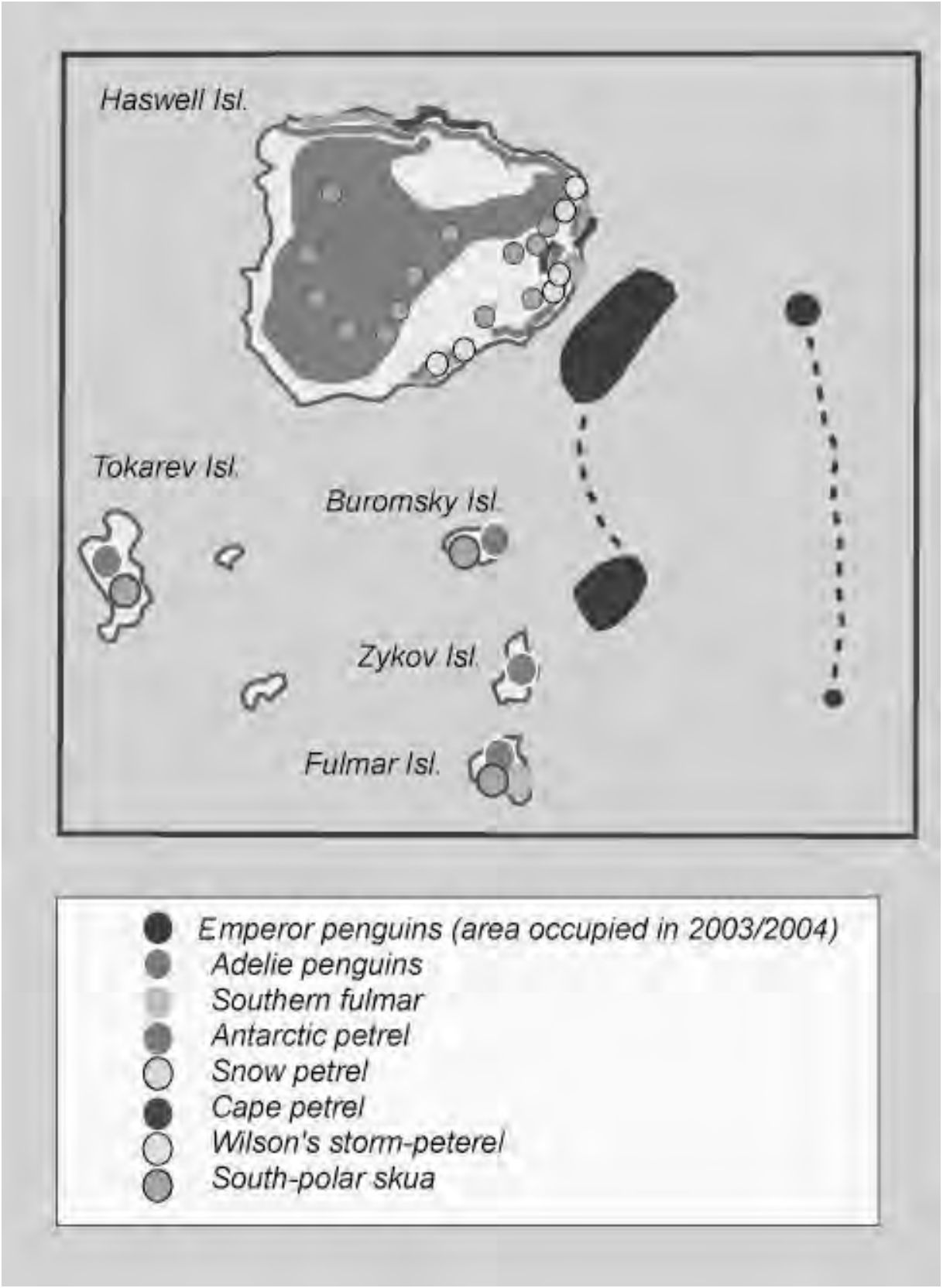
Map 1: Location of the Haswell Islands, Mirny Station, and logistic activity sites.



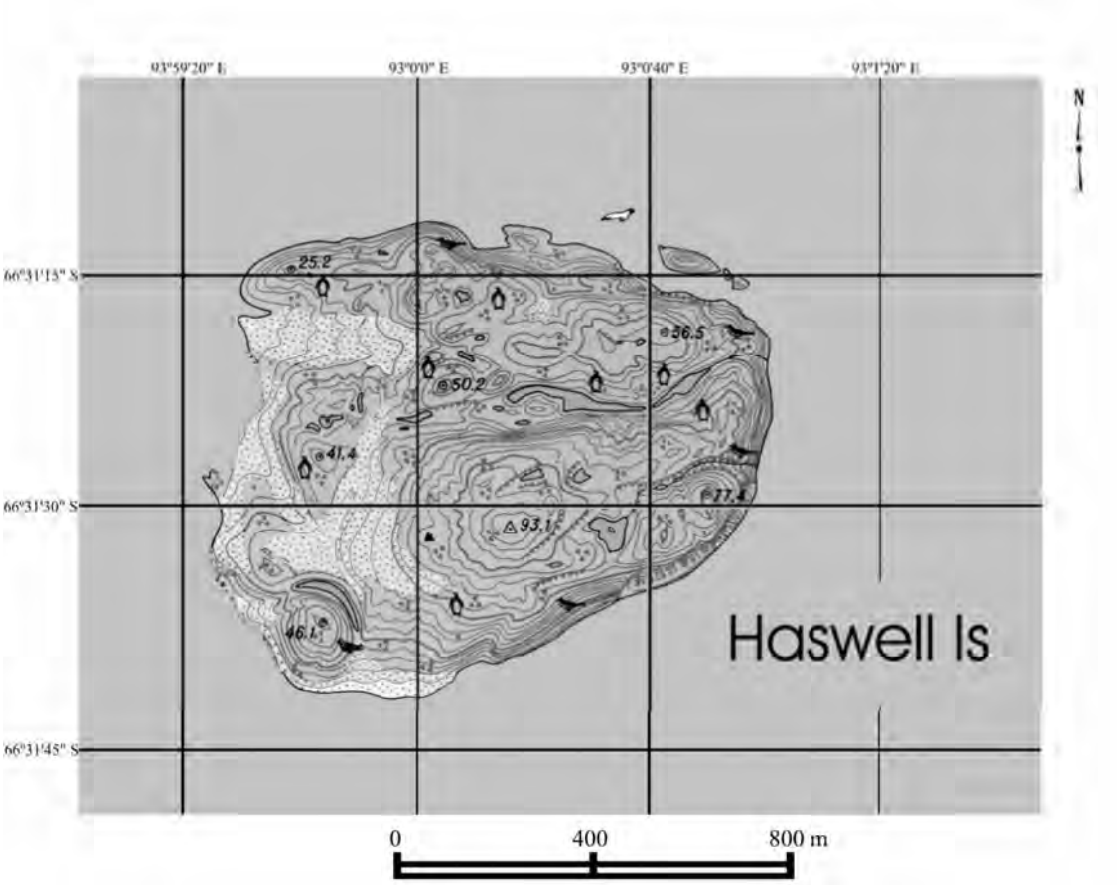
Map 2: Boundaries of Antarctic Specially Protected Area 127, Haswell Island.



Map 3: Location of breeding seabird colonies.



Map 4: Topographic map of Haswell Island.



Antarctic Specially Protected Area No 131 (Canada Glacier, Lake Fryxell, Taylor Valley, 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 Canada Glacier, Lake Fryxell, Taylor Valley, Victoria Land as Site of Special Scienti c Interest ("SSSI") No 12 and annexed a Management Plan for the site;
- Recommendation XVI-7 (1987), which extended the expiry date of SSSI 12 to 31 December 2001;
- Measure 3 (1997), which adopted a revised Management Plan for SSSI 12;
- Decision 1 (2002), which renamed and renumbered SSSI 12 as ASPA 131;
- Measure 1 (2006), which adopted a revised Management Plan for ASPA 131;

Recalling that Measure 3 (1997) has not become effective;

Recalling that Recommendation XVI-7 (1987) has not become effective and that it is designated as no longer current by Decision 1 (2011);

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 131;

Desiring to replace the existing Management Plan for ASPA 131 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 131 (Canada Glacier, Lake Fryxell, Taylor Valley, Victoria Land), which is annexed to this Measure, be approved;
2. the prior Management Plans for ASPA 131, including the one annexed to Measure 1 (2006), shall cease to be effective; and
3. Measure 3 (1997), which has not become effective, be withdrawn.

Measure 6 (2011) – Annex

Management Plan For Antarctic Specially Protected Area No. 131 CANADA GLACIER, LAKE FRYXELL, TAYLOR VALLEY, VICTORIA LAND

1. Description of values to be protected

In 1985, an area of approximately 1 km^2 between the east side of Canada Glacier and Lake Fryxell was designated in Recommendation XIII-8 (1985) as SSSI No. 12, following a proposal by New Zealand on the grounds that it contained some of the richest plant growth (bryophytes and algae) in the McMurdo Dry Valleys. The Area is designated primarily to protect the site's scientific and ecological values.

The boundaries of the Area were increased by Measure 3 (1997) to include biologically rich areas that were previously excluded. The Area was redesignated by Decision 1 (2002) as Antarctic Specially Protected Area (ASPA) No. 131. and a revised Management Plan was adopted through Measure 1 (2006).

The Area comprises sloping ice-free ground with summer ponds and small meltwater streams draining from Canada Glacier towards Lake Fryxell. Most of the plant growth occurs in a wet area (referred to as 'the flush') close to the glacier in the central part of the Area. The composition and distribution of the moss, lichen, cyanobacteria, bacteria and algae communities in the Area are correlated closely with the water regime. Thus, hydrology and water quality are important to the values of the site.

The Area has been well-studied and documented, which adds to its scientific value. The vegetation communities, particularly the bryophytes, are vulnerable to disturbance by trampling and sampling. Damaged areas may be slow to recover. Sites damaged at known times in the past have been identified, which are valuable in that they provide one of the few areas in the McMurdo Dry Valleys where the long-term effects of disturbance, and recovery rates, can be measured.

The Area is of regional significance and remains of exceptional scientific value for ecological investigations. Increasing pressure from scientific, logistic and tourist activities in the region coupled with the vulnerability of the Area to disturbance through trampling, sampling, pollution or introduction of non-native species mean the values of the Area continue to require on-going protection.

2. Aims and objectives

Management of Canada Glacier 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 while ensuring protection from over-sampling;

- allow other scientific research in the Area provided it is for compelling reasons which cannot be served elsewhere;
- prevent or minimise the introduction to the Area of alien plants, animals and microbes; and
- 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:

- Copies of this Management Plan, including maps of the Area, shall be made available at adjacent operational research stations and all of the research hut facilities located in the Taylor Valley that are within 20 km of the Area.
- Signs illustrating the location and boundaries of the Area, with clear statements of entry restrictions, shall be placed at appropriate locations on the boundary of the Area to help avoid inadvertent entry.
- Markers, signs or other structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition and removed when no longer required.
- The Area shall be visited as necessary, and no less than once every five years, to assess whether it continues to serve the purposes for which it was designated and to ensure that management activities are adequate.
- National Antarctic Programmes operating 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: Canada Glacier, Lake Fryxell, Taylor Valley, Regional Topographic Map.
Map specifications: Projection - Lambert conformal conic. Standard parallels - 1st 79° 18' 00" S; 2nd 76° 42' 00"S. Central Meridian - 162° 30' 00" E. Latitude of Origin - 78° 01' 16.2106" S. Spheroid - WGS84.

Map B: Canada Glacier, Lake Fryxell, Taylor Valley, Vegetation Density Map.
Map specifications are the same as those for Map A. Contours are derived from combining orthophotograph and Landsat images. Precise areas of moist ground associated with the flush are subject to variation seasonally and inter-annually.

6. Description of the Area

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

Canada Glacier is situated in the Taylor Valley, in the McMurdo Dry Valleys. The designated Area encompasses most of the glacier forefront area on the east side of the lower Canada Glacier, on the north shore of Lake Fryxell (77° 37' S, 163° 03' E: Map A). It comprises gently to moderately sloping ice-free ground at an elevation of 20 m to 220 m with seasonal melt water ponds and streams draining Canada Glacier into Lake Fryxell.

The southern boundary of the Area is defined as the shoreline of Lake Fryxell, to the water's edge. This boundary extends northeast for approximately 1 km along the shoreline from where Canada Glacier meets Lake Fryxell (77° 37.20’ S, 163° 3.64’ E) to the southeast corner of the boundary which is marked with a cairn (77° 36.83' S, 163° 4.88' E) adjacent to a small island in Lake Fryxell. The island was once a part of a small peninsula extending into Lake Fryxell but recent lake level rise has turned it into an island (Map B). The peninsula was once marked by a large split rock surrounded by a circle of rocks which was a benchmark for the 1985 NZ survey of the original SSSI, but is no longer visible. A wooden post marking the Dry Valley Drilling Project Site 7 (1973) is still visible on the island.

A moraine ridge extending upslope from the southeast corner of the boundary in a northerly direction defines the eastern boundary of the Area. A cairn (77° 36.68' S, 163° 4.40' E) is located on a knoll on this ridge 450 m from the southeast corner of the boundary. The ridge dips sharply before joining the featureless slope of the main Taylor Valley wall. The northeast boundary corner of the Area is in this dip and is marked by a cairn (77° 36.43' S, 163° 3.73' E).

From the northeast boundary cairn, the northern boundary slopes gently upwards and west for 1.7 km to Canada Glacier, to the point where the stream flows from the glacier and snow field, through a conspicuously narrow gap in the moraine (77° 36.42’ S, 162° 59.69’ E).

The western boundary follows the glacier edge for about 1 km, down a slope of lateral moraine of fairly even gradient to the southwest corner of the boundary where the glacier meets the lake shore (77° 37.20’ S, 163° 3.64’ E).

The flush area at Canada Glacier is believed to be the largest high density area of vegetation in the McMurdo Dry Valleys (Map B). The summer water flow, in conjunction with the microtopography, has the greatest influence in determining where mosses, lichens, cyanobacteria, bacteria and algae grow. The glacier face also provides protection from destructive winds which could blow the mosses away in their freeze dry state and from abrasion from wind borne dust.

The flush is located close to the glacier edge. There are two main vegetated areas, separated to the north and south by a small, shallow pond (Map B). The flush area is gently sloping and very moist in summer with areas of wet ground, numerous small ponds and rivulets. The slopes above this area are drier, but vegetation colonises several small stream channels which extend parallel to the glacier from the upper boundary of the Area down to the flush. Undulating moraines assist accumulation of persistent snow patches on this slope, which may also provide moisture for plant growth. Stream channels, and associated vegetation, become less obvious with distance from the glacier (Map B). These slopes and the central flush are drained to the southeast by Canada Stream. Hydrological data collected from this stream

measured the average discharge rate of Canada Stream when it was flowing as 26.41 L/s [min = 0.0 L/s and max = 190.4 L/s] from November 2009 to February 2010. The average water temperature over this time was 3.96 °C [min = -0.1 °C and max = 11.73 °C] (http://www.mcmlter.org/).

Four moss species have been identified from the flush area: *Bryum argenteum* (previously referred to as *Bryum subrotundifolium)* and *Hennediella heimii* (previously referred to as *Pottia heimii)* dominate, with rare occurrences of *Bryum pseudotriquetrum* and *Syntrichia sarconeurum* (formerly known as *Sarconeurum glaciale*). *B. argenteum* occurs mainly in areas of flowing water and seepage. Where water is flowing, a high proportion of this moss has epiphytic *Nostoc* communities associated with it. Towards the edges of the flowing water zones or on higher ground, *Hennediella heimii* dominates. Sporophytes of *Hennediella heimii* are found at this location and may be the most southerly recorded fruiting location for a moss.

Lichen growth in the Area is inconspicuous, but the epilithic lichens, *Carbonea vorticosa, Sarcogyne privigna*, *Lecanora expectans, Rhizoplaca melanophthalma* and *Caloplaca citrina* may be found in a small area near the outflow of the pond near Canada Glacier. Chasmoendolithic lichens also occur in many boulders throughout the flush area.

Over 37 species of freshwater algae and cyanobacteria have been described at the site. The upper part of Canada Stream superficially appears sparse but encrusting communities dominated by cyanobacterium grow on the sides and undersides of stones and boulders. The green alga *Prasiola calophylla* and cyanobacterium *Chamaesiphon subglobosus* have been observed only in this upper part of the stream. *Prasiola calophylla,* growing in dense green ribbons beneath stones in the stream, is generally only apparent when stones are overturned. Cyanobacterial mats, comprising a diverse assemblage of species (including *Oscillatoria, Pseudanabaena, Leptolyngbya, Phormidium, Gloeocapsa, Calothrix* and *Nostoc*) are extensive in the middle and lower reaches of the stream and more diverse than those in the upper stream. Mucilaginous colonies of *Nostoc commune* dominate standing water in the central flush and grow epiphytically on mosses in the wetted margins of water courses, while cyanobacterial mats cover much of the mineral fines and gravels in flowing sections. The filamentous green alga *Binuclearia* is found streaming out in the flow in the middle reaches of the stream. The lower stream is similar in floral composition to the upper, although the algae *Tribonema elegans* and *Binuclearia* have been reported as abundant, but *Prasiola calophylla* is absent. *Tribonema elegans* is rarely encountered in this region of Antarctica.

Invertebrates from six phyla have been described in the Area: the three main groups are Rotifera, Nematoda and Tardigrada, with Protozoa, Platyhelminthes, and Arthropoda also present.

The Canada flush vegetation has been described as profuse but lacking in diversity, when compared to other botanically rich sites in Antarctica. This may be attributable at least in part to the oligotrophic nature of the site. Water flowing through the stream is similar to glacial ice melt, with conductivity in December 2010 of close to 30 $\mu S\ cm^{-1}$ from the point where it left the glacier to the delta where it enters the lake. The prevalence of nitrogen fixing cyanobacteria (*Nostoc* and *Calothrix* species) further supports the view of a low nutrient status.

Based on the Environmental Domain Analysis for Antarctica (Resolution 3 (2008)), Canada Glacier is located within Environment S *McMurdo South Victoria Land geologic*.

Evidence of past human activity is noticeable within the Area. Within the flush area, damage to the vegetation including paths and footprints and sites of experimental removal of core samples and larger clumps from moss turfs are visible. A number of old markers are also present in the flush area.

A plastic greenhouse was erected within the Area close to the flush from 1979 to 1983 for research and experimental growth of garden vegetables. The structure was removed at the end of each season. In 1983 it was destroyed by a winter storm. Remains of the greenhouse found in the Area have since been removed.

Near the flush area, the first site of the New Zealand hut at Canada Glacier consisted of paths marked by lines of rocks, areas cleared for use as campsites, an old helicopter pad, and several low rock structures. A series of at least four shallow pits (~1 m in depth) were also dug close to the site. This site was relocated to a second site in 1989 and the first hut site was remediated. The second hut site comprised two small buildings, several new campsites, and a helicopter pad. The buildings were removed completely in the 1995–96 season. However, the helicopter pad remains and is the only helicopter landing site in the Area. This camp site area is still the preferred camping site in the Area (Map B).

A weir is present on Canada Stream (see Section 6(iii)). A path from the Lake Fryxell Camp Facilities Zone is located between the lake shore and the weir on Canada Stream (Map B). Another path exists between the designated camp site and the Canada Glacier edge, crossing a moist area of plant growth, but is not indicated on the map. An access route is also located between Lake Hoare Camp Facilities Zone and Lake Fryxell Camp Facilities Zone running just above the northern boundary (Maps A and B).

6(ii) Special zones within the Area
None.

6(iii) Location of structures within and adjacent to the Area
A rock weir was constructed in the constricted part of Canada Stream in the 1981/1982 season and was fully removed at the end of the season. In 1990 a more substantial weir and 9-inch Parshall flume were installed nearby (Maps B). The flume is made of black fibreglass. The weir consists of polyester sandbags filled with alluvium from near the stream channel. Areas disturbed during construction were restored and after one season were not evident. The upstream side of the weir is lined with vinyl-coated nylon. A notch has been built into the weir for relief in case of high flow. Clearance of seasonal snow from the channel has been necessary to prevent water from backing up at the weir. Data logging instrumentation and batteries are stored in a plywood crate located nearby on the north side of the stream. The weir is maintained by the McMurdo Dry Valleys Long Term Ecological Research project.

Three cairns mark the Area boundaries.

The Lake Fryxell Camp Facilities Zone (USA) is located 1.5 km to the east of the Area (20 m asl) midway along Lake Fryxell on the north side of the lake. The F6 Camp Facilities Zone is located approximately 10 km to the east of the Area on the south side of Lake Fryxell. The Lake Hoare Camp Facilities Zone (USA) is located 3 km to the west of the Area (65 m asl) on the western side of Canada Glacier at the base of the glacier on the north side of Lake

Hoare. The Taylor Valley Visitor Zone is located to the south of the Area at the terminus of Canada Glacier (Map A).

6(iv) Location of other protected areas in the vicinity
The nearest protected areas to Canada Glacier are:

- Linnaeus Terrace, Asgard Range (ASPA No. 138) 47 km west in the Wright Valley; and
- Barwick and Balham Valleys, Southern Victoria Land (ASPA No. 123) 50 km to the northwest (Map A, Inset).

7. Terms and conditions for entry Permits

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 reasons essential to the management of the Area;
- the actions permitted will not jeopardise the ecological or scientific values of the Area;
- access to any zone marked as possessing medium or higher vegetation density (Map B) should be carefully considered and special conditions to access such areas should be attached to the Permit;
- any management activities are in support of the aims 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; and
- the Permit shall be issued for a stated period.

7(i) Access to and movement within or over the Area
Access to the Area shall be by foot or by helicopter. Vehicles are prohibited within the Area and all movement within the Area should be on foot.

Pedestrians travelling up or down the valley shall not enter the Area without a Permit. Permitted visitors entering the Area are encouraged to keep to established paths where possible. Visitors should avoid walking on visible vegetation or through stream beds. Care should be exercised when walking in areas of moist ground, where foot traffic can easily damage sensitive soils, plant, algal and bacteria communities, and degrade water quality: walk around such areas, on ice or rocky ground, and step on larger stones when stream crossing is unavoidable. Care should also be taken around salt-encrusted vegetation in drier areas, which can be inconspicuous. 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.

Where possible, helicopters should land at existing landing sites in nearby Facilities Zones and the Visitor Zone. Helicopter access to the Area should be approached from south of the line marked on Map B. Helicopters shall land only at the designated landing site (163° 02.88' E, 77° 36.97' S: Map B). Over flight of the Area should generally be avoided. Within the Area overflights less than 100 m Above Ground Level (AGL) north of the line indicated on

Map B are prohibited. Exceptions to these flight restrictions will only be granted for an exceptional scientific or management purpose and must be specifically authorised by Permit. Use of helicopter smoke grenades within the Area is prohibited unless absolutely necessary for safety, and then these should be retrieved. 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 site unless specifically authorised by a Permit.

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

- Scientific research that will not jeopardise the ecosystem of the Area;
- Essential management activities, including monitoring and inspection.

In view of the importance of the water regime to the ecosystem, activities should be conducted so that disturbance to water courses and water quality is minimised. Activities occurring outside of the Area (e.g. on the Canada Glacier) which may have the potential to affect water quantity and quality should be planned and conducted taking possible downstream effects into account. Those conducting activities within the Area should also be mindful of any downstream effects within the Area and on endorheic Lake Fryxell.

7(iii) Installation, modification or removal of structures

No structures are to be erected within the Area, or scientific equipment installed, except for compelling scientific or management reasons as specified in a permit. All markers, structures or scientific equipment installed in the Area must be authorised by a Permit and clearly identified by country, name of the principal investigator, year of installation and date of expected removal. All such items should be free of organisms, propagules (e.g. seeds, eggs) and non-sterile soil, and be made of materials that pose minimal risk of contamination of the Area. Removal of specific structures or equipment for which the Permit has expired shall be a condition of the Permit. Permanent structures or installations are prohibited.

7(iv) Location of field camps

Nearby Facilities Zones outside of the Area should be used as a base for work in the Area (Map A). Camping at the designated campsite (Map B) may be permitted to meet specific essential scientific or management needs.

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 and precautions listed in paragraph 7(ix) below 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 or other chemicals shall not be stored in the Area, unless required for essential purposes connected with the activity for which the Permit has been granted, and must be contained within an emergency cache authorized by an appropriate authority. All materials introduced shall be for a stated period only, be removed at or before the conclusion of that stated period, and 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

Taking of, or harmful interference with, native flora and fauna is prohibited, except in accordance with a separate 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 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) 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. Similarly, sampling is to be carried out using techniques which minimise disturbance to the Area as well as duplication. 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 removal is likely to be greater than leaving the material in situ: if the impact of removal is likely to be greater than leaving the material in situ the appropriate authority should 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 continue to meet the aims and objectives of the Management Plan
Permits may be granted to enter the Area to:

- carry out biological monitoring and Area inspection activities, which may involve the collection of a small number of samples or data for analysis or review;
- erect or maintain signposts, structures or scientific equipment;
- carry out protective measures;

Any specific sites of long-term monitoring shall be appropriately marked on site and on maps of the Area. A GPS position should be obtained for sites of long-term monitoring and scientific sampling for lodgement with the Antarctic Master Directory system through the appropriate national authority. If appropriate, metadata should also be provided for the Antarctic Master Directory system through the appropriate national authority.

To help maintain the ecological and scientific values of the plant communities found 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 minimise the risk of introductions, visitors shall thoroughly clean footwear and any equipment to be used in the area particularly camping and sampling equipment and markers before entering the Area.

7(x) Requirements for reports
The principal permit holder for each visit to the Area shall submit a report to the appropriate national authority as soon as practicable, and no later than six months after the visit has been completed. Such reports should include, as appropriate, the information identified in the visit report form contained in the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas.

If appropriate, the national authority should also forward a copy of the visit report to the Party that proposed the Management Plan, to assist in managing the Area and reviewing the Management Plan. Parties should maintain a record of such activities and report them in the Annual Exchange of Information. Parties should, wherever possible, deposit originals or copies of such original visit 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.

8. Bibliography

Broady, P.A. 1982. Taxonomy and ecology of algae in a freshwater stream in Taylor Valley, Victoria Land, Antarctica. Archivs fur Hydrobiologia 32 (Supplement 63 (3), Algological Studies): 331-349.

Conovitz, P.A., McKnight, D.M., MacDonald, L.H., Fountain, A.G. and House, H.R. 1998. Hydrologic processes influencing stream flow variation in Fryxell Basin, Antarctica. Ecosystem Processes in a Polar Desert: The McMurdo Dry Valleys, Antarctica. Antarctic Research Series 72: 93-108.

Green, T.G.A., Seppelt, R.D. and Schwarz, A-M.J. 1992. Epilithic lichens on the floor of the Taylor Valley, Ross Dependency, Antarctica. Lichenologist 24(1): 57-61.

Lewis, K.J., Fountain, A.G. and Dana, G.L. 1999. How important is terminus cliff melt? A study of the Canada Glacier terminus, Taylor Valley, Antarctica. Global and Planetary Change 22(1-4): 105-115.

Lewis, K.J., Fountain, A.G. and Dana, G.L. 1998. Surface energy balance and meltwater production for a Dry Valley glacier, Taylor Valley, Antarctica. International Symposium on Antarctica and Global Change: Interactions and Impacts, Hobart, Tasmania, Australia, July 13-18, 1997. Papers. Edited by W.F. Budd, et al; Annals of glaciology, Vol.27, p.603-609. United Kingdom.

McKnight, D.M. and Tate, C.M. 1997. Canada Stream: A glacial meltwater stream in Taylor Valley, South Victoria Land, Antarctica. Journal of the North American Benthological Society 16(1): 14-17.

Pannewitz, S., Green, T.G.A., Scheiddegger, C., Schlensog, M. and Schroeter, B. 2003. Activity pattern of the moss *Hennediella heimii* (Hedw.) Zand. in the Dry Valleys, Southern Victoria Land, Antarctica during the mid-austral summer. Polar Biology 26(8): 545-551.

Seppelt, R.D. and Green, T.G.A. 1998. A bryophyte flora for Southern Victoria Land, Antarctica. New Zealand Journal of Botany 36: 617-635.

Seppelt, R.D., Green, T.G.A., Schwarz, A-M.J. and Frost, A. 1992. Extreme southern locations for moss sporophytes in Antarctica. Antarctic Science 4: 37-39.

Seppelt, R.D., Turk, R., Green, T.G.A., Moser, G., Pannewitz, S., Sancho, L.G. and Schroeter, B. 2010. Lichen and moss communities of Botany Bay, Granite Harbour, Ross Sea, Antarctica. Antarctic Science 22(6): 691-702.

Schwarz, A.-M. J., Green, J.D., Green, T.G.A. and Seppelt, R.D. 1993. Invertebrates associated with moss communities at Canada Glacier, southern Victoria Land, Antarctica. Polar Biology 13(3): 157-162.

Schwarz, A-M. J., Green, T.G.A. and Seppelt, R.D. 1992. Terrestrial vegetation at Canada Glacier, South Victoria Land, Antarctica. Polar Biology 12: 397-404.

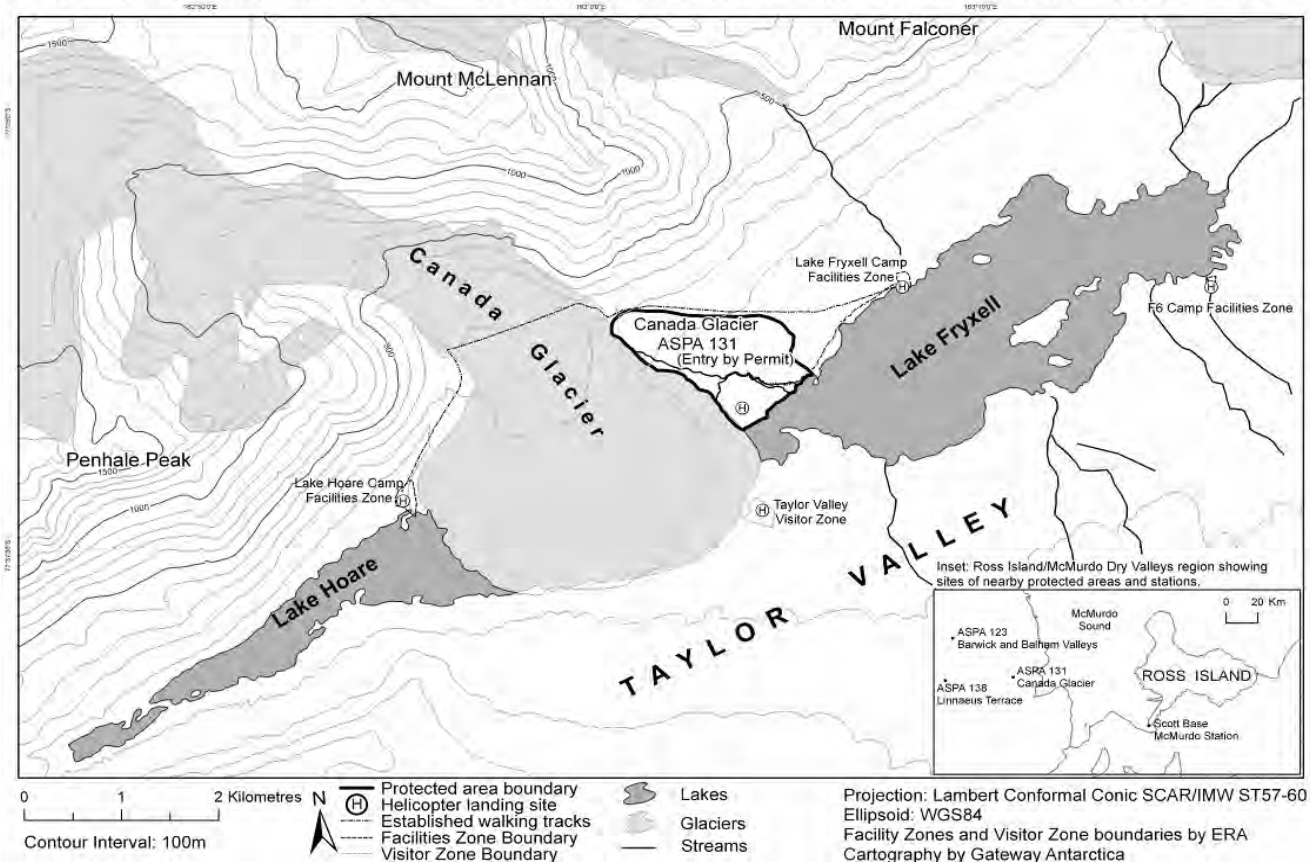
Sjoling, S. and Cowan, D.A. 2000. Detecting human bacterial contamination in Antarctic soils. Polar Biology 23(9): 644-650.

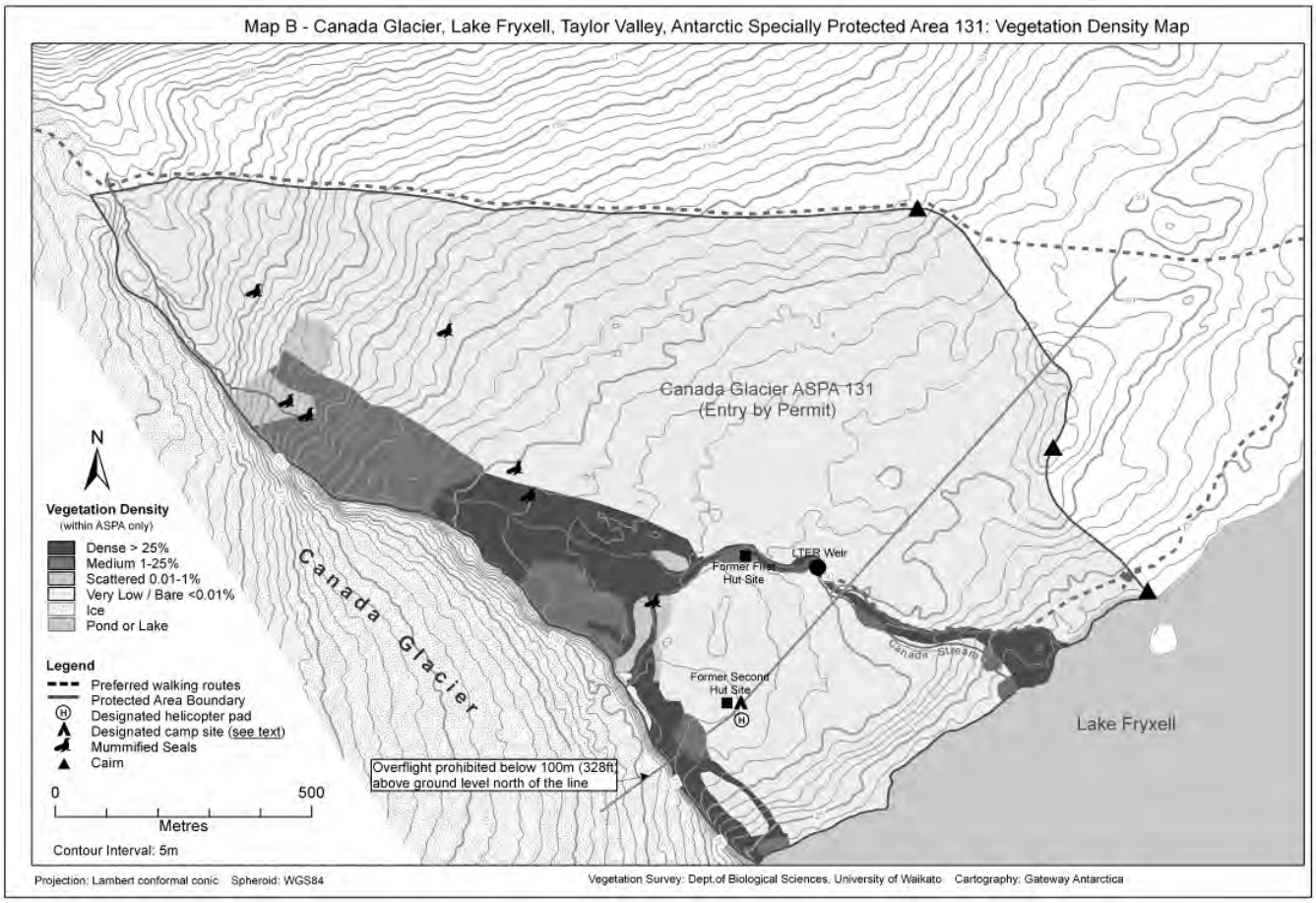
Skotnicki, M.L., Ninham, J.A. and Selkirk, P.M. 1999. Genetic diversity and dispersal of the moss *Sarconeurum glaciale* on Ross Island, East Antarctica. Molecular Ecology 8(5): 753-
762.

Strandtmann, R.W. and George, J.E. 1973. Distribution of the Antarctic mite *Stereotydeus mollis* Womersley and Strandtmann in South Victoria Land. Antarctic Journal of the USA
8:209-211.

Vandal, G.M., Mason, R.P., McKnight, D.M. and Fitzgerald, W. 1998. Mercury speciation and distribution in a polar desert lake (Lake Hoare, Antarctica) and two glacial meltwater streams. Science of the Total Environment 213(1-3): 229-237.

Map A - Canada Glacier, Lake Fryxell, Taylor Valley, Antarctic Specially Protected Area 131: Regional Topographic Map




Map B - Canada Glacier, Lake Fryxell, Taylor Valley, Antarctic Specially Protected Area 131: Vegetation Density Map
Canada Glacier ASPA 131
(Entry by Permit)
N
Vegetation Density
(within ASPA only)
Dense > 25%
Medium 1-25%
Scattered 0.01-1%
Very Low / Bare <0.01%
Ice
Pond or Lake
Legend
Preferred walking routes
Protected Area Boundary
Designated helicopter pad
Designated camp site (see text)
Mummified Seals
Cairn
0
500
Metres
Contour Interval: 5m
Canada Glacier
Former First Hut Site
LTER Weir
Canada Stream
Former Second Hut Site
Lake Fryxell
Overflight prohibited below 100m (328ft) above ground level north of the line
Projection: Lambert conformal conic Spheroid: WGS84
Vegetation Survey: Dept.of Biological Sciences, University of Waikato Cartography: Gateway Antarctica

Measure 7

Antarctic Specially Protected Area No 149 (Cape Shirreff and San Telmo Island, Livingston Island, South Shetland Islands): 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-11 (1966), which designated Cape Sherriff and San Telmo Island, Livingston Island, South Shetland Islands as Specially Protected Area ("SPA") No 11;
- Recommendation XV-7 (1989), which terminated SPA 11 and redesignated the area as Site of Special Scientific Interest ("SSSI") No 32 and annexed a Management Plan for the site;
- Resolution 3 (1996), which extended the expiry date of SSSI 32 from 31 December 1999 to 31 December 2000;
- Measure 2 (2000), which extended the expiry date of SSSI 32 from 31 December 2000 to 31 December 2005;
- Decision 1 (2002), which renamed and renumbered SPA 11 as ASPA 149;
- Measure 2 (2005), which adopted a revised Management Plan for ASPA 149;

Recalling that Recommendation XV-7 (1989) and Measure 2 (2000) have not become effective, and that Measure 2 (2000) was withdrawn by Measure 5 (2009);

Recalling that Recommendation XV-7 (1989) and Resolution 3 (1996) are designated as no longer current by Decision 1 (2011);

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 149;

Desiring to replace the existing Management Plan for ASPA 149 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 149 (Cape Sheriff and San Telmo Island, Livingston Island, South Shetland Islands), which is annexed to this Measure, be approved; and
2. the Management Plan for ASPA 149 annexed to Measure 2 (2005) shall cease to be effective.

Management Plan for Antarctic Specially Protected Area (ASPA) No. 149 CAPE SHIRREFF AND SAN TELMO ISLAND, LIVINGSTON ISLAND, SOUTH SHETLAND ISLANDS

Introduction

The Cape Shirreff Antarctic Specially Protected Area (ASPA) is situated on the northern coast of Livingston Island, South Shetland Islands, at 62°27'30"S, 60°47'17"W, and is approximately 9.7 km^2 in area. The primary reason for designation of the Area is to protect the biota present within the Area, in particular the large and diverse seabird and pinniped populations which are the subject of long term scientific monitoring. Krill fishing is carried out within the foraging range of these species. Cape Shirreff is thus a key site for ecosystem monitoring, which helps to meet the objectives of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). The Area contains the largest Antarctic fur seal (*Arctocephalus gazella*) breeding colony in the Antarctic Peninsula region and is the most southerly colony where fur seal reproduction, demography and diet can be monitored. Palynoflora discovered within the Area are of significant scientific interest. The Area also contains numerous items of historical and archaeological value, mostly associated with sealing activities in the 19th Century. The Area was originally designated following proposals by Chile and the United States of America and adopted through Recommendation IV-11 [1966, Specially Protected Area (SPA) No. 11]. The Area was re-designated as Site of Special Scientific Interest (SSSI) No. 32 through Recommendation XV-7 (1989). The Area was designated as CCAMLR Ecosystem Monitoring Program (CEMP) Site No. 2 through CCAMLR Conservation Measure 82/XIII (1994); protection was continued by Conservation Measure (CM) 91/02 (2004) and boundaries were extended through Measure 2 (2005) to include a larger marine component and to incorporate plant fossil sites. Conservation Measure 91-02 was lapsed in November 2009 and protection of Cape Shirreff continues as ASPA No. 149 (SC-CCAMLR-XXVIII, Annex 4, para 5.29).

1. Description of values to be protected

Cape Shirreff (62°27'30" S, 60°47'17" W, a peninsula of approximately 3.1 km^2), Livingston Island, South Shetland Islands, was originally designated as Specially Protected Area (SPA) No. 11 through Recommendation IV-11 (1966). In the light of results from the first census of Pinnipedia carried out in the South Shetland Islands (Aguayo and Torres, 1966), Chile considered special protection for the site was needed. Formal proposal of the SPA was made by the United States (US). The Area included the ice-free ground of the Cape Shirreff peninsula north of the Livingston Island ice cap margin. Values protected under the original designation included the diversity of plant and animal life, many invertebrates, a substantial population of southern elephant seals (*Mirounga leonina*) and a small colony of Antarctic fur seals (*Arctocephalus gazella*).

Following designation, the size of the Cape Shirreff Antarctic fur seal colony increased to a level at which biological research could be undertaken without threatening continued colony growth. A survey of the South Shetland Islands and the Antarctic Peninsula identified Cape Shirreff – San Telmo Island as the most suitable site to monitor Antarctic fur seal colonies potentially affected by fisheries around the South Shetland Islands. In order to accommodate the monitoring program, the SPA was redesignated as Site of Special Scientific Interest (SSSI) No. 32 through Recommendation XV-7 (1989) following a joint proposal by Chile, the United Kingdom and the US. Designation was on the grounds that the "presence of both Antarctic fur seal and penguin colonies, and of krill

fisheries within the foraging range of these species, make this a critical site for inclusion in the ecosystem monitoring network being established to help meet the objectives of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). The purpose of the designation is to allow planned research and monitoring to proceed, while avoiding or reducing, to the greatest extent possible, other activities which could interfere with or affect the results of the research and monitoring program or alter the natural features of the Site". The boundaries were enlarged to include San Telmo Island and associated nearby islets. Following a proposal prepared by Chile and the US, the Area was subsequently designated as CCAMLR Ecosystem Monitoring Program (CEMP) Site No. 2 through CCAMLR Conservation Measure 82/XIII (1994), with boundaries identical to SSSI No. 32. Protection of Cape Shirreff as a CCAMLR Ecosystem Monitoring Program (CEMP) was continued by Conservation Measure (CM) 91/02 (2004).

The boundaries of the Area were further enlarged through Measure 2 (2005) to include a larger marine component and to incorporate two new sites where plant fossils were discovered in 2001 (Maps 1 and 2). The designated Area (9.7 km^2) comprises the entire Cape Shirreff peninsula north of the Livingston Island permanent ice cap, the adjacent part of the Livingston Island permanent ice cap where the fossil discoveries were made in 2001, the San Telmo Island group, and the surrounding and intervening marine area enclosed within 100 m of the coast of the Cape Shirreff peninsula and of the outer islets of the San Telmo Island group. The boundary extends from the San Telmo Island group to the south of Mercury Bluff.

Conservation Measure 91-02 lapsed in November 2009, with the protection of Cape Shirreff continuing under the management plan for ASPA No. 149 (SC-CCAMLR-XXVIII, Annex 4, para 5.29). The change was made with the aim of harmonizing protection under both CCAMLR and the Protocol on Environmental Protection to the Antarctic Treaty (The Protocol) and to eliminate any potential duplication in management requirements and procedures.

The current Management Plan reaffirms the exceptional scientific and monitoring values associated with the large and diverse populations of seabirds and pinnipeds which breed within the Area, and in particular those of the Antarctic fur seal colony. The Antarctic fur seal colony is the largest in the Antarctic Peninsula region and is the most southerly that is large enough to study growth, survival, diet, and reproduction parameters: it numbered around 21,000 individuals in 2002 (Hucke-Gaete *et al*. 2004). Monitoring of the Antarctic fur seal colony began in 1965 (Aguayo and Torres 1966, 1967) and seasonal data are available from 1991, making this one of the longest continuous Antarctic fur seal monitoring programs. As part of the CCAMLR Ecosystem Monitoring Program (CEMP), monitoring was established to detect and avoid possible adverse effects of fisheries on dependant species such as pinnipeds and seabirds, as well as target species such as Antarctic krill (*Euphausia superba*). Long-term studies are assessing and monitoring the survival, feeding ecology, growth, condition, reproduction, behavior, vital rates, and abundance of pinnipeds and seabirds that breed within the Area. Data from these studies will be evaluated in context with environmental and other biological data and fisheries statistics to help identify possible cause-effect relationships between fisheries and pinniped and seabird populations.

In 2001-02 imprints of megaflora were discovered in rocks incorporated within moraines of the Livingston Island glacier (Palma-Heldt *et al*. 2004, 2007) (Map 2). The fossiliferous rocks were found to contain two distinct palynological assemblages, indicative of different time periods and climatic conditions, and formed part of a study into the geological history of Antarctica and Gondwana. Studies of microbial research were carried out within the Area in 2009-10, to assess the influence of microhabitats on microbial diversity and metabolic capacity (INACH 2010).

The original values of the protected area associated with the plant and invertebrate communities cannot be confirmed as primary reasons for special protection of the Area because there is a lack of data available describing the communities.

The Area contains a number of pre -1958 human artifacts. HSM No.59, a rock cairn commemorating those who died when the Spanish ship San Telmo sank in the Drake Passage in 1819, lies within the Area. Remnants of a 19th Century sealing community also can be found within the Area.

2. Aims and objectives

Management at Cape Shirreff aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance;
- avoid activities that would harm or interfere with CEMP research and monitoring activities;
- allow scientific research on the ecosystem and physical environment in the Area associated with the CEMP;
- allow other scientific research within the Area provided it is for compelling reasons which cannot be served elsewhere and provided it will not compromise the values for which the Area is protected;
- allow archaeological and historical research and measures for artifact protection, while protecting the historic artifacts present within the Area from unnecessary destruction, disturbance, or removal;
- minimize the possibility of introduction of alien plants, animals and microbes to the Area; and
- allow visits for management purposes in support of the aims of the management plan.

3. Management activities

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

- Copies of this management plan, including maps of the Area, shall be made available at the following locations:

    1. accommodation facilities at Cape Shirreff;

    2. Saint Kliment Ohridski Station (Bulgaria), Hurd Peninsula, Livingston Island;

    3. Arturo Prat Station (Chile), Discovery Bay/Chile Bay, Greenwich Island; and

    4. Base Juan Carlos I (Spain), Hurd Peninsula, Livingston Island.

- A sign showing the location and boundaries of the Area with clear statements of entry restrictions should be placed at Módulo Beach, Cape Shirreff, to help avoid inadvertent entry;
- Markers, signs or other structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition;
- National Antarctic programs operating within the Area should maintain a record of all new markers, signs and structures erected within the Area;
- 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 implemented.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

Map 1: Cape Shirreff and San Telmo Island, ASPA No. 149, in relation to Livingston Island, showing the location of Base Juan Carlos I (Spain) and Saint Kliment Ohridiski Station (Bulgaria), and the location of the closest protected area, Byers Peninsula (ASPA No. 126), also on Livingston Island. Map specifications: Projection: Lambert Conformal Conic; Standard parallels: 1st 60°00' S; 2nd 64°00' S; Central Meridian: 60°45' W; Latitude of Origin: 62°00' S; Spheroid: WGS84; Horizontal accuracy: < ±200 m. Bathymetric contour interval 50 m and 500 m; vertical accuracy unknown. Data sources: land features from SCAR Antarctic Digital Database v. 4.1 (2007); bathymetry supplied by the Antarctic Marine Living Resources (AMLR) Program, NOAA, US (2002).

Inset: the location of Map 1 in relation to the South Shetland Islands and the Antarctic Peninsula.

Map 2: Cape Shirreff and San Telmo Island, ASPA No. 149, protected area boundary and access guidelines. Map specifications as per Map 1, except the vertical contour interval is 10 m and the horizontal accuracy is expected to be greater than ±5 m. Data source: from digital data supplied by Instituto Antártico Chileno (INACH) (2002) (Torres *et al.* 2001).

Map 3: Cape Shirreff, ASPA No. 149: breeding wildlife and human features. Map specifications and data source as per Map 2 with the exception of the vertical contour interval, which is 5 m.

6. Description of the Area

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

Boundaries and coordinates

Cape Shirreff (62°27'30" S, 60°47'17" W) is situated on the northern coast of Livingston Island, the second largest of the South Shetland Islands, between Barclay Bay and Hero Bay (Map 1). The cape lies at the northern extremity of an ice-free peninsula of low-lying, hilly relief. To the west of the peninsula lies Shirreff Cove, to the east Black Point, and to the south lies the permanent ice cap of Livingston Island. The peninsula has an area of approximately 3.1 km^2, being 2.6 km from north to south and ranging from 0.5 to 1.5 km from east to west. The interior of the peninsula comprises a series of raised beaches and both rounded and steep-sided hills, rising to a high point at Toqui Hill (82 m) in the central northern part of the peninsula. The western coast is formed by almost continuous cliffs 10 to 15 m high, while the eastern coast has extensive sand and gravel beaches.

A small group of low-lying, rocky islets lie approximately 1200 m west of the Cape Shirreff peninsula, forming the western enclosure of Shirreff Cove. San Telmo Island, the largest of the group, is 950 m in length, up to 200 m in width, and of approximately 0.1 km^2 in area. There is a sand and pebble beach on the southeastern coast of San Telmo Island, separated from a sand beach to the north by two irregular cliffs and narrow pebble beaches.

The designated Area comprises the entire Cape Shirreff peninsula north of the permanent Livingston Island ice cap, the San Telmo Island group, and the surrounding and intervening marine area (Map 2). The marine boundary encloses an area that extends 100 m from, and parallel to, the outer coastline of the Cape Shirreff peninsula and the San Telmo Island group. In the north, the marine boundary extends from the northwestern extremity of the Cape Shirreff peninsula to the southwest for 1.4 km to the San Telmo Island group, enclosing the intervening sea within Shirreff Cove. The western boundary extends southwards for 1.8 km from 62°28' S to a small island near 62°29' S, passing around the western shore of this small island and proceeding a further 1.2 km south-east to the shore of Livingston Island at 62°29'30" S, which is approximately 300 m south of Mercury Bluff. From this point on the coast, the southern boundary extends approximately 300 m

due east to 60°49' W, from where it proceeds in a northeasterly direction parallel to the coast for approximately 2 km to the ice sheet margin at 60°47' W. The southern boundary then extends due east for 600 m to the eastern coast. The eastern boundary is marine, following the eastern coastline 100 m from the shore. The boundary encompasses an area of 9.7 km^2 (Map 2).

Climate

Meteorological records for Cape Shirreff have been collected for a number of years by Chilean and US scientists and are currently recorded by instruments mounted on the Cape Shirreff Field Station buildings. During recent summer seasons (Nov – Feb inclusive, 2005-06 to 2009-10) the mean air temperature recorded at Cape Shirreff was 1.84ºC (AMLR Program data, 2005-2010). The maximum air temperature recorded during this period was 19.9ºC and the minimum was -8.1ºC. Wind speed averaged 5.36 m/s and the maximum recorded wind speed reached 20.1 m/s. Wind direction over the data collection period was predominantly from the west, followed by WNW and ENE. Meteorological data are available for two recent winters, with mean daily temperature for Jun-Aug 2007 of -6.7ºC with a minimum of -20.6ºC and a maximum of +0.9ºC, and a mean daily temperature for Jun-Sep 2009 of -5.8ºC with a minimum of -15.2ºC and a maximum of +1.9ºC.

Precipitation recorded in summer seasons (21 Dec – 24 Feb, 1998-2001) ranged from 56.0 mm (recorded on 36 days in 2000-01) to 59.6 mm (recorded on 43 days in 1998-99) (Goebel *et al*. 2000; 2001). The peninsula is snow-covered for much of the year, but is mostly snow-free by the end of the summer.

Geology, geomorphology and soils

Cape Shirreff is composed of porphyritic basaltic lavas and minor volcanic breccias of approximately 450 m in thickness (Smellie *et al*. 1996). The rocks at Cape Shirreff are deformed into open folds, which trend in a NW-SE direction, and subvertical axial surfaces that are intruded by numerous dykes. A rock sample obtained from the southern side of Cape Shirreff was identified as fresh olivine basalt and was composed of approximately 4% olivine and 10% plagioclase phenocrysts in a groundmass of plagioclase, clinopyroxene and opaque oxide. Rock samples at Cape Shirreff have been K-Ar dated as of late Cretaceous age with a minimum age of 90.2± 5.6 million years old (Smellie *et al*. 1996). The volcanic sequences at Cape Shirreff form part of a broader group of relatively fresh basalt and andesite lavas covering eastern-central Livingston Island that are similar to basalts found on Byers Peninsula.

The Cape Shirreff peninsula is predominantly a raised marine platform, 46 to 53 m above sea level, (Bonner and Smith 1985). The bedrock is largely covered by weathered rock and glacial deposits. Two lower platforms, covered with rounded water-worn pebbles, occur at elevations of approximately 7-9 m and 12-15 m above Mean Sea Level (MSL) (Hobbs 1968).

There is little information on the soils of Cape Shirreff. They are mainly fine, highly porous, ash and scoria. The soils support a sparse vegetation and are enriched by bird and seal colonies which inhabit the Area.

Palaeonotology

A fossilized wood specimen belonging to the Araucariaceae family (*Araucarioxylon* sp.) was recorded from Cape Shirreff (Torres, 1993). It is similar to fossils found at Byers Peninsula (ASPA No. 126), a site with rich fossil flora and fauna 20 km to the southwest. Several fossil specimens have also been found at the northern extremity of the Cape Shirreff peninsula. In 2001-02 fossiliferous rocks of two different ages were discovered incorporated within frontal and lateral moraines of the Livingston Island permanent ice cap (Map 2). Study of the palynomorphs found within the moraines identified two distinct palynological assemblages, arbitrarily named ‘Type A’ and ‘B’ (Palma-Held *et al*. 2004, 2007). The ‘Type A’ association was dominated by Pteridophyta, mainly Cyatheaceae and

Gleicheniaceae, and by *Podocarpidites* spp. and also contained *Myrtaceidites eugenioides* and epiphyllous fungal spores. The assemblage is believed to be indicative of warm and humid conditions of Early Cretaceous in age (Palma-Heldt *et al*. 2007). The 'Type B' assemblage was characterized by a subantarctic flora with *Nothofagidites*, *Araucariacites australis*, *Podocarpidites otagoensis, P. marwickii*, *Proteacidites parvus* and also epiphyllous fungal spores, which indicate a cold and humid temperate climate (Palma-Heldt *et al*. 2007). The age of the assemblage is estimated to be Late Cretaceous-Paleogene (Palma-Heldt *et al*. 2004; Leppe *et al*. 2003). Palynological investigations were undertaken at Cape Shirreff in order to investigate the evolution of the southern Pacific margin of Gondwana and to develop a model of the Mesozoic-Cenozoic evolution of the Antarctic Peninsula. It has been noted that other fossils may be revealed by further recession of the Livingston Island permanent ice cap (D. Torres, A. Aguayo and J. Acevedo, pers. comm. 2010).

Streams and lakes

There is one permanent lake on Cape Shirreff, located north and at the base of Toqui Hill (Map 3). The lake is approximately 2-3 m deep and 12 m long at full capacity, diminishing in size after February (Torres 1995). Moss banks grow on surrounding slopes. There are also several ephemeral ponds and streams on the peninsula, fed by snow-melt, especially in January and February. The largest of the streams is found draining southwestern slopes toward the coast at Yamana Beach.

Vegetation and invertebrates

Although a comprehensive survey of the vegetation communities at Cape Shirreff has not been undertaken, Cape Shirreff appears to be less well vegetated than many other sites in the South Shetland Islands. Observations to date have recorded one grass, five species of moss, six of lichen, one fungi and one nitrophilous macroalgae (Torres 1995).

Patches of Antarctic hairgrass (*Deschampsia antarctica*) can be found in some valleys, often growing with mosses. Mosses are predominantly found inland from the coast. In a valley running northwest from Half Moon Beach, there is a moderately well-developed wet moss carpet of *Warnstorfia laculosa* (*=Calliergidium austro-stramineum,* also *=Calliergon sarmentosum*) (Bonner 1989, in Heap 1994). In areas with better drainage, *Sanionia uncinata* (*=Drepanocladus uncinatus*) and *Polytrichastrum alpinum* (*=Polytrichum alpinum*) are found. The raised beach areas and some higher plateaus have extensive stands of the foliose nitrophilous macroalga *Prasiola crispa*, which is characteristic of areas enriched by animal excreta and has been observed to replace moss-lichen associations damaged by fur seals (Bonner 1989, in Heap 1994).

The six lichen species thus far described at Cape Shirreff are *Caloplaca spp, Umbilicaria antarctica, Usnea antarctica*, *U. fasciata*, *Xanthoria candelaria* and *X. elegans*. The fruticose species *Umbilicaria antarctica, Usnea antarctica* and *U. fasciata* form dense growths on cliff faces and on the tops of steep rocks (Bonner 1989, in Heap 1994). The bright yellow and orange crustose lichens *Caloplaca spp, Xanthoria candelaria* and *X. elegans* are common beneath bird colonies and are also present with the fruticose species. The identity of the single recorded fungal species is unknown.

The invertebrate fauna at Cape Shirreff has not been described.

Microbial ecology

Field studies of the microbial ecology at Cape Shirreff were carried out 11-21 January 2010 and results were compared with the bacterial communities present at Fildes Peninsula, King George Island. The study aimed to evaluate the influence of the different microhabitats on the biodiversity and metabolic capacities of bacterial communities found at Cape Shirreff and Fildes Peninsula (INACH, 2010).

Breeding birds

The avifauna of Cape Shirreff is diverse, with ten species known to breed within the Area, and several non- breeding species present. Chinstrap (*Pygoscelis antarctica*) and Gentoo (*P. papua*) penguins breed within the Area; Adélie penguins (*P. adeliae*) have not been observed to breed on Cape Shirreff or San Telmo Island, although are widely distributed throughout the region. Both Chinstrap and Gentoo penguins are found in small colonies on the northeastern and northwestern coasts of Cape Shirreff peninsula (Map 3). Data have been collected on the Chinstrap and Gentoo penguin colonies every summer season since 1996-97, including reproductive success, demography, diet, foraging and diving behaviour (e.g. Hinke *et al*. 2007; Pietrzak *et al*. 2009). During the 2009-10 summer season, Chinstrap and Gentoo penguins at Cape Shirreff were tagged with satellite transmitters, in order to study their over-winter behaviour.

In 2008-09 there were 19 active breeding sub-colonies at Cape Shirreff, with a total of 879 Gentoo and 4026 Chinstrap penguin nests (Pietrzak *et al*. 2009), although the number of the sub-colonies and their composition show some inter-annual variation. From the late 1990's to 2004, the numbers of Chinstrap penguins at Cape Shirreff declined significantly, whilst Gentoo populations showed no discernible trend.(Hinke *et al*. 2007). The negative trend in Chinstrap numbers has continued and nest counts for both penguin species reached their lowest for 11 years in 2007-08, due to poor weather conditions (Chisholm *et al*. 2008; Miller and Trivelpiece 2008). In 2008-09 the population and reproductive success of both Gentoos and Chinstraps at Cape Shirreff increased significantly in comparison to the previous season but numbers of Chinstrap nests remained 30% below average for the site (Pietrzak *et al*. 2009). The differing trends in Chinstrap and Gentoo populations at Cape Shirreff have been attributed to the higher winter juvenile mortality rate experienced by Chinstraps (Hinke *et al*. 2007) and a greater flexibility in feeding patterns exhibited by Gentoos (Miller *et al.* 2009).

In general, the Chinstrap penguins nest on higher escarpments at Cape Shirreff, although they are also found breeding on small promontories near the shore. Gentoo penguins tend to breed on more gentle slopes and rounded promontories. During the period of chick rearing, foraging by both species of penguin is confined to the shelf region, approximately 20 to 30km offshore of Cape Shirreff (Miller and Trivelpiece 2007).Data available on penguin numbers are presented in Table 1.

Several other species breed within the Area (Map 3), although data on numbers are patchy. Kelp gulls (*Larus domincanus)* and Brown skuas (*Catharacta loennbergi*) nest in abundance along the entire coastline of the Area. In 2000 there were 25 and 22 breeding pairs of these species respectively (AMLR, pers. comm.2000). In 2007-08, 24 pairs of skuas were identified at Cape Shirreff and Punta Oeste, of which 23 were Brown skuas (*Catharacta loennbergi*) and one pair was a hybrid of Brown-South Polar skuas (*C. maccormicki*). Fifty-six Kelp gull nests were observed at Cape Shirreff during the 2006-07 season. Reproductive success of skuas and kelp gulls has been regularly monitored during recent summer seasons at nesting sites around Cape Shirreff (Chisholm *et al*. 2008; Pietrzak *et al*. 2009).

Sheathbills (*Chionis alba*) nest in two places: one pair has been recorded nesting on the western coast of the Cape Shirreff peninsula; a second pair has been observed breeding among rocks at the northern beach on San Telmo Island, near an Antarctic fur seal breeding site (Torres, pers. comm. 2002). Antarctic terns (*Sterna vittata*) breed in several locations, which have been observed to vary from year to year. Since 1990-91 a small colony of approximately 11 pairs of Antarctic shag (*Phalacrocorax* [atriceps] *bransfieldensis*) has been observed breeding on Yeco Rocks, on the western coast of the peninsula (Torres, 1995). Cape petrels (*Daption capense*) breed on cliffs on the western coast of the Area; 14 pairs were recorded in January 1993, nine in January 1994, three in January 1995 and eight in 1999. Wilson's storm petrel (*Oceanites oceanicus*) also breed on the western coast of the Area. Black-bellied storm petrel (*Fregetta tropica*) have been observed

to breed near the field camp on the eastern coast. A large number of non-breeding Southern Giant petrels (*Macronectes giganteus*) frequent the Area in the summer, and a report of a breeding colony on the peninsula (Bonner 1989, in Heap 1994) is incorrect (Torres, pers. comm. 2002). Other bird species recorded but not breeding within the Area include Macaroni penguin (*Eudyptes chrysolophus*), King penguin (*Aptenodytes patagonicus*), Emperor penguin (*Aptenodytes forsteri*), Snow petrel (*Pagadroma nivea*), White-rumped sandpiper (*Calidris fuscicollis*), Black-necked swan (*Cygnus melanocoryphus*), and the Cattle egret *Bubulcus ibis* (Torres 1995; Olavarría *et al.* 1999). Additional bird species recorded as foraging close to Cape Shireff include the Black-browed albatross (*Thalassarche melanophris*) and Gray-headed albatross (*T.chrysostoma*), although neither species has yet been recorded within the Area (Cox *et al*. 2009).

Table 1: Chinstrap (*Pygoscelis antarctica)* and Gentoo (*P. papua*) penguin numbers at Cape Shirreff.

Year	Chinstrap (pairs)	Gentoo (pairs)	Source
1958	2000 (N3[1])	200-500 (N1[1])	Croxall and Kirkwood, 1979
1981	2164 (A4)	843 (A4)	Sallaberry and Schlatter, 1983 [2]
1987	5200 (A3)	300 (N4)	Woehler, 1993
1997	6907 (N1)	682 (N1)	Hucke-Gaete *et al*. 1997a
1999-00	7744 (N1)	922 (N1)	AMLR data, Carten *et al*. 2001
2000-01	7212 (N1)	1043 (N1)	AMLR data, Taft *et al.* 2001
2001-02	6606	907	AMLR data, Saxer *et al*. 2003
2002-03	5868 (A3)	778 (A3)	AMLR data, Shill *et al*. 2003
2003-04	5636 (N1)	751 (N1)	AMLR data, Antolos *et al.* 2004
2004-05	4907 (N1)	818 (N1)	AMLR data, Miller *et al.* 2005
2005-06	4849 (N1)	807 (N1)	AMLR data, Leung *et al.* 2006
2006-07	4544 (N1)	781 (N1)	AMLR data, Orben *et al.* 2007
2007-08	3032 (N1)	610 (N1)	AMLR data, Chisholm *et al*. 2008
2008-09	4026 (N1)	879 (N1)	AMLR data, Pietrzak *et al.* 2009

1. Alphanumeric code refers to the type of count, as in Woehler (1993).
2. Reported data did not specify species. It has been assumed that the higher number referred to Chinstrap penguins. Data were reported as individuals, which have been halved to derive 'pairs' in the table.

Breeding mammals

Cape Shirreff (including San Telmo Island) is presently the site of the largest known breeding colony of the Antarctic fur seal in the Antarctic Peninsula region. Antarctic fur seals were once abundant throughout the South Shetland Islands but were hunted to local extinction between 1820 and 1824. The next observation of Antarctic fur seals at Cape Shirreff was on 14 January 1958, when 27 animals were recorded, including seven juveniles (Tufft 1958). The following season, on 31 January 1959, a group of seven adult males, one female and one male pup were recorded, along with one dead male pup (O'Gorman, 1961). A second female arrived three days later, and by mid-March 32 Antarctic fur seals were present. By 2002, the estimated Antarctic fur seal population at Cape Shirreff (excluding San Telmo Island) increased to 14,842 animals (including 6,453 pups), with the total population (including San Telmo Island) being 21,190 animals (including 8577 pups) (Hucke-Gaete *et al*. 2004). More recent data on Antarctic fur seal numbers have yet to be published. However, the present number of Antarctic fur seals at Cape Shirreff remain an order of magnitude lower than pre-exploitation populations, and it is unclear whether numbers will recover to their previous levels (Hucke-Gaete *et al*. 2004).

Antarctic fur seal breeding sites at Cape Shirreff are concentrated around the coastline of the northern half of the peninsula (Map 3). At San Telmo Island, breeding is concentrated at both ends of the island, with juveniles commonly found near the middle (Torres 1995). Long term monitoring of Antarctic fur seals has been carried at Cape Shirreff since 1991, with the primary objective of studying breeding success in relation to prey availability, environmental variability and human impacts (Osman *et al*. 2004). Researchers have studied various aspects of the fur seal colony, including pup production, predation and growth, female attendance behavior, seal diet and diving and foraging. During the 2009-10 summer season, researchers tagged Antarctic fur seals, along with Weddell seals and Leopard seals, to monitor their behavior over the winter period.

During the 2008-09 season, the AMLR program reported a 13.3% reduction in pup production from the previous summer season (Goebel *et al.* 2009). Pup production at Cape Shirreff was particularly low during both the 2007-08 and 2008-09 seasons, most likely as a result unfavorable winter conditions (Goebel *et al.* 2008; 2009). During recent seasons, growth rates of fur seal pups within the Area have been studied in relation to sex, breeding season and maternal foraging and attendance (Vargas *et al*. 2009) and a number of extremely rare color patterns in fur seal pups have been recorded within the Area. Antarctic fur seals with pie-bald or light colorings were documented for the first time and an albino Weddell seal represented the first confirmed case of albinism in Weddell, Leopard, Ross or Crabeater seals (Acevedo *et al.* 2009a, 2009b).

A small number of Southern Elephant seals breed in October on several eastern beaches (AMLR, pers. comm. 2000; Torres, pers. comm. 2002). On 2 Nov 1999 34 pups were counted on beaches south of Condor Hill (AMLR, unpublished data). During the 2008-09 season, a total of 34 Southern Elephant seal pups were born at Cape Shirreff and an additional six were born on a small sandy point between Cape Shirreff and Punta Oeste (Goebel *et al.* 2009). Groups of non-breeding Southern Elephant seals are also present, while isolated animals, mainly juveniles, may be found on various beaches. The foraging behavior of Southern Elephant seals has been studied using satellite tracking of animals tagged at Cape Shirreff and analyzed in relation to the physical properties of the water column (Huckstadt *et al*. 2006; Goebel *et al.* 2009). Seals were found to forage as far afield as the Amundsen Sea and one animal was observed travelling 4700 km due west of the Antarctic Peninsula.

Weddell seals, Leopard seals and Crabeater seals have been observed on the Cape Shirreff peninsula and are the subject of monitoring programs (O'Gorman 1961; Bengtson *et al.* 1990; Oliva *et al.* 1988; Torres 1995; Goebel, pers. comm. 2010). Monitoring of leopard seal predation on the Antarctic fur seal pup population was initiated in 2001-02 and was recorded during the 2003-04 Antarctic season (Vera *et al*. 2004). Leopard seals hauling out at Cape Shirreff have been fitted with satellite trackers to monitor their foraging range and dispersal. Observations of leopard seal feeding behaviour and pup survival studies suggest that they consume up to half of all Antarctic fur seal pups born within the Area each year (Goebel *et al.* 2008, 2009,). During the 2008-09 field season, DNA samples were collected from four seal species at Cape Shirreff and stored in the Southwest Fisheries Science Center DNA archives (Goebel *et al.* 2009). Humpback whales (*Megaptera novaeangliae*) have been observed in the offshore area immediately to the north-east of the Area (Cox *et al*. 2009).

Marine environment and ecosystem

The seafloor surrounding the Cape Shirreff peninsula slopes relatively gently from the coast, reaching depths of 50 m approximately 2-3 km from the shore and 100 m at about 6-11 km (Map 1). This relatively shallow and broad submarine ridge extends to the NW for about 24 km before dropping more steeply at the continental shelf edge. The ridge is about 20 km in width and flanked either side by canyons reaching depths of around 300-400 m. There is abundant macroalgae present in the intertidal zone. The limpet *Nacella concinna* is common, as elsewhere in the South Shetland Islands.

The waters offshore from Cape Shirreff have been identified as one of three areas of consistently high krill biomass density in the South Shetland Islands area, although absolute krill populations fluctuate significantly over time (Hewitt *et al*. 2004; Reiss *et al*. 2008). The spatial distribution, demography, density and size of krill and krill swarms have been studied in the nearshore region at Cape Shirreff, primarily using acoustic surveys and also using an Autonomous Underwater Vehicle (AUV) (Reiss *et al*. 2008; Warren *et al*. 2005). Acoustic surveys of the nearshore environment indicate that krill in this area are most abundant in to the south and SE of Cape Shirreff and at the margins of the two submarine canyons, which are believed to be a source of nutrient rich water that may increase productivity in the nearshore area surrounding Cape Shirreff (Warren *et al.* 2006, 2007). Nearshore net tows indicated that the organisms identified in acoustic surveys were primarily the euphausiids, *Euphausia superba*, *Thysanoessa macrura* and *Euphausia frigida*, and may also include chaetognaths, salps, siphonophores, laval fish, myctophids and amphipods (Warren *et al.* 2007).

The nearshore environment surrounding Cape Shirreff has been identified as a primary feeding ground for penguins resident at the site, particularly during the breeding season when chick provisioning limits foraging range (Cox *et al*. 2009). Fur seals and penguins at Cape Shirreff depend strongly upon krill for prey, particularly when juvenile. Predator foraging ranges are known to overlap with areas of commercial krill fisheries and changes in the abundance of both predators and krill have been linked to climatic change. Research at Cape Shirreff therefore aims to monitor krill abundance in combination with predator populations and breeding success, in order to assess the potential effects of commercial fishing, as well as environmental variability and climatic change on the ecosystem.

Numerous studies of the marine environment have been conducted in the region offshore from Cape Shirreff as part of research carried out within the AMLR survey grid. These studies include investigations into various aspects of the marine environment, including physical oceanography, environmental conditions, phytoplankton distribution and productivity, krill distribution and biomass and the distribution and density of seabirds and marine mammals (AMLR 2008, 2009).

Historical features

Following discovery of the South Shetland Islands in 1819, intensive sealing at Cape Shirreff between 1820 and 1824 exterminated almost the entire local populations of Antarctic fur seals and Southern Elephant seals (Smith and Simpson 1987). In January 1821 60–75 British sealers were recorded living ashore at Cape Shirreff and 95,000 skins were taken during the 1821-22 season (O'Gorman 1963). Evidence of the sealers' occupation remains, with ruins of at least one sealers' hut in the northwestern region of the peninsula and remains of sealer's settlements recorded on a number of the beaches (D. Torres, A. Aquayo and J. Acevedo, pers. comm. 2010). The shoreline of several bays is also littered with timbers and sections of wrecked sealers' vessels. Other evidence of sealing activity includes the remains of stoves, pieces of glass bottles, a wooden harpoon, and a handcrafted bone figure (Torres and Aguayo 1993). Fildes (1821) reported that sealers found spars and an anchor stock from the Spanish ship San Telmo on Half Moon Beach around the time she was lost. The ship sank in the Drake Passage at around 62°S on 4 September 1819, with 644 persons aboard (Headland 1989; Pinochet de la Barra 1991). These were possibly the first people to die in Antarctica, and the event remains the greatest single loss of life yet to occur south of 60°S. A cairn has been erected on the northwestern coast of Cape Shirreff peninsula to commemorate the loss, which is designated as Historic Monument No. 59 (Map 3).

The remains of a camp were found close to the site of present camp facilities (Torres and Aguayo 1993). On the evidence of the script on items found at the site, the camp is believed to be of Russian origin and date from the 1940-50s, although its exact origins have yet to be determined. Items found include parts of an antenna, electrical wires, tools, boots, nails, battery cells, canned food, and a wooden box covered by a pyramid of stones. Several notes in Russian, dating from later visits, were found in this box.

In January 1985 a human skull was found at Yamana Beach (Torres 1992), determined to be that of a young woman (Constantinescu and Torres 1995). In January 1987 part of a human femur was found on the ground surface nearby, inland from Yamana Beach. After a careful surface survey, no other remains were evident at that time. However, in January 1991, another part of a femur was found in close proximity to the site of the earlier (1987) find. In January 1993 an archaeological survey was carried out in the area, although no further human remains were found. The original samples were dated as from approximately 175 years BP, and it was hypothesised they belong to a single individual (Torres 1999).

Human activities / impacts

The modern era of human activity at Cape Shirreff has been largely confined to science. During the past three decades, the population of Antarctic fur seals in the South Shetland Islands grew to a level at which tagging and other research could be undertaken without threatening the existence and growth of the local population. Chilean studies on Cape Shirreff began in 1965 (Aguayo and Torres 1966, 1967), with a more intensive program initiated by Chilean scientists in 1982, including an ongoing Antarctic fur seal tagging program (Cattan *et al*. 1982; Torres 1984; Oliva *et al*. 1987). United States investigators have conducted pinniped and seabird surveys at Cape Shirreff and San Telmo Island since 1986-87 (Bengtson *et al*. 1990).

CEMP studies at Cape Shirreff began in the mid-1980s, initiated by Chilean and US scientists. Cape Shirreff was designated as a CEMP Site in 1994 to protect the site from damage or disturbance that could adversely affect long-term CEMP monitoring. As part of the CEMP, long-term studies are assessing and monitoring the feeding ecology, growth and condition, reproductive success, behavior, vital rates, and abundance of pinnipeds and seabirds that breed in the Area. The results of these studies will be evaluated in context with environmental data, offshore sampling data, and fishery statistics to identify possible cause-effect relationships between krill fisheries and pinniped and seabird populations.

Brucella and herpes virus antibodies were detected in tissue samples taken from Antarctic fur seals at Cape Shirreff over summer seasons from 1998-2001, and Brucella antibodies were also detected in Weddell seal tissue (Blank *et al*. 1999; Blank *et al*. 2001a & b). Studies on the mortality of Antarctic fur seal pups from diseases began in the 2003-04 Antarctic season (Torres and Valdenegro 2004). Enteropathogenic *Escherichia coli* (EPEC) has been recorded in swabs from Antarctic fur seals at Cape Shirreff, with two out of 33 pups sampled testing positive for the pathogen. The findings were the first reports of EPEC in Antarctic wildlife and in pinipeds, and the effects of the pathogen on Antarctic wildlife is unknown (Hernandez *et al*. 2007).

Plastic rubbish was first reported at Cape Shirreff by Torres and Gajardo (1985), and marine debris monitoring studies have been carried out regularly since 1992 (Torres and Jorquera 1995). Debris remains an ongoing problem at the site, with over 1.5 tons of material removed from the area by Chilean scientists to date (D. Torres, A. Aquayo and J. Acevedo, pers. comm., 2010). Recent surveys have yielded large numbers of articles, mostly made of plastic, but have also included vegetable waste from ships, metal oil drums, rifle shells and an antenna on beaches. For example, the 2000-01 season survey recorded a total of 1,774 articles, almost 98% of which were made of plastic and the remainder made of glass, metal and paper. It is significant that 34% of the plastic items found in 2000-01 were packing bands, representing approximately 589 bands. Of these, 40 were uncut and another 48 had been knotted into a loop. Several articles found in this survey were oiled, and some plastic articles were partially burnt. Antarctic fur seal entanglement in marine debris has been recorded frequently at Cape Shirreff (Torres 1990; Hucke-Gaete *et al*. 1997c; Goebel *et al.* 2008, 2009), primarily in fishing equipment such as nylon ropes, net fragments and packing bands. Between 1987- 1997 a total of 20 Antarctic fur seals were recorded with ‘neck collars’ from such debris. Plastic fibers are also found in Kelp gull and Chinstrap penguin nests (Torres and Jorquera 1992), as well as those of Sheathbills (Torres and Jorquera 1994).

The waters surrounding Cape Shirreff represent an important krill fishing area. Catch data specifically for Cape Shirreff are unavailable, but fishing statistics are published for CCAMLR Statistical Subarea 48.1, within which the Area lies. In 2008-09, 33970 tons of Antarctic krill (*Euphausia superba*) were caught in Subarea 48.1 compared with an average of 32993 tons per year caught during the period 1999-00 to 2008-09 (CCAMLR 2010). On 10 October 2010, the krill fishery in Subarea 48.1 was closed for the remainder of the 2009-10 fishing season (1 December 2009- 30 November 2010) because the catch reached 99.9% of the annual limit for the Subarea (155,000 tonnes). Nations recorded as fishing for krill within the Subarea during the recent past included Japan, Korea, Norway, Poland, Ukraine, Uruguay, the United States and Vanuatu. Krill fishing generally occurred between December and August, with the highest catches usually occurring between March and May. Catches of other species occurred in very much smaller quantities and included *Champsocephalus gunnari*, *Champsocephalus gunnari*, *Nototheniops nybelini*, *Notothenia coriiceps*, *Notolepis* spp, *Notothenia gibberifrons*, *Notothenia neglecta*, *Notothenia rossii*, *Pseudochaenichthys georgianus* and *Chaenocephalus aceratus* (CCAMLR 2010).

6(ii) Access to the Area

Access to the Area may be made by small boat, by aircraft or across sea ice by vehicle or on foot. Historically seasonal sea ice formation in the South Shetlands area generally began in early April and persisted until early December, although more recently the South Shetland Islands can be ice-free year round as a result of regional warming.

Air access restrictions apply for the period 01 November – 31 March inclusive. During this time, helicopters may land at either of the two helicopter landing sites (Map 2), but landing at site A is preferred under most circumstances. Landing site A is located approximately 150m north-west of the summit of Condor Hill on the eastern side of the peninsula (62°46'27"S, 60°28'17"W). Landing site B is situated on a wide area of flat ground on Ancho Pass, approximately 300m east of Selknam Hill (62°46'48"S, 60°28'16"W). To the maximum extent practicable, aircraft should follow the Helicopter Access Zone when accessing the Area and should approach from the south, across the Livingston Island permanent ice cap. Air access is prohibited within the Restricted Zone, unless authorised by permit. The zone is situated north of 62°28' S (Map 2), or north of 62°29' S and west of 60°48' W and is designated because it contains the highest concentrations of wildlife in the Area. Due to the presence of wildlife, aircraft are encouraged to maintain a horizontal and vertical separation of 2000 ft (~610 m) from the protected area boundary, unless accessing the designated landing sites or otherwise authorized by permit.

When access to the Area is made from the sea, small boats should land at one of the following locations: the eastern coast of the peninsula at El Módulo Beach, where a deep channel enables relatively easy access; the northern end of Half Moon Beach; the northern end of Yámana Beach, on the western coast (suitable at high tide only);or the southern end of the northern beach on San Telmo Island. Small boats may land at any other location within the Area, provided that this is consistent with the purposes for which a permit has been granted and where practicable, visitors should avoid landing where wildlife colonies are present. Two anchorages have been identified close to the Area; 1600 m north-east of the main camp facilities and approximately 800 m north of San Telmo Island. Sea states are generally between 1 and 4 m, decreasing closer to shore or in lea of Cape Shirreff (Warren *et al.* 2006, 2007).

When sea ice conditions allow, the Area may be accessed over sea ice on foot or by vehicle. However, vehicle use within the Area is restricted to the coastal zone between Módulo Beach and the Chilean / US camp facilities only. Persons entering the Area may not move beyond the immediate vicinity of their landing site unless authorised by Permit.

6(iii) Restricted and managed zones within the Area

A zone in the north and west of the Area is designated as a Restricted Zone, due to its high concentrations of wildlife. Restrictions apply to air access only and prohibit overflight below 2000 ft (~610m), unless specifically authorized by permit. The Restricted Zone is defined as the area north of 62°28' S (Map 2), and north of 62°29' S and west of 60°48' W.

A Helicopter Access Zone (Map 2) has been defined which applies to aircraft entering the Area and accessing the designated landing sites. The Helicopter Access Zone extends from the Livingston Island permanent ice cap northward following the main ridgeline of the peninsula for 1200 m (~ 0.65 n. mi.) towards Selknam Hill. The Helicopter Access Zone then extends east by 300 m (~0.15 n. mi) (to helicopter landing site B at Ancho Pass and a further 400 m (~0.23 n. mi) east to the summit of Condor Hill close to helicopter landing site. The southern boundary of the Helicopter Access Zone is coincident with the southern boundary of the Area.

6(iv) Structures within and near the Area

A semi-permanent summer-only research camp has been established on the eastern coast of the Cape Shirreff peninsula, located at the base of Condor Hill (62°28'12" S, 60°46'17" W) (Map 3). Buildings for the camp remain *in situ* year-round. In 2010, the field camp known as Cape Shirreff Field Station (US), consisted of four small buildings and an outhouse. The camp 'Dr Guillermo Mann-Fischer' (Chile) is located around 50m from the US station and comprised of a main hut, laboratory, store house, a fiberglass igloo, an outhouse and a wind-powered generator in 2010 (Goebel pers. comm. 2010, D. Torres, A. Aquayo and J. Acevedo, pers. comm., 2010)). The Chilean fiberglass igloo was originally installed in 1990-91, while the US camp was established in 1996-97. Storage areas are also present, and tents are erected seasonally nearby as required. During the 2009-10 season, an All Terrain Vehicle (ATV) shed, with secondary containment for summer use and winter storage of ATVs, was constructed at the US camp. The site was selected to remain within the existing station footprint and to avoid interference with seal traffic. A 'Weatherport' is stored at Cape Shirreff as additional accommodation for visiting scientists and is erected within 10 m of the south side of the US station when needed.

Two automatic weather stations are mounted on the exterior of existing buildings at Cape Shirreff. A remote receiving station used for seal tracking studies is stored within a box (90x60x100cm) located on a small ridge to the southeast of Mansa Bay.

A boundary marker is located at Módulo Beach, close to the Chilean and US stations. The marker states that the Area is protected and that access is prohibited. In 2009-10 season, the marker was weathered but legible (Goebel, pers. comm. 2010). The boundaries of the protected area are not otherwise marked.

The remains of a camp, believed to be of Russian origin, are present near the Chilean and US camps. In other parts of the peninsula, sparse evidence may be found of 19th Century sealers' camps (Smith and Simpson 1987; Torres 1993; Stehberg and Lucero 1996). A cairn (Historic Monument No. 59) has been erected on Gaviota Hill on the northwestern coast to commemorate the loss of those aboard the San Telmo in 1819 (Map 3). In 1998-99 a 5x7 m bird observation / emergency hut (62°27'41" S, 60°47'28" W) was installed by US scientists on the northern slopes of Enrique Hill above Bahamonde Beach, close to the penguin colonies (Map 3).

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

The nearest protected areas to Cape Shirreff are Byers Peninsula (ASPA No. 126), which lies about 20 km to the southwest; Port Foster (ASPA No. 145, Deception Island) and other parts of Deception Island (ASPA No. 140), which are approximately 30 km to the south; and 'Chile Bay' (Discovery Bay) (ASPA No. 144), which lies about 30 km to the east at Greenwich Island (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 associated with the CEMP, or for compelling scientific, educational, archaeological or historic purposes that cannot be served elsewhere; or
- it is issued for essential management purposes consistent with plan objectives such as inspection, maintenance or review;
- the actions permitted will not jeopardize the ecological, scientific, educational archaeological 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 to the Area shall be by small boat, by helicopter, on foot or by vehicle.

Boat access

Access by small boats should be at one of the following locations (Map 2):

1. the eastern coast of the peninsula at El Módulo Beach, 300 m north of the camp facilities, where a deep channel enables relatively easy access;
2. the northern end of Half Moon Beach, on the eastern coast of the peninsula;
3. the northern end of Yámana Beach, on the western coast (suitable at high tide only);
4. the southern end of the northern beach on San Telmo Island.

Access by small boat at other locations around the coast is allowed, provided this is consistent with the purposes for which a Permit has been granted. Two anchorages have been identified close to the Area; 1600 m north-east of the main camp facilities and approximately 800 m north of San Telmo Island. Visitors should, where practicable, avoid landing where pinniped or seabird colonies are present on or near the coast.

Aircraft access and overflight

Due to the widespread presence of pinnipeds and seabirds over the Cape Shirreff peninsula during the breeding season (01 November – 31 March), access to the Area by aircraft in this period is strongly discouraged. Where possible and by preference, access should be by small boat. All restrictions on aircraft access and overflight apply between 01 November – 31 March inclusive, when aircraft shall operate and land within the Area according to strict observance of the following conditions:

1) It is recommended that aircraft maintain a horizontal and vertical separation distance 2000 ft (~610 m) from the Antarctic Specially Protected Area boundary (Map 2), unless accessing the designated landing sites through the Helicopter Access Zone or otherwise authorized by permit;

2) Overflight of the Restricted Zone is prohibited below 2000 ft (~610 m) unless authorized by permit. The Restricted Zone is defined as the area north of 62°28' S, or north of 62°29' S and west of 60°48' W (Map 2), and includes the areas of greatest wildlife concentration;

3) Helicopter landing is permitted at two designated sites (Map 2). The landing sites with their coordinates are described as follows:

(A) on a small area of flat ground, ~150 m northwest of the summit of Condor Hill (50 m, or ~150 ft) (62°46'27"S, 60°28'17"W), which is the preferred landing site for most purposes; and

(B) on the wide flat area on Ancho Pass (25 m), situated between Condor Hill and Selknam Hill (62°46'48"S, 60°28'16"W).

4) Aircraft accessing the Area should follow the Helicopter Access Zone to the maximum extent practicable. The Helicopter Access Zone allows access from the south across the Livingston Island permanent ice cap and extends along the main ridgeline of the peninsula for 1200 m (~ 0.65 n. mi.) towards Selknam Hill (elevation = 50 m, or ~150 ft). The Helicopter Access Zone then extends east by 300m (~ 0.15 n. mi) to Ancho Pass, where helicopter landing site B is situated, and a further 400m (~0.23 n. mi) east to the summit of Condor Hill (elevation -= 50 m, or ~150 ft), close to helicopter landing site A. Aircraft should avoid overflight of the hut and beach areas on the eastern side of Condor Hill.

5) The preferred approaches to the Helicopter Access Zone are from the south across the Livingston Island permanent ice cap, from the southwest from the direction of Barclay Bay, and from the southeast from the direction of Hero Bay (Maps 1 and 2).

6) Weather with a low cloud ceiling often prevails at Cape Shirreff, particularly in the vicinity of the permanent ice cap, which can make snow/ice ground definition difficult to discern from the air. On-site personnel who may be advising on local conditions before aircraft approaches should be aware that a minimum cloud base of 150 m (500 ft) AMSL over the approach zone of the Livingston Island ice cap is necessary in order for access guidelines to be followed;

7) Use of smoke grenades to indicate wind direction is prohibited within the Area unless absolutely necessary for safety, and any grenades used should be retrieved.

Vehicle access and use

Access by vehicle over land may be made to the boundary to the Area. Access by vehicle over sea ice may be made to the shore within the Area. Vehicles are permitted to operate on land only in the coastal zone between Módulo Beach and the Chilean / US camp facilities (Map 3). The use of vehicles elsewhere within the Area is prohibited.

Foot access and movement within the Area

With the exception of the restricted use of vehicles described above, movement on land within the Area shall be on foot. Pilots, air, boat or vehicle crew, or other people in aircraft, boats, or vehicles are prohibited from moving on foot beyond the immediate vicinity of their landing site or the hut facilities unless specifically authorised by Permit. Visitors should move carefully so as to minimize disturbance to flora, fauna, and soils, and should walk on snow or rocky terrain if practical, but taking care not to damage lichens. Pedestrian traffic should be kept to the minimum consistent with the objectives of any permitted activities and every reasonable effort should be made to minimize effects.

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

- Scientific research that will not jeopardize the values of the Area, in particular those associated with the CEMP;
- Essential management activities, including monitoring;
- Activities with educational aims (such as documentary reporting (photographic, audio or written) or the production of educational resources or services) that cannot be served elsewhere.
- Activities with the aim of preserving or protecting historic resources within the Area.
- Archaeological research that will not threaten the values of 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;
- The principal camp facilities shall be limited to the area within 200 m of the existing Chilean and US field camps (Map 3). Small temporary hides, blinds or screens may be constructed for the purpose of facilitating scientific study of the fauna;
- All structures, scientific equipment or markers 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 harm to fauna or of contamination of the Area;
- Installation (including site selection), maintenance, modification or removal of structures shall be undertaken in a manner that minimizes disturbance to flora and fauna, preferably avoiding the main breeding season (1 November – 31 March);
- Removal of structures, equipment, hides or markers 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 200 m of the facilities of the Chilean and US field camps, on the eastern coast of the Cape Shirreff peninsula (Map 3). Temporary camping is permitted at the northern extremity of Yamana beach to support fieldwork on the San Telmo Islets (Map 3). The US bird observation hut on the northern slopes of Enrique Hill (62°27'41" S, 60°47'28" W) may be used for temporary overnight camping for research purposes, although should not be used as a semi-permanent camp. Camping is permitted on San Telmo Island when necessary for purposes consistent with plan objectives. The preferred camping location is at the southern end of the northern beach on the island. Camping is prohibited elsewhere within the Area.

7(v) Restrictions on materials and organisms which 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 at Cape Shirreff and San Telmo Island visitors shall take special precautions against introductions. Of concern are pathogenic, microbial, invertebrate or plant introductions sourced from other Antarctic sites, including stations, or from regions outside Antarctica. Visitors shall ensure that sampling equipment and markers brought into the Area are clean. To the maximum extent practicable, footwear and other equipment used or brought into the area (including backpacks, carry-bags and tents) shall be thoroughly cleaned before entering the Area;

- Dressed poultry should be free of disease or infection before shipment to the Area and, if introduced to the Area for food, all parts and wastes of poultry shall be completely removed from the Area or incinerated or boiled long enough to kill any potentially infective bacteria or viruses;
- 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 activities for which a 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 the appropriate national authority specifically for that purpose. CEMP research programs in progress within the Area should be consulted before other Permits for taking or harmful interference with animals are granted.

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, and is clearly of no historic value 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.
- Material found that is likely to possess important archaeological, historic or heritage values should not be disturbed, damaged, removed or destroyed. Any such artifacts should be recorded and referred to the appropriate authority for a decision on conservation or removal. Relocation or removal of artifacts for
the purposes of preservation, protection, or to re-establish historical accuracy is allowable by permit;
- The appropriate national authority should be notified of any items removed from the Area that were not introduced by the permit holder.

7(viii) Disposal of waste

All wastes shall be removed from the Area, except human wastes and domestic liquid wastes, which may be removed from the Area or disposed of into the sea.

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

1) 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.

2) Any specific sites of long-term monitoring should be appropriately marked.

3) To avoid interference with long-term research and monitoring activities or possible duplication of effort, persons planning new projects within the Area should consult with established programs working at Cape Shirreff, such as those of Chile and the US, before initiating the work.

4) In view of the fact that geological sampling is both permanent and of cumulative impact, visitors removing geological samples from the Area shall complete a record describing the geological type, quantity and location of samples taken, which should, at a minimum, be deposited with their National Antarctic Data Centre or with the Antarctic Master Directory.

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 the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas.

- 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.

References

Acevedo, J., Vallejos, V., Vargas, R., Torres, J.P. & Torres, D. 2002. Informe científico. ECA XXXVIII (2001/2002). Proyecto INACH 018 "Estuios ecológicos sobre el lobo fino antásrtico, Arctocephalus gazella", cabo Shirreff, isla Livingston, Shetland del Sur, Antártica. Ministerio de Relaciones Exteriores, Instituto Antártico Chileno. Nº Ingreso 642/710, 11.ABR.2002.

Acevedo, J., Aguayo-Lobo, A. & Torres, D. 2009a. Albino Weddell seal at Cape ShirreV, Livingston Island, Antarctica. *Polar Biology* **32** (8):1239–43.

Acevedo, J., Aguayo-Lobo, A. & Torres, D. 2009b. Rare piebald and partially leucistic Antarctic fur seals, Arctocephalus gazella, at Cape Shirreff, Livingston Island, Antarctica. *Polar Biology* **32** (1): 41–45.

Agnew, A.J. 1997. Review: the CCAMLR Ecosystem Monitoring Programme. *Antarctic Science* **9** (3): 235-242.

Aguayo, A. 1978. The present status of the Antarctic fur seal *Arctocephalus gazella* at the South Shetland Islands. *Polar Record* **19**: 167-176.

Aguayo, A. & Torres, D. 1966. A first census of Pinnipedia in the South Shetland Islands and other observations on marine mammals. In: SCAR / SCOR / IAPO / IUBS Symposium on Antarctic Oceanography, Santiago, Chile, 13-16 September 1966, Section 4: Coastal Waters: 166-168.

Aguayo, A. & Torres, D. 1967. Observaciones sobre mamiferos marinos durante la Vigésima Comisión Antártica Chilena. Primer censo de pinípedos en las Islas Shetland del Sur. Revta. Biol. Mar., **13**(1):1-57.

Aguayo, A. & Torres, D. 1993. Análisis de los censos de *Arctocephalus gazella* efectuados en el Sitio de Especial Interés Científico No. 32, isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **43**: 87-91.

AMLR 2008. AMLR 2007-2008 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. October 2008.

AMLR 2009. AMLR 2008-2009 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. May 2009.

Antolos, M.,Miller, A.K. & Trivelpiece, W.Z. 2004. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2003-2004. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2003-2004 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Bengston, J.L., Ferm, L.M., Härkönen, T.J. & Stewart, B.S. 1990. Abundance of Antarctic fur seals in the South Shetland Islands, Antarctica, during the 1986/87 austral summer. In: Kerry, K. and Hempel, G. (Eds). *Antarctic Ecosystems, Proceedings of the Fifth SCAR Symposium on Antarctic Biology.* Springer-Verlag, Berlin: 265-270.

Blank, O., Retamal, P., Torres D. & Abalos, P. 1999. First record of *Brucella* spp. antibodies in *Arctocephalus gazella* and *Leptonychotes weddelli* from Cape Shirreff, Livingston Island, Antarctica. (SC-CAMLR-XVIII/BG/17.) *CCAMLR Scientific Abstracts* 5.

Blank, O., Retamal, P., Abalos P. & Torres, D. 2001a. Additional data on anti-*Brucella* antibodies in *Arctocephalus gazella* from Cape Shirreff, Livingston Island, Antarctica. *CCAMLR Science* **8**: 147-154

Blank, O., Montt, J.M., Celedón M. & Torres, D. 2001b. Herpes virus antobodies in *Arctocephalus gazelle*from Cape Shirreff, Livingston Island, Antarctica. WG-EMM- 01/59.

Bonner, W.N. & Smith, R.I.L. (Eds) 1985. *Conservation areas in the Antarctic.* SCAR, Cambridge: 59-63.

Carten, T.M., Taft, M., Trivelpiece W.Z. & Holt, R.S. 2001. Seabird research at Cape Shirreff, Livingston Island, Antarctica, 1999/2000. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 1999- 2000 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Cattan, P., Yánez, J., Torres, D., Gajardo, M. & Cárdenas, J. 1982. Censo, marcaje y estructura poblacional del lobo fino antártico *Arctocephalus gazella* (Peters, 1875) en las islas Shetland del Sur, Chile. *Serie Científica Instituto Antártico Chileno* **29**: 31-38.

CCAMLR 1997. Management plan for the protection of Cape Shirreff and the San Telmo Islands, South Shetland Islands, as a site included in the CCAMLR Ecosystem Monitoring Program. In: *Schedule of Conservation Measures in Force 1996/97*: 51-64.

CCAMLR 2010. *CCAMLR Statistical Bulletin* **22** (2000–2009). CCAMLR, Hobart, Australia.

Chisholm, S.E., Pietrzak, K.W., Miller, A.K. & Trivelpiece, W.Z. 2008. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2007-2008. In Van Cise, A.M. (ed) AMLR (Antarctic Marine Living Resources) 2007-2008 Field Season Report, Ch. 5. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Constantinescu, F. & Torres, D. 1995. Análisis bioantropológico de un cráneo humano hallado en cabo Shirreff, isla Livingston, Antártica. Ser. Cient. INACH **45**: 89-99.

Cox, M.J., Demer, D.A., Warren, J.D., Cutter, G.R. & Brierley, A.S. 2009. Multibeam echosounder observations reveal interactions between Antarctic krill and air-breathing predators. *Marine Ecology Progress Series* **378**: 199–209.

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

Everett, K.R. 1971. Observations on the glacial history of Livingston Island. *Arctic* **24** (1): 41-50.

Fildes, R. 1821. A journal of a voyage from Liverpool towards New South Shetland on a sealing and sea elephant adventure kept on board Brig Robert of Liverpool, Robert Fildes, 13 August - 26 December 1821. MS 101/1, Scott Polar Research Institute, Cambridge.

Goebel, M.E., Rutishauser, M., Parker, B., Banks, A., Costa, D.P., Gales, N. & Holt, R.S. 2001a. Pinniped research at Cape Shirreff, Livingston Island, Antarctica, 1999/2000. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 1999-2000 Field Season Report, Ch. 8. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Goebel, M.E., Parker, B., Banks, A., Costa, D.P., Pister, B. & Holt, R.S. 2001b. Pinniped research at Cape Shirreff, Livingston Island, Antarctica, 2000/2001. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2000-01 Field Season Report, Ch. 8. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Goebel, M.E., McDonald, B.I., Freeman, S., Haner, R., Spear, N. & Sexton, S. 2008. Pinniped Research at Cape Shirreff, Livingston Island, 2008/09. In AMLR 2007-2008 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. La Jolla, California.

Goebel, M.E., Krause, D., Freeman, S., Burner, R., Bonin, C., Vasquez del Mercado, R., Van Cise, A.M. & Gafney, J. 2009. Pinniped Research at Cape Shirreff, Livingston Island, Antarctica, 2008/09. In AMLR 2008-2009 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. La Jolla, California.

Garcia, M., Aguayo, A. & Torres, D. 1995. Aspectos conductuales de los machos de lobo fino antartico, *Arctocephalus gazella* en Cabo Shirreff, isla Livingston, Antártica, durante la fase de apareamiento. *Serie Científica Instituto Antártico Chileno* **45**: 101-112.

Harris, C.M. 2001. Revision of management plans for Antarctic protected areas originally proposed by the United States of America and the United Kingdom: Field visit report. Internal report for the National Science Foundation, US, and the Foreign and Commonwealth Office, UK. *Environmental Research & Assessment*, Cambridge.

Headland, R. 1989. *Chronological list of Antarctic expeditions and related historical events.* Cambridge University Press, Cambridge.

Heap, J. (ed) 1994. *Handbook of the Antarctic Treaty System.* 8th Edn. U.S. Department of State, Washington.

Hobbs, G.J. 1968. The geology of the South Shetland Islands. IV. The geology of Livingston Island. *British Antarctic Survey Scientific Reports* **47**.

Henadez, J., Prado, V., Torres, D., Waldenström, J., Haemig, P.D. & Olsen, B. 2007. Enteropathogenic *Escherichia coli* (EPEC) in Antarctic fur seals *Arctocephalus gazella***.** *Polar Biology* **30** (10):1227–29.

Hewitt, R.P., Kim, S., Naganobu, M., Gutierrez, M., Kang, D., Taka, Y., Quinones, J., Lee Y.-H., Shin, H.- C., Kawaguchi, S., Emery, J.H., Demer, D.A. & Loeb, V.J. 2004. Variation in the biomass density and demography of Antarctic krill in the vicinity ofthe South Shetland Islands during the 1999/2000 austral summer. *Deep-Sea Research* II **51** 1411–1419.

Hinke, J.T., Salwicka, K., Trivelpiece, S.G., Watters, S.G., & Trivelpiece, W.Z. 2007. Divergent responses of *Pygoscelis* penguins reveal a common environmental driver. *Oecologia* **153**:845–855.

Hucke-Gaete, R., Acevedo, J., Osman, L., Vargas, R., Blank, O. & Torres, D. 2001. Informe científico. ECA XXXVII (2000/2001). Proyecto 018 "Estudios ecológicos sobre el lobo fino antártico, Arctocephalus gazella", cabo Shirreff, isla Livingston, Shetland del Sur, Antártica.

Hucke-Gaete, R., Torres, D., Aguayo, A. & Vallejos, V. 1998. Decline of Arctocephalus gazella population at SSSI No. 32, South Shetlands, Antarctica (1997/98 season): a discussion of possible causes. WG- EMM-98/17. August 1998. Kochin. 10: 16–19

Hucke-Gaete, R, Torres, D. & Vallejos, V. 1997a. Population size and distribution of *Pygoscelis antarctica* and *P. papua* at Cape Shirreff, Livingston Island, Antarctica (1996/97 Season). CCAMLR WG-EMM-97/62.

Hucke-Gaete, R, Torres, D., Vallejos, V. & Aguayo, A. 1997b. Population size and distribution of *Arctocephalus gazella* at SSSI No. 32, Livingston Island, Antarctica (1996/97 Season). CCAMLR WG-EMM-97/62.

Hucke-Gaete, R, Torres, D. & Vallejos, V. 1997c. Entanglement of Antarctic fur seals, *Arctocephalus gazella*, by marine debris at Cape Shirreff and San Telmo Islets, Livingston Island, Antarctica:1998- 1997. *Serie Científica Instituto Antártico Chileno* **47**: 123-135.

Hucke-Gaete, R., Osman, L.P., Moreno, C.A. & Torres, D. 2004. Examining natural population growth from near extinction: the case of the Antarctic fur seal at the South Shetlands, Antarctica. *Polar Biology* **27** (5): 304–311

Huckstadt, L., Costa, D. P., McDonald, B. I., Tremblay, Y., Crocker, D. E., Goebel, M. E. & Fedak, M. E. 2006. Habitat Selection and Foraging Behavior of Southern Elephant Seals in the Western Antarctic Peninsula. American Geophysical Union, Fall Meeting 2006, abstract #OS33A-1684.

INACH (Instituto Antártico Chileno) 2010. Chilean Antarctic Program of Scientific Research 2009-2010. Chilean Antarctic Institute Research Projects Department. Santiago, Chile.

Kawaguchi, S., Nicol, S., Taki, K. & Naganobu, M. 2006. Fishing ground selection in the Antarctic krill fishery: Trends in patterns across years, seasons and nations. *CCAMLR Science*, **13** : 117–141.

Leppe, M., Fernandoy, F., Palma-Heldt, S. & Moisan, P 2004. Flora mesozoica en los depósitos morrénicos de Cabo Shirreff, Isla Livingston, Shetland del Sur, Península Antártica, in Actas del 10º Congreso Geológico Chileno. CD-ROM. Resumen Expandido, 4pp. Universidad de Concepción. Concepción. Chile.

Leung, E.S.W., Orben, R.A. & Trivelpiece, W.Z. 2006. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2005-2006. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2005-2006 Field Season Report, Ch. 9. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Miller, A.K., Leung, E.S.W. & Trivelpiece, W.Z. 2005. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2004-2005. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2004-2005 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Miller, A.K. & Trivelpiece, W.Z. 2007. Cycles of *Euphausia superba* recruitment evident in the diet of Pygoscelid penguins and net trawls in the South Shetland Islands, Antarctica. *Polar Biology* **30** (12):1615–1623.

Miller, A.K. & Trivelpiece, W.Z. 2008. Chinstrap penguins alter foraging and diving behavior in response to the size of their principle prey, Antarctic krill. *Marine Biology* **154**: 201-208.

Miller, A.K., Karnovsky, N.J. & Trivelpiece, W.Z. 2008. Flexible foraging strategies of gentoo penguins *Pygoscelis papua* over 5 years in the South Shetland Islands, Antarctica. *Marine Biology* **156**: 2527-2537.

O'Gorman, F.A. 1961. Fur seals breeding in the Falkland Islands Dependencies. *Nature* **192**: 914-16. O'Gorman, F.A. 1963. The return of the Antarctic fur seal. *New Scientist* **20**: 374-76.

Olavarría, C., Coria, N., Schlatter, R., Hucke-Gaete, R., Vallejos, V., Godoy, C., Torres D. & Aguayo, A. 1999. Cisnes de cuello negro, *Cygnus melanocoripha* (Molina, 1782) en el área de las islas Shetland del Sur y península Antártica. *Serie Científica Instituto Antártico Chileno* **49**: 79-87.

Oliva, D., Durán, R, Gajardo, M. & Torres, D. 1987. Numerical changes in the population of the Antarctic fur seal *Arctocephalus gazella* at two localities of the South Shetland Islands. *Serie Científica Instituto Antártico Chileno* **36**: 135-144.

Oliva, D., Durán, R, Gajardo, M. & Torres, D. 1988. Population structure and harem size groups of the Antarctic fur seal *Arctocephalus gazella* Cape Shirreff, Livingston Island, South Shetland Islands. Meeting of the SCAR Group of Specialists on Seals, Hobart, Tasmania, Australia. *Biomass Report Series* **59**: 39.

Orben, R.A., Chisholm, S.E., Miller, S.K. & Trivelpiece, W.Z. 2007. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2006-2007. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2006-2007 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Osman, L.P., Hucke-Gaete, R., Moreno, C.A., & Torress, D. 2004. Feeding ecology of Antarctic fur seals at Cape Shirreff, South Shetlands,Antarctica. *Polar Biology* **27**(2): 92–98.

Palma-Heldt, S., Fernandoy, F., Quezada, I. & Leppe, M 2004. Registro Palinológico de Cabo Shirreff, Isla Livingston, nueva localidad para el Mesozoico de Las Shetland del Sur, in V Simposio Argentino y I Latinoamericano sobre Investigaciones Antárticas CD-ROM. Resumen Expandido N° 104GP. Buenos Aires, Argentina.

Palma-Heldt, S., Fernandoy, F., Henríquez, G. & Leppe, M 2007. Palynoflora of Livingston Island, South Shetland Islands : Contribution to the understanding of the evolution of the southern Pacific Gondwana margin. U.S. Geological Survey and The National Academies; USGS OF-2007-1047, Extended Abstract 100.

Pietrzak, K.W., Breeden, J.H, Miller, A.K. & Trivelpiece, W.Z. 2009. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2008-2009. In Van Cise, A.M. (ed) AMLR (Antarctic Marine Living Resources) 2008-2008 Field Season Report, Ch. 6. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Pinochet de la Barra, O. 1991. El misterio del "San Telmo". ¿Náufragos españoles pisaron por primera vez la Antártida? *Revista Historia* (Madrid), **16** (18): 31-36.

Reid, K., Jessop, M.J., Barrett, M.S., Kawagucji, S., Siegel, V. & Goebel, M.E. 2004. Widening the net: spatio-temporal variability in the krill population structure across the Scotia Sea. *Deep-Sea Research* II **51**: 1275–1287

Reiss, C. S., Cossio, A. M., Loeb, V. & Demer, D. A. 2008. Variations in the biomass of Antarctic krill (Euphausia superba) around the South Shetland Islands, 1996–2006. *ICES Journal of Marine Science* **65**: 497–508.

Sallaberry, M. & Schlatter, R. 1983. Estimacíon del número de pingüinos en el Archipiélago de las Shetland del Sur. *Serie Científica Instituto Antártico Chileno* **30**: 87-91.

Saxer, I.M., Scheffler, D.A. & Trivelpiece, W.Z. 2003. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2001-2002. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2001-2002 Field Season Report, Ch. 6. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Shill, L.F., Antolos, M. & Trivelpiece, W.Z. 2003. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2002-2003. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2002-2003 Field Season Report, Ch. 8. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Smellie, J.L., Pallàs, R.M., Sàbata, F. & Zheng, X. 1996. Age and correlation of volcanism in central Livingston Island, South Shetland Islands: K-Ar and geochemical constraints. *Jounral of South American Earth Sciences* **9** (3/4): 265-272.

Smith, R.I.L. & Simpson, H.W. 1987. Early Nineteeth Century sealers' refuges on Livingston Island, South Shetland Islands. *British Antarctic Survey Bulletin* **74**: 49-72.

Stehberg, R. & V. Lucero, 1996. Excavaciones arqueológicas en playa Yámana, cabo Shirreff, isla Livingston, Shetland del Sur, Antártica. *Serie Científica Instituto Antártico Chileno* 46: 59-81.

Taft, M.R., Saxer, I.M. & Trivelpiece W.Z 2001. Seabird research at Cape Shirreff, Livingston Island, Antarctica, 2000/2001. In Lipsky, J. (ed) AMLR (Antarctic Marine Living Resources) 2000-01 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Torres, D. 1984. Síntesis de actividades, resultados y proyecciones de las investigaciones chilenas sobre pinípedos antarcticos. *Boletín Antártico Chileno* **4**(1): 33-34.

Torres, D. 1990. Collares plásticos en lobos finos antárticos: Otra evidencia de contaminación. *Boletín Antártico Chileno* **10** (1): 20-22 .

Torres, D. 1992. ¿Cráneo indígena en cabo Shirreff? Un estudio en desarrollo. *Boletín Antártico Chileno* **11** (2): 2-6.

Torres, D. 1994. Synthesis of CEMP activities carried out at Cape Shirreff. Report to CCAMLR WG-CEMP 94/28.

Torres, D. 1995. Antecedentes y proyecciones científicas de los estudios en el SEIC No. 32 y Sitio CEMP «Cabo Shirreff e islotes San Telmo», isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **45**: 143-169.

Torres, D. 1999. Observations on ca. 175-Year Old Human Remains from Antarctica (Cape Shirreff, Livingston Island, South Shetlands). *International Journal of Circumpolar Health* **58**: 72-83.

Torres, D. & Aguayo, A. 1993. Impacto antrópico en cabo Shirreff, isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **43**: 93-108.

Torres, D. & Gajardo, M. 1985. Información preliminar sobre desechos plásticos hallados en cabo Shirreff, isla Livingston, Shetland del Sur, Chile. *Boletín Antártico Chileno* **5**(2): 12-13.

Torres, D. & Jorquera, D. 1992. Analysis of Marine Debris found at Cape Shirreff, Livingston Island, South Shetlands, Antarctica. SC-CAMLR/BG/7, 12 pp. CCAMLR, Hobart, Australia.

Torres, D. & Jorquera, D. 1994. Marine Debris Collected at Cape Shirreff, Livinston Island, during the Antarctic Season 1993/94. CCMALR-XIII/BG/17, 10 pp. 18 October 1994. Hobart, Australia.

Torres, D. & Jorquera, D. 1995. Línea de base para el seguimiento de los desechos marinos en cabo Shirreff, isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **45**: 131-141.

Torres, D., Jaña, R., Encina, L. & Vicuña, P. 2001. Cartografía digital de cabo Shirreff, isla Livingston, Antártica: un avance importante. *Boletín Antártico Chileno* **20** (2): 4-6.

Torres, D.E. & Valdenegro V. 2004. Nuevos registros de mortalidad y necropsias de cachorros de lobo fino antártico, Arctocephalus gazella, en cabo Shirreff, sila Livingston, Antártica. *Boletín Antártico Chileno* **23** (1).

Torres, D., Vallejos, V., Acevedo, J., Hucke-Gaete, R. & Zarate, S. 1998. Registros biologicos atípico en cabo Shirreff, isla Livingston, Antártica. *Boletín Antártico Chileno* **17** (1): 17-19.

Torres, D., Vallejos, V., Acevedo, J., Blank, O., Hucke-Gaete, R. & Tirado, S. 1999. Actividades realizadas en cabo Shirreff, isla Livingston, en temporada 1998/99. *Boletín Antártico Chileno* **18** (1): 29-32

orres, T. 1993. Primer hallazgo de madera fósil en Cabo Shirreff, isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **43**: 31-39.

Tufft, R. 1958. Preliminary biology report Livingston Island summer survey. Unpublished British Antarctic Survey report, BAS Archives Ref. AD6/2D/1957/N2.

Vargas, R., Osman, L.P. & Torres, D. 2009. Inter-sexual diVerences in Antarctic fur seal pup growth rates: evidence of environmental regulation? Polar Biology **32** (8):1177–86

Vallejos, V., Acevedo, J., Blank, O., Osman, L. & Torres, D. 2000. Informe científico - logístico. ECA XXXVI (1999/2000). Proyecto 018 "Estudios ecológicos sobre el lobo fino antártico, Arctocephalus gazella", cabo Shirreff, archipiélago de las Shetland del Sur, Antártica. Ministerio de Relaciones Exteriores, Instituto Antártico Chileno. Nº Ingreso 642/712, 19 ABR.2000.

Vallejos, V., Osman, L., Vargas, R., Vera, C. & Torres, D. 2003. Informe científico. ECA XXXIX (2002/2003). Proyecto INACH 018 "Estudios ecológicos sobre el lobo fino antártico, Arctocephalus gazella", cabo Shirreff, isla Livingston, Shetland del Sur, Antártica. Ministerio de Relaciones Exteriores, Instituto Antártico Chileno.

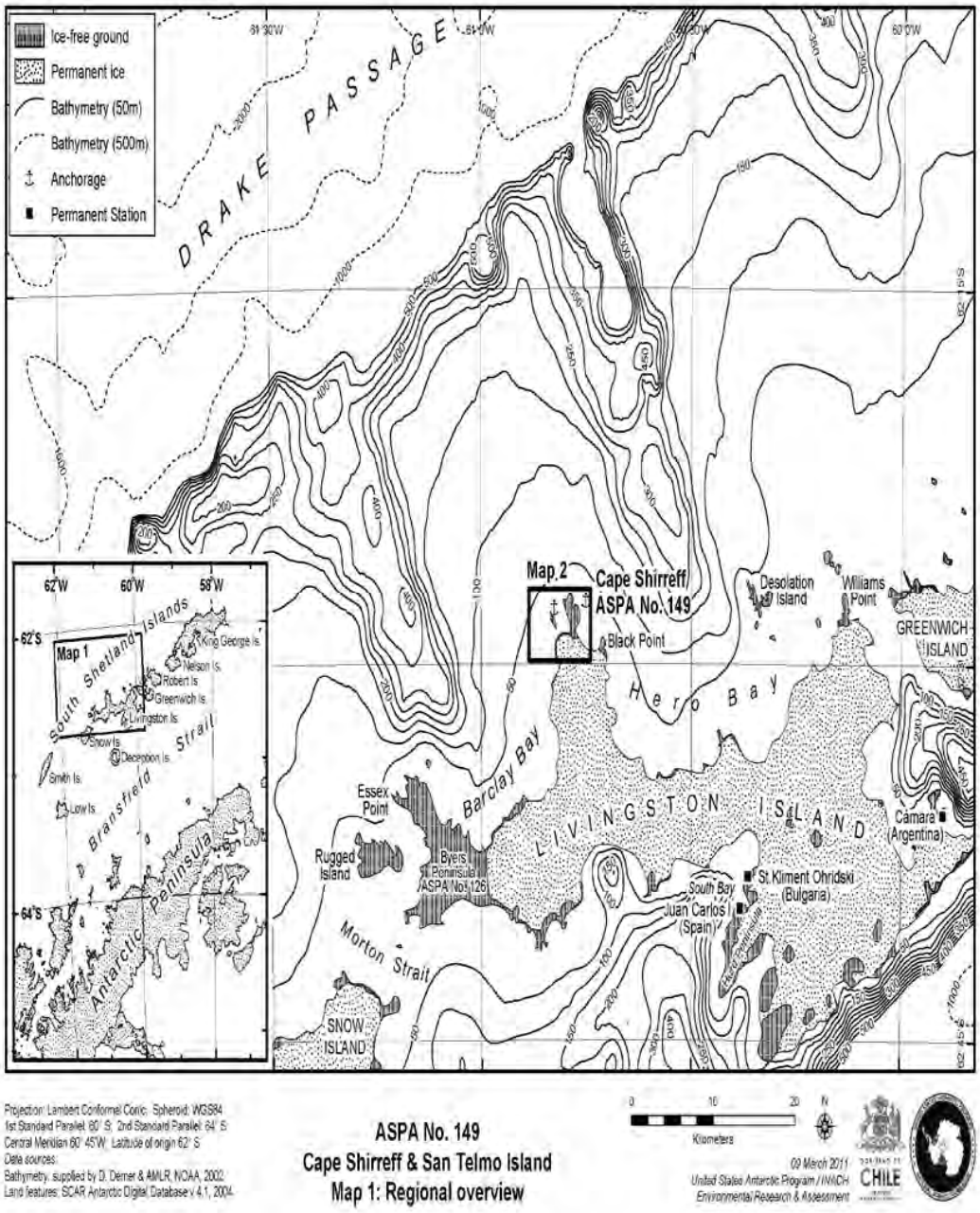
Vera, C., Vargas, R. & Torres, D. 2004. El impacto de la foca leopardo en la población de cachorros de lobo fino antártico en cabo Shirreff, Antártica, durante la temporada 2003/2004. *Boletín Antártico Chileno* **23** (1).

Warren, J., Sessions, S., Patterson, M. Jenkins, A., Needham, D. & Demer, D. 2005. Nearshore Survey. In AMLR 2004-2005 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. La Jolla, California.

Warren, J., Cox, M., Sessions, S. Jenkins, A., Needham, D. & Demer, D. 2006. Nearshore acoustical survey near Cape Shirreff, Livingston Island. In AMLR 2005-2006 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. La Jolla, California.

Warren, J., Cox, M., Sessions, S. Jenkins, A., Needham, D. & Demer, D. 2007. Nearshore acoustical survey near Cape Shirreff, Livingston Island. In AMLR 2006-2007 field season report. Objectives, Accomplishments and Tentative Conclusions. Southwest Fisheries Science Center Antarctic Ecosystem Research Group. La Jolla, California.

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

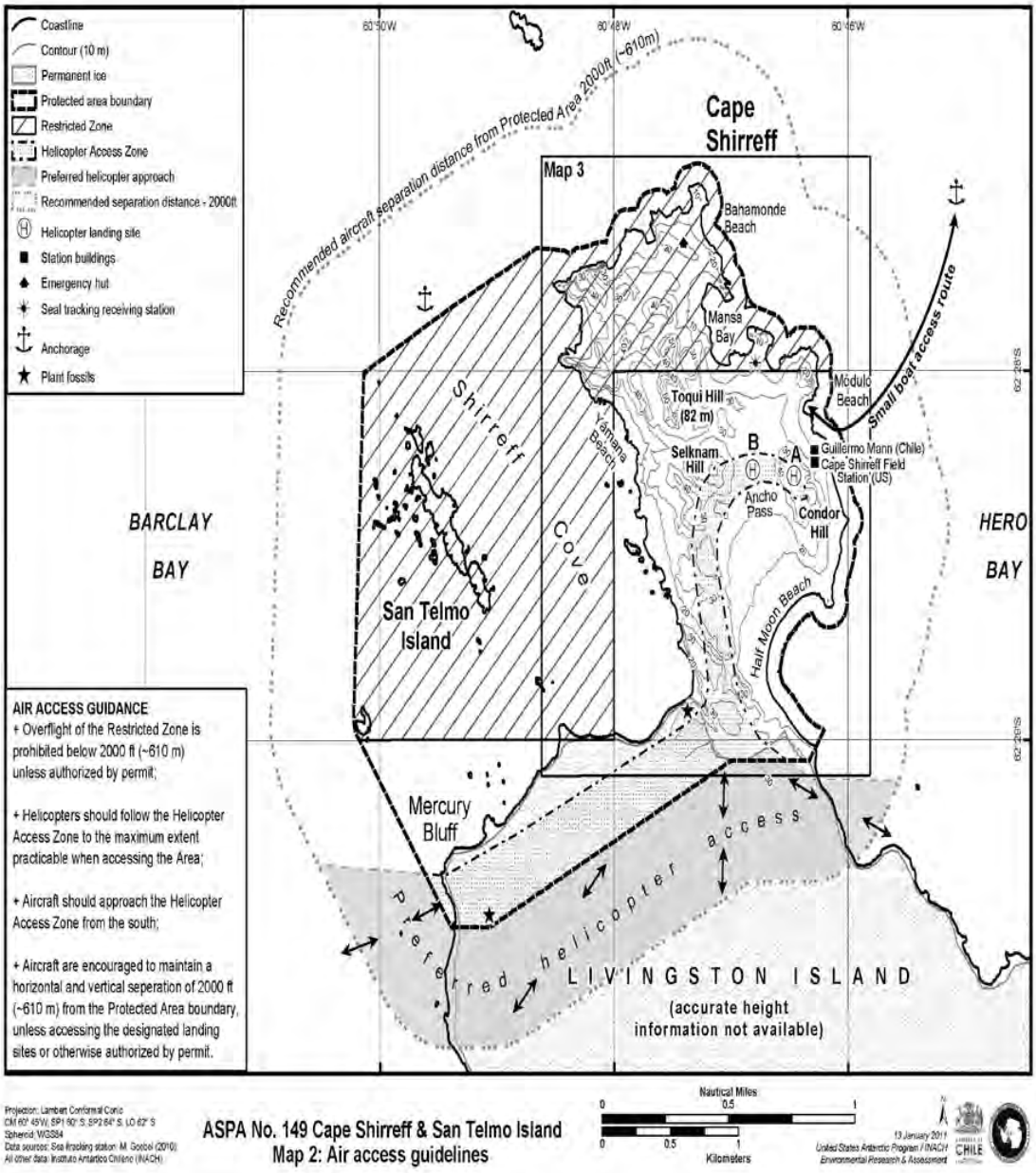


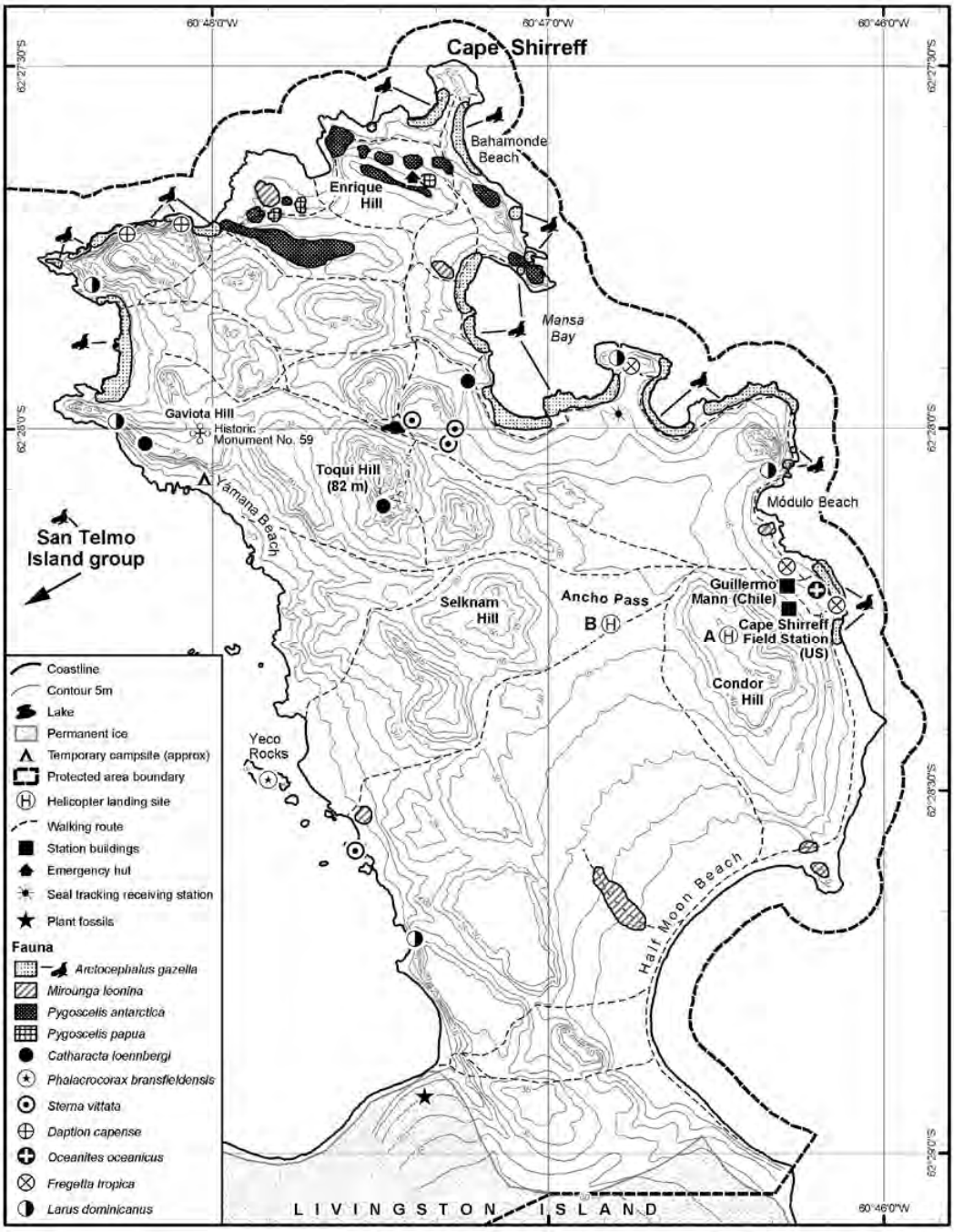
Projection: Lambert Conformal Conic. Spheroid: WGS84
1st Standard Parallel: 60° S; 2nd Standard Parallel: 64° S
Central Meridian 60° 45'W; Latitude of origin 62° S
Data sources:
Bathymetry: supplied by D. Demer & AMLR, NOAA, 2002.
Land features: SCAR Antarctic Digital Database v 4.1, 2004.

ASPA No. 149
Cape Shirreff & San Telmo Island
Map 1: Regional overview

0 10 20 N
Kilometers

09 March 2011
United States Antarctic Program / NMICH
Environmental Research & Assessment


Coastline
Contour (10 m)
Permanent ice
Protected area boundary
Restricted Zone
Helicopter Access Zone
Preferred helicopter approach
Recommended separation distance - 2000ft
Helicopter landing site
Station buildings
Emergency hut
Seal tracking receiving station
Anchorage
Plant fossils
60°50'W
60°48'W
60°46'W
62°28'S
Recommended aircraft separation distance from Protected Area 2000ft (~610m)
Cape Shirreff
Map 3
Bahamonde Beach
Mansa Bay
Small boat access route
Módulo Beach
Toqui Hill (82 m)
Yamana Beach
Selknam Hill
B
A
Guillermo Mann (Chile)
Cape Shirreff Field Station (US)
Ancho Pass
Condor Hill
Shirreff Cove
San Telmo Island
Half Moon Beach
BARCLAY BAY
HERO BAY
Mercury Bluff
Preferred helicopter access
LIVINGSTON ISLAND
(accurate height information not available)
AIR ACCESS GUIDANCE
+ Overflight of the Restricted Zone is prohibited below 2000 ft (~610 m) unless authorized by permit;
+ Helicopters should follow the Helicopter Access Zone to the maximum extent practicable when accessing the Area;
+ Aircraft should approach the Helicopter Access Zone from the south;
+ Aircraft are encouraged to maintain a horizontal and vertical seperation of 2000 ft (~610 m) from the Protected Area boundary, unless accessing the designated landing sites or otherwise authorized by permit.
Projection: Lambert Conformal Conic
CM 60° 45'W, SP1 60° S, SP2 64° S, LO 62° S
Spheroid: WGS84
Data sources: Sea tracking station: M. Goebel (2010)
All other data: Instituto Antartico Chileno (INACH)
ASPA No. 149 Cape Shirreff & San Telmo Island
Map 2: Air access guidelines
Nautical Miles
0
0.5
1
0
0.5
1
Kilometers
13 January 2011
United States Antarctic Program / INACH
Environmental Research & Assessment
CHILE



Projection: Lambert Conformal Conic
CM 60° 45'W; SP1 60° S; SP2 64° S; LO 62° S
Spheroid: WGS84
Data sources: Seal tracking station: M. Goebel (2010);
All other data: Instituto Antártico Chileno (INACH)

ASPA No. 149
Cape Shirreff & San Telmo Island
Map 3: Breeding colonies & human features

0 100 200 300
Meters
13 January 2011
United States Antarctic Program / INACH
Environmental Research & Assessment

Antarctic Specially Protected Area No 165 (Edmonson Point, Wood 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 1 (2006), which designated Edmonson Point, Wood Bay, Ross Sea as ASPA 165 and annexed a Management Plan for the Area;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 165;

Desiring to replace the existing Management Plan for ASPA 165 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 165 (Edmonson Point, Wood Bay, Ross Sea), which is annexed to this Measure, be approved; and
2. the Management Plan for ASPA 165 annexed to Measure 1 (2006) shall cease to be effective.

Management Plan for Antarctic Specially Protected Area No. 165

EDMONSON POINT, WOOD BAY, VICTORIA LAND, ROSS SEA

1. Description of values to be protected

Edmonson Point (74°20' S, 165°08' E, 5.49 km^2), Wood Bay, Victoria Land, Ross Sea, is proposed as an Antarctic Specially Protected Area (ASPA) by Italy on the grounds that it has outstanding ecological and scientific values which require protection from possible interference that might arise from unregulated access. The Area includes ice-free ground and a small area of adjacent sea at the foot of the eastern slopes of Mount Melbourne (2732 m), which is of limited extent and is the subject of ongoing and long-term scientific research.

The terrestrial and freshwater ecosystem at Edmonson Point is one of the most outstanding in northern Victoria Land. An exceptional diversity of freshwater habitats is present, with numerous streams, lakes, ponds and seepage areas, exhibiting nutrient conditions ranging from eutrophic to oligotrophic. Such a range of freshwater habitats is rare in Victoria Land. Consequently, these habitats support a high diversity of algal and cyanobacterial species, with over 120 species so far recorded, and the stream network is the most extensive and substantial in northern Victoria Land. The volcanic lithology and locally nutrient-enriched (by birds) substrata, together with a localised abundance of water, provides a habitat for relatively extensive bryophyte development. Plant communities are highly sensitive to changes in the hydrological regime, and environmental gradients produce sharply defined community boundaries. Thus, the range of vegetation is diverse, and includes epilithic lichen communities, some of which are dependent on high nitrogen input from birds, communities associated with late-lying snow patches, and moss-dominated communities that favour continually moist or wet habitats. The site represents one of the best examples of the latter community-type in Victoria Land. Invertebrates are unusually abundant and extensively distributed for this part of Antarctica.

The nature and diversity of the terrestrial and freshwater habitats offer outstanding scientific opportunities, especially for studies of biological variation and processes along moisture and nutrient gradients. The site is considered one of the best in Antarctica for studies of algal ecology. These features were among those that led to the selection of Edmonson Point as a key site in the Scientific Committee on Antarctic Research's Biological Investigations of Terrestrial Antarctic Systems (BIOTAS) programme in 1995-96. A coordinated multinational research programme, known as BIOTEX-1, established study sites and made extensive collections of soil, rock, water, snow, guano, bacteria, vegetation (cyanobacterial mats, fungi, algae, lichens, bryophytes) and of terrestrial invertebrates.

The scientific value of Edmonson Point is also considered exceptional for studies on the impact of climate change on terrestrial ecosystems. Its location at approximately the mid-point in a north- south latitudinal gradient extending along Victoria Land is complementary to other sites protected for their important terrestrial ecological values, such as Cape Hallett (ASPA No. 106) and Botany Bay, Cape Geology (ASPA No. 154), which are about 300 km to the north and south respectively. This geographical position is recognised as important in a continent-wide ecological research network (e.g. the Scientific Committee on Antarctic Research 'RiSCC' programme). In addition, the lakes are among the best in northern Victoria Land for studies of biogeochemical processes with short- and long-term variations. Together with the unique properties of the permafrost active layer, which is unusually thick in this location, these features are considered particularly useful as sensitive indicators of ecological change in response to levels of UV radiation and in shifting climate.

A colony of approximately 2000 pairs of Adélie penguins (*Pygoscelis adeliae*) has been a focus of ongoing research since 1994-95 together with a colony of approximately 120 pairs of south polar skuas (*Catharacta maccormicki*). The Edmonson Point Adélie penguin colony is included in the ecosystem monitoring network of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). The site is considered a good example of this species assemblage, which is representative of those found elsewhere. It is unusual, however, for the diverse range of breeding habitat available for south polar skuas, and also because of the unusually high skua to penguin ratio (1:20). The geographical position, the size of the colonies, the terrain and habitat features of the site, the natural protection given by the summer fast ice extension and the distance from Mario Zucchelli Station at Terra Nova Bay (which isolates the colony from research station disturbance but allows for logistic support) make Edmonson Point particularly suitable for the research being undertaken on these birds. The research contributes to the CCAMLR Ecosystem Monitoring Programme (CEMP), focusing on population monitoring, reproductive success, feeding and foraging strategies, migration, and behaviour. This research is important to broader studies of how natural and human-induced variations in the Antarctic ecosystem may affect the breeding success of Adélie penguins, and to understand the potential impact of harvesting of Antarctic krill (*Euphausia superba*).

The near-shore marine environment is a good and representative example of the sea-ice habitat used by breeding Weddell seals to give birth and wean pups early in the summer season. Only one other ASPA in the Ross Sea region has been designated to protect Weddell seals (ASPA No. 137 Northwest White Island, McMurdo Sound), although this site is designated because the small breeding group of seals in that locality is highly unusual; in contrast, inclusion here is as a representative example similar to breeding sites throughout the region.

In addition to the outstanding biological values, a diversity of geomorphic features is present, including a series of ice-cored moraines incorporating marine deposits, raised beaches, patterned ground, a cuspate foreland, and fossil penguin colonies. The cuspate foreland at Edmonson Point is a rare feature in Victoria Land, and is one of the best examples of its kind. It is unusual in that it is not occupied by a breeding colony of penguins, as is the case at Cape Hallett and Cape Adare. The glacial moraines that incorporate marine deposits, including seal bones and shells of the bivalves *Laternula elliptica* and *Adamussium colbecki*, are particularly valuable for dating regional glacier fluctuations. Sedimentary sequences in the north-west of Edmonson Point contain fossils from former penguin colonies. These are useful for dating the persistence of bird breeding at the site, which contributes to reconstructions of Holocene glacial phases and palaeoclimate.

The wide representation and the quality of phenomena at Edmonson Point have attracted interest from a variety of disciplines and research has been carried out at the site for more than 20 years. Over this period, substantial scientific databases have been established, which adds to the value of Edmonson Point for current, on-going and future research. It is important that pressures from human activities in the Area are managed so that the investments made in these long-term data sets are not inadvertently compromised. These factors also make the site of exceptional scientific value for multi-disciplinary studies.

Given the duration and range of past activities, Edmonson Point cannot be considered pristine. Some environmental impacts have been observed, such as occasional damage to soils and moss communities by trampling, dispersal of materials from scientific equipment by wind, and alteration of habitat by construction of facilities. In contrast, the ice-free area at Colline Ippolito (Ippolito Hills) (1.67 km^2) approximately 1.5 km to the north-west, has received relatively little visitation and human disturbance at this site is believed to be minimal. As such, Colline Ippolito is considered particularly valuable as a potential reference area for comparative studies to the main Edmonson Point, and it is important that this potential scientific value is maintained. While the precise effects of scientific research and human presence at both sites are uncertain, because detailed studies on human impact have not yet been undertaken, contaminants in the local marine ecosystem remain

very low and human impacts on the ecosystem as a whole, particularly at Colline Ippolito, are considered to be generally minor.

The biological and scientific values at Edmonson Point and Colline Ippolito are vulnerable to human disturbance. The vegetation, water-saturated soils and freshwater environments are susceptible to damage from trampling, sampling and pollution. Scientific studies could be compromised by disturbance to phenomena or to installed equipment. It is important that human activities are managed so that the risks of impacts on the outstanding values of the Area are minimised.

The total Area of 5.49 km^2 comprises the ice-free area of Edmonson Point (1.79 km^2), the smaller but similar ice-free area at Colline Ippolito (1.12 km^2) approximately 1.5 km to its north which is designated a Restricted Zone, and the adjacent marine environment (2.58 km^2) extending 200 m offshore from Edmonson Point and Colline Ippolito and including Baia Siena (Siena Bay) (Map 1).

2. Aims and objectives

Management at Edmonson Point aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance;
- allow scientific research while ensuring protection from mutual interference and/or over-sampling;
- allow scientific research provided it is for reasons which cannot reasonably be served elsewhere;
- protect sites of long-term scientific studies from disturbance;
- preserve a part of the natural ecosystem as a potential 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 for management purposes in support of the aims of the Management Plan.

3. Management activities

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

- Copies of this management plan, including maps of the Area, shall be made available at Mario Zucchelli Station at Terra Nova Bay (Italy), Gondwana Station (Germany), and at any other permanent stations established within 100 km of the Area;
- Structures, markers, signs, fences or other equipment erected within the Area for scientific or management purposes shall be secured and maintained in good condition and removed when no longer necessary;
- Durable wind direction indicators should be erected close to the designated helicopter landing sites whenever it is anticipated there will be a number of landings in a given season;
- Markers, which should be clearly visible from the air and pose no significant risk to the environment, should be placed to mark the designated helicopter landing sites;
- Markers, such as a series of durable sticks, should be placed to mark the preferred inland walking routes between the Adélie penguin colony and the designated helicopter landing sites;
- 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 1: Edmonson Point ASPA No. 165, Wood Bay, Victoria Land, Ross Sea. Map specifications: Projection: UTM Zone 58S; Spheroid: WGS84; Ice-free areas and coastline derived from rectified Quickbird satellite image with a ground pixel resolution of 70 cm, acquired 04/01/04 by Programma Nazionale di Ricerche in Antartide (PNRA), Italy. Horizontal accuracy approx ±10 m; elevation information unavailable. Inset 1: the location of Wood Bay in Antarctica. Inset 2. The location of Map 1 in relation to Wood Bay and Terra Nova Bay. The location of Mario Zucchelli Station (Italy), Gondwana Station (Germany), and the nearest protected areas are shown.

Map 2: Edmonson Point, ASPA No. 165, Physical / human features and access guidelines. Map derived from digital orthophotograph with ground pixel resolution of 25 cm, from ground GPS surveys and observations, and from Quickbird satellite image (04/01/04). Map specifications: Projection: Lambert Conformal Conic; Standard parallels: 1st 72° 40' 00" S; 2nd 75° 20' 00"S; Central Meridian: 165° 07' 00" E; Latitude of Origin: 74° 20' 00" S; Spheroid: WGS84; Vertical datum: Mean Sea Level. Vertical contour interval 10 m. Horizontal accuracy: ±1 m; vertical accuracy expected to be better than ±1 m.

Map 3: Restricted Zone, Colline Ippolito: Edmonson Point ASPA No. 165. Map derived from Quickbird satellite image (04/01/04). Map specifications as for Map 2, except for horizontal accuracy which is approx ±10 m, and elevation information is not available. Sea level is approximated from coastline evident in satellite image.

Map 4: Edmonson Point ASPA No. 165, topography, wildlife and vegetation. Map specifications as for Map 2, except for contour interval which is 2 m.

Map data and preparation: PNRA, Dipartimento di Scienze Ambientali (Università di Siena), Environmental Research & Assessment (Cambridge), Gateway Antarctica (Christchurch).

6. Description of the Area

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

GENERAL DESCRIPTION

Edmonson Point (74°20' S, 165°08' E) is a coastal ice-free area of 1.79 km^2 situated at Wood Bay, 50 km north of Terra Nova Bay, and 13 km east of the summit and at the foot of Mount Melbourne (2732 m), Victoria Land. The Area comprises a total of 5.49 km^2, including the entire ice-free ground of Edmonson Point (1.79 km^2), the separate ice-free area of Colline Ippolito (Ippolito Hills) (1.12 km^2) approximately 1.5 km north-west of Edmonson Point, and the nearshore marine environment and intervening sea of Baia Siena (Siena Bay) between these ice-free areas (2.58 km^2), which lie east and at the foot of the permanent ice sheet extending from Mount Melbourne (Map 1). Part of the glacier from Mount Melbourne separates the two ice-free areas on land. A broad pebbly beach extends the length of the coastline of Edmonson Point, above which cliffs rise up to 128 m

towards the south of the Area. The topography of the Area is rugged, with several hills of volcanic origin of up to 134 m in height, and ice-free slopes rising to around 300 m adjacent to the ice sheet, although accurate elevation information in these areas is not currently available. Undulating ice-cored moraines, boulder fields and rock outcrops are separated by small ash plains and shallow valleys. The Area is dissected by numerous valleys and melt streams, with several small lakes, and seepage areas being common features throughout the Area. In the central region of Edmonson Point are several wide shallow basins, at about 25 m elevation, covered by fine scoria and coarse sand, mixed with extensive carpets of vegetation and areas of patterned ground. The northern coast of Edmonson Point is a cuspate foreland comprising several raised beaches.

The environmental character of Colline Ippolito is similar to that of Edmonson Point. This area has a narrow boulder beach backed by a ridge running parallel to the coast. Small meltwater streams run through shallow gullies and across flats into two lakes behind the coastal ridge in the north. Ridges and cones rise to about 200 m before merging with the snow fields and glaciers of Mount Melbourne in the south.

BOUNDARIES

The margin of the permanent ice sheet extending from Mount Melbourne is defined as the boundary in the west, north and south of the Area (Maps 1-3). The eastern boundary is marine, which in the southern half of the Area follows the coastline 200 m offshore from the southern to northern extremities of the ice-free area of Edmonson Point. From the northern extremity of Edmonson Point, the eastern boundary extends NW across Baia Siena for a distance of 2 km to a position 200 m due east from the coast of the northern extremity of Colline Ippolito. Baia Siena is thus enclosed within the Area. Boundary markers have not been installed because the ice sheet margin and the coast are obvious boundary references.

CLIMATE

No extended meteorological records are available for Edmonson Point, although annual data for McMurdo Station, Scott Base and Cape Hallett suggest the average mean temperature in the Edmonson Point vicinity would be around -16º C, and the mean annual snow accumulation about 20-50 cm, equivalent to 10-20 cm of water (Bargagli *et al.,* 1997). Short-term data are available for December 1995 – January 1996, collected during the BIOTEX 1 expedition. During this period temperatures ranged from -7º C to 10º C, with 0º C exceeded every day. Relative humidity was low (15-40% day, 50-80% night), precipitation occasional as light snow and wind speeds mostly low. From late January weather conditions deteriorated, with frequent subzero daytime temperatures, snow-fall and high winds. Data available for summer seasons in 1998-99 and 1999-00 from a weather station installed near the penguin colony suggest prevailing summer winds at Edmonson Point come from the east, southeast and south. Daily average wind speeds were generally in the range of 3-6 knots, with daily maximums usually being of 6-10 knots, occasionally reaching up to 25-35 knots. Daily average air temperatures ranged from around -15°C in October, -6°C in November, -2.5°C in December to -1°C in January, decreasing to -3.5°C again in February (Olmastroni, pers. comm., 2000). The highest daily maximum in the two summer periods was recorded as 2.6°C on 25 December 1998. The average air temperature recorded over both summers was approximately -4°C, while the average wind speed was 4.5 knots. Average daily relative humidity generally ranged between 40-60%.

GEOLOGY AND SOILS

The geology at Edmonson Point is derived from Cenozoic eruptive activity of Mount Melbourne (Melbourne Volcanic Province), part of the McMurdo Volcanic Group (Kyle, 1990), combined with glacial deposits from the marine-based ice sheet that covered much of the Victoria Land coastline during the last glacial maximum (7500 to 25000 years B.P) (Baroni and Orombelli, 1994). The volcanic complex at Edmonson Point is composed of a large subaerial tuff ring, scoria cones, lava flows, and subaquatic megapillow lava sequences (Wörner and Viereck, 1990). The rocks are mainly of basaltic and/or trachytic composition, and include various additional volcanic products, such as accumulations of tuffs, pumices and debris deposits (Simeoni *et al.,* 1989; Bargagli *et al.,* 1997). The ground surface is composed mainly of dry, coarse-textured volcanic materials with a low proportion of silt and clay (Bargagli *et al.,* 1997). These exposed surfaces, as well as beneath the surfaces of stones and boulders, are often coated with white encrustations or efflorescences of soluble salts. Most of the ground is dark-coloured, with brownish or yellowish patches of scoria and tuffite. Unstable scree is common on hill slopes, which are dry and mostly unvegetated. Valley and basin floors are covered by fine scoria and coarse sand (Bargagli *et al.,* 1999).

GEOMORPHOLOGY

A series of marine deposits are visible on the cuspate foreland at the northern extremity of Edmonson Point. The gently sloping raised beaches of the foreland are composed of differing ratios of sands, pebbles and boulders distributed over lava flows (Simeoni *et al.,* 1989). Numerous small crater-like pits, many containing melt-water or ice, can be observed just above the high tide mark in this locality; these are thought to have been formed by extreme tides and the melting of coastal ice accumulations. South of the cuspate foreland, volcanic bedrock exposures are common over much of the ground extending up to about 800 m inland from the coast, most evident in the prominent hills of about 120 m in height in the central northern part of Edmonson Point. A series of late-Pleistocene moraines and related tills lie on the western side of these exposures, with bands of Holocene ice-cored moraine, talus and debris slopes adjacent to the glacier ice which extends from Mount Melbourne (Baroni and Orombelli, 1994).

STREAMS AND LAKES

There are six lakes on Edmonson Point, ranging in length up to 350 m, and in area from approximately 1600 m^2 up to 15,000 m^2 (Map 2). Two further lakes occur behind the coastal ridge at Colline Ippolito, the largest of which is approximately 12,500 m^2 (Map 3). In addition, on Edmonson Point there are approximately 22 smaller ponds of diameters of less than 30 m (Broady, 1987). The larger ponds are permanently ice-covered, with peripheral moats forming during the summer. Detailed physico-chemical characteristics and limnology of the lakes of Edmonson Point are reported in Guilizzoni *et al*. (1991). There are numerous streams throughout the Area, some of which are supplied with meltwater from the adjacent ice sheet, while others are fed by lakes and general ice / snow melt. Several stream beds have flood terraces of fine soil covered by pumice-like pebbles of 5-10 mm diameter. Many of the streams and pools are transient, drying up shortly after the late snow patches in their catchments disappear.

PLANT BIOLOGY

Compared to several other sites in central Victoria Land, Edmonson Point does not have a particularly diverse flora, and there are only a few extensive closed stands of vegetation. Six moss species, one liverwort, and at least 30 lichen species have been recorded within the Area (Broady, 1987; Lewis Smith, 1996, 1999; Lewis Smith pers. comm., 2004; Castello, 2004). Cavacini (pers. comm., 2003) noted that recent analyses have identified at least 120 alga and cyanobacteria species

present at Edmonson Point. These are present in a range of forms including algal mats on soil and as epiphytes on mosses, and in a range of habitats such as in lakes, streams and snow, and on moist ornithogenic and raw mineral soils. At the onset of summer, snow melt reveals small stands of algae and moss on valley floors, although much of these lie buried by up to 5 cm of wind-blown and melt-washed fine mineral particles. This community is capable of rapid growth during December, when moisture is available and soil temperatures are relatively high, bringing shoot apices up to a centimetre above the surface as the surface accumulation of sand is washed or blown away. Increased water flow or strong winds can quickly bury these stands, although sufficient light for growth can penetrate 1-2 cm below the surface (Bargagli *et al.,* 1999).The principal moss communities occur on more stable substrata which are not subjected to burial by sand, for example in sheltered depressions or along the margins of ponds and meltwater streams, and seepage areas below late snow beds where moisture is available for several weeks. Some of these are among the most extensive stands found in continental Antarctica, being of up to 3000 m^2, most notably the stand of *Bryum subrotundifolium* (= *B. argenteum*) several hundred metres west of the main Adélie colony (Map 4). Other, less extensive, notable stands occur near the lake adjacent to the Adélie colony (Map 4), and smaller localized stands of *Ceratodon purpureus* (with relatively thick deposits of dead organic material) being found in a valley in the north of Edmonson Point and in the upper area of the principal stream in the northern ice-free area. Greenfield *et. al*. (1985) suggested that, apart from Cape Hallett, no area in the Ross Sea has a comparable abundance of plants, although in 1996 a similarly extensive area colonised almost exclusively by *Bryum subrotundifolium* (= *B. argenteum*) was discovered on Beaufort Island (ASPA No. 105), approximately 280 km to the south of Edmonson Point.

The moss-dominated communities comprise up to seven bryophyte species, several algae and cyanobacteria and, at the drier end of the moisture gradient, several lichens encrusting moribund moss (Lewis Smith, 1999; Bargagli *et al.,* 1999). There are mixed communities or zones of *Bryum subrotundifolium* (= *B. argenteum*), *B. pseudotriquetrum* and *Ceratodon purpureus*. In some wetter sites the liverwort *Cephaloziella varians* occurs amongst *C. purpureus*. Dry, very open, often lichen-encrusted moss communities usually contain *Hennediella heimii*, and often occur in hollows which hold small late snow patches. *Sarconeurum glaciale* occurs in a stable scree above the large lake in the south of the Area (Lewis Smith, 1996). The upper portions of moss colonies are often coated with white encrustations of soluble salts (Bargagli *et al.,* 1999).

The lichen communities are relatively diverse, with 24 species identified and at least six crustose species so far unidentified, although few are abundant (Castello, 2004; Lewis Smith, pers. comm. 2004). Epilithic lichens are generally sparse and not widespread, being mainly crustose and microfoliose species restricted to rocks used as skua perches and occasionally on stable boulders in scree, moist gullies and temporary seepage areas. Macrolichens are scarce, with *Umbilicaria aprina* and *Usnea sphacelata* found in a few places. The former species is more abundant on the gently sloping intermittently inundated outwash channels of Colline Ippolito, together with *Physcia* spp. and associated with small cushions of *Bryum subrotundifolium* (= *B. argenteum*) (Given, 1985, 1989), *B. pseudotriquetrum* and *Ceratodon purpureus* (Lewis Smith, pers comm. 2004). *Buellia frigida* is the most widespread crustose lichen on the hard lavas, but a distinct community of nitrophilous species occurs on rocks used as skua perches (*Caloplaca, Candelariella, Rhizoplaca, Xanthoria*). In gravelly depressions below late snow beds, moss turves are often colonised by encrusting cyanobacteria and ornithocoprophilic lichens (*Candelaria, Candelariella, Lecanora, Xanthoria*) and, where there is no bird influence, by the white *Leproloma cacuminum* (Lewis Smith, 1996).

Early work on the algal flora at Edmonson Point identified 17 species as Cyanophyta, 10 as Chrysophyta and 15 as Chlorophyta (Broady, 1987). More recent analyses (Cavacini, pers. comm., 2003) have identified 120 alga and cyanobacteria species, which is considerably more than the numbers of species of Cyanophyta (28), Chlorophyta (27), Bacillariophyta (25) and Xanthophyta (5) recorded previously (Cavacini, 1997, 2001; Fumanti *et al.,* 1993, 1994a, 1994b; Alfinito *et al.,*

1998). Broady (1987) observed few areas of algal vegetation on ground surfaces; the most extensive were oscillatoriacean mats in moist depressions in areas of beach sand, which may have been temporary melt ponds prior to when the survey was undertaken. Similar mats were found adjacent to an area of moss with a *Gloeocapsa* sp. as an abundant associate. *Prasiococcus calcarius* was observed in the vicinity of the Adélie penguin colony, both as a small area of rich green crusts on soil and growing on an area of moribund moss cushions. Other epiphytic algae include Oscillatoriaceae, *Nostoc* sp., unicellular chlorophytes including *Pseudococcomyxa simplex*, and the desmid *Actinotaenium cucurbita*. Substantial stream algae were observed with waters containing oscillatoriacean mats over the stream beds, wefts of green filaments attached to the surface of stones (mainly *Binuclearia tectorum* and *Prasiola* spp.), small ribbons of *Prasiola calophylla* on the under-surfaces of stones, and dark brown epilithic crusts of cyanophytes (dominated by *Chamaesiphon subglobosus* and *Nostoc* sp.) coating boulders. Ponds present in beach sand contained *Chlamydomonas* sp. and cf. *Ulothrix* sp., while ponds fertilized by penguin and skua guano contained *Chlamydomonas* sp. and black benthic oscillatoriacean mats. Other ponds also contained rich benthic growths of Oscillatoriaceae, frequently associated with *Nostoc sphaericum*. Other abundant algae were *Aphanothece castagnei*, *Binuclearia tectorum*, *Chamaesiphon subglobosus*, *Chroococcus minutus*, *C. turgidus*¸ *Luticola muticopsis*, *Pinnularia cymatopleura*, *Prasiola crispa* (particularly associated with penguin colonies and other nitrogen-enriched habitats), *Stauroneis anceps*, various unicellular chlorophytes, and – in the highest conductivity pond in beach sand – cf. *Ulothrix* sp. Algae and cyanobacteria are locally abundant in moist soils, and filaments and foliose mats of *Phormidium* spp. (dominant on patches of wet ground and in shallow lake bottoms), aggregates of *Nostoc commune* and a population of diatoms have been identified (Wynn-Williams, 1996; Lewis Smith pers. comm., 2004). The fungal species *Arthrobotrys ferox* has been isolated from moss species *Bryum pseudotriquetrum* (= *B. algens*) and *Ceratodon purpureus*. *A. ferox* produces an adhesive secretion which has been observed to capture springtails of the species *Gressittacantha terranova* (about 1.2 mm in length) (Onofri and Tosi, 1992).

7. Scientific values

7(i) Invertebrate

There is a high diversity of soil nematodes in the moist soils at Edmonson Point when compared to other areas described in Victoria Land. Nematodes found at Edmonson Point include *Eudorylaimus antarcticus, Monhysteridae* sp., *Panagrolaimus* sp., *Plectus antarcticus, P. frigophilus*, and *Scottnema lyndsayea* (Frati, 1997; Wall pers. comm., 2000). The latter species, previously only known from the McMurdo Dry Valleys, was found at Edmonson Point in 1995-96 (Frati, 1997). Less abundant are the springtails, most commonly *Gressittacantha terranova*, which was found under rocks and on soil and mosses in a number of moist microhabitats (Frati, 1997). Red mites (likely to be either *Stereotydeus* sp. or *Nanorchestes*, although species not identified) are common in aggregations beneath stones in moist habitats, and Collembola, rotifers, tardigrades and a variety of protozoans are also found (Frati *et al.,* 1996; Lewis Smith, 1996; Wall pers. comm., 2000; Convey pers. comm., 2003).

7(ii) Breeding birds

Adélie penguins (*Pygoscelis adeliae*) breed in two groups near the coast in the central and eastern-most part of Edmonson Point, occupying an area of about 9000 m^2 (Map 4). The number of breeding pairs recorded between 1981-2005 is summarised in Table 1, the average number in this period being 2080. In 1994-95 the majority of birds were recorded to arrive around 30-31 October, while the majority of the season's chicks had fledged by 12 February, with fledging complete by 21 February (Franchi *et al.,* 1997). An abandoned nesting site, occupied approximately 2600-3000 years ago, lies about 1 km to the northwest of the current colony, on bedrock adjacent to the cuspate foreland (Baroni and Orombelli, 1994).

Table 1. Adélie penguins (breeding pairs) at Edmonson Point 1981-2005 (data Woehler, 1993; Olmastroni, 2005, *pers. comm*.).

Year	No. of breeding pairs	Year	No. of breeding pairs
1981	1300	1995	1935
1984	1802	1996	1824
1987	2491	1997	1961
1989	1792	1999	2005
1991	1316	2001	1988
1994	1960	2003	2588
		2005	2385

Between 2005 and 2010 according to CEMP procedures, three population counts were made at Edmonson Point, the colony consisting of 2385, 2303 and 2112 occupied nests in 2005, 2007 and 2010 respectively.

The average number since the beginning of the research program being 2112. Thus total population seem stable with respect to the average value 2080 from 1994 to 2005.

The ratio between skua and penguin remained high (1:20) as previously reported by Pezzo *et al*, (2001). Edmonson Point's skua population nearby Adélie penguin colony remained stable through years consisting of about 130 breeding pairs in 2010 summer season. Also at Edmonson Point North and South 55 and 61 breeding pairs respectively , were counted in 2010 summer season.

A breeding colony of south polar skuas (*Catharacta maccormicki*) within the Area is one of the most numerous in Victoria Land, with over 120 pairs, of which 36 pairs occupy Colline Ippolito (CCAMLR, 1999; Pezzo *et al*., 2001; Volpi pers. comm. 2005). . Furthermore the Area includes two "club sites", nearby large freshwater ponds, used throughout the breeding seasons by groups of non-breeders ranging between 50 and 70 individuals (Pezzo 2001; Volpi 2005 pers. comm.). Flocks of snow petrels (*Pagodroma nivea*) have been observed flying over the Area, and Wilson's storm petrels (*Oceanites oceanicus*) have been sighted regularly. Neither of these latter two species is known to breed within the Area.

7(iii) Breeding mammals

At Edmonson Point numerous (>50) Weddell seals (Leptonychotes weddellii) regularly breed in the near shore marine environment (on fast ice) within the Area. Females use this area to give birth and raise pups on the fast ice along the coastline of the whole Area. Later in the summer Weddell seals frequently haul out on beaches within the Area.

8. Scientific Research

8(i) CCAMLR Ecosystem Monitoring Programme (CEMP) Studies

1. The presence at Edmonson Point of breeding penguin colonies and the absence of krill fisheries within their foraging range make this a critical site for comparative studies and inclusion with other CEMP sites in the ecosystem monitoring network established to meet the objectives of CCAMLR. The purpose of protected area designation is to allow planned research and monitoring to proceed, while avoiding or reducing, to the greatest extent possible, other activities which could interfere with or affect the results of the research and monitoring programme of alter the natural features of the site.

2. The Adélie penguin is a species of particular interest for CEMP routine monitoring and directed research at this site. For this purpose the Adélie Penguin Monitoring Program, a joint research project between Italian and Australian biologists, has been ongoing at Edmonson Point since 1994-95. An Automated Penguin Monitoring System (APMS) along with on-site observations by researchers, forms the basis of a study of at least 500-600 nests within the northern sector of the colony as part of the CEMP (CCAMLR, 1999; Olmastroni *et al*., 2000). Fences have been installed to direct penguins over a bridge which registers their weight, identity and crossing direction as they move between the sea and their breeding colony.

3. Parameters routinely monitored include trends in population size (A3), demography (A4), duration of foraging trips (A5), breeding success (A6), chick fledging weight (A7), chick diet (A8) and breeding chronology (A9).

4. The studies on Adélie penguin also involve population monitoring, experiments with satellite transmitters and temperature-depth recorders to investigate foraging location and duration. Combined with stomach flushing to record the diet of monitored penguins, this programme is developing comprehensive observations of Adélie penguin feeding ecology (Olmastroni, 2002). Diet data (Olmastroni *et al*., 2004) confirmed the results of studies from krill distribution in the Ross Sea (Azzali and Kalinowski, 2000; Azzali *et al.,* 2000) and indicate that this colony is located at a transition point in the availability of *E. superba* between northern and more southerly colonies where this species is absent or rare in the diet of penguins (Emison, 1968; Ainley, 2002). These studies also highlighted the importance of fish to the diet of the Adélie penguin, which represented up to 50% of stomach contents in some years.

Local sea ice and weather data contribute to the understanding of possible factors affecting the breeding biology of this species (Olmastroni *et al*., 2004). Moreover behavioural studies are also part of the research (Pilastro *et al.,* 2001).

Research on the south polar skua colony focuses on breeding biology (Pezzo *et al*., 2001), population dynamics, biometry, reproductive biology and migratory patterns. Since 1998/99 more than 300 south polar skuas have been banded by metal and coloured rings, which facilitate field research that requires the recognition of individual birds and will allow for identification of birds migrating from the Area.

8(ii) Scientific Research after 2005

Ecology of marine birds and CCAMLR Ecosystem Monitoring Programme (CEMP) Studies.

The studies on Adélie penguin population involved demographic parameters that were estimated in relation to individual characteristics (sex and age) and to large scale (Ross Sea winter ice extent anomalies and SOI) and local scale (food availability) environmental variables. While large-scale environmental factors affected adult survival, breeding success varied principally according to local variables. Breeding success was particularly low when local stochastic events (storms) occurred at sensitive times of the breeding cycle (immediately after the hatching) (Olmastroni et al. 2004; Pezzo et al, 2007; Ballerini et al., 2009). Also changes in fast-ice extent in front of the breeding area influenced the adult breeders transit times between colony and foraging grounds, and females conducted longer foraging trips, dived for longer periods and made more dives than males. The diving parameters were affected neither by the sex nor by the year, but differed between the breeding stages (Nesti et al, 2010). Annual adult survival probability at Edmonson Point (0.85, range 0.76– 0.94) was similar to that estimated from other Adélie penguin populations in which individuals were marked with passive transponders. An annual average survival rate of 0.85 seems to be typical of the species and is consistent with an expected average lifespan of about 11 years (6.6 years after adulthood) (Ballerini et al., 2009).

Some aspects of the breeding biology of the south polar skua, during five seasons are under investigation being the subject of a doctoral thesis that is being carried out at University of Siena (A. Franceschi, Aspetti della Biologia riproduttiva dello Stercorario di McCormick, *Stercorarius maccormicki*).

8(iii) Other Scientific Activities

Studies of terrestrial ecology at Edmonson Point were initiated in the 1980s, although this type of research and other forms of science increased in the 1990s, in particular by Italian scientists. Edmonson Point was the location of BIOTEX 1, the first SCAR Biological Investigation of Antarctic Terrestrial Ecosystems (BIOTAS) research expedition, during December 1995 and January 1996. Ten researchers from three countries participated in a variety of scientific projects which included: taxonomic, ecological, physiological and biogeographical studies on cyanobacteria, algae, bryophytes, lichens (including chasmolithic and endolithic communities), nematodes, springtails and mites; studies of soil and freshwater biogeochemistry; microbial metabolic activity and colonisation studies; and investigations into the photosynthetic responses to ambient and controlled conditions of mosses, lichens and plant pigments that may act as photoprotectants (Bargagli, 1999). While the BIOTAS programme has now formally concluded, it is expected that further studies of this type will be on-going at Edmonson Point.

9. Human Activities/Impacts

Edmonson Point was probably first visited on 6 February 1900 when Carsten Borchgrevink landed just north of Mount Melbourne on "a promontory almost free of snow .... about 100 acres in extent" and climbed about 200 m up the slopes (Borchgrevink, 1901: 261). The Wood Bay region was rarely mentioned during the following 70 years, and presumably was visited only infrequently. Activity in the area increased in the 1980s, first with visits by the GANOVEX expeditions (Germany). Botanical research was undertaken in December 1984 (Given, 1985; Greenfield *et. al*.,1985; Broady, 1987) and in January 1989, at which time the first proposals for special protection of the site were made (Given pers. comm. 2003). Italy established a station in close proximity at Terra Nova Bay in 1986-87 and increased research interest in the site followed.

The modern era of human activity at Edmonson Point has been largely confined to science. The impacts of these activities have not been described, but are believed to be minor and limited to items such as campsites, footprints, markers of various kinds, human wastes, scientific sampling, handling of limited numbers of birds (e.g. installation of devices to track birds, stomach lavage, biometric measurements, etc), and potentially some impacts associated with helicopter access and installation and operation of camp and research facilities at the penguin colony and on the northern cuspate foreland. At least one fuel spill of around 500 ml, and other smaller spills, were reported in 1996 as a result of refuelling operations at the generator and fuel store located at the penguin colony (see disturbed sites marked on Map 4). In addition, seaborne litter is occasionally washed onto beaches within the Area. The Restricted Zone at Colline Ippolito has received less human activity than Edmonson Point and impacts in this area are expected to be negligible.

9(i) Restricted and managed zones within the Area

Restricted Zone

The ice-free area of Colline Ippolito (1.12 km^2) approximately 1.5 km north-west of Edmonson Point 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 terrestrial Area (which is similar in biology, features and character) is more generally available for research programmes and sample collection. The northern, western and southern boundaries of the Restricted Zone are defined as the margins of the permanent ice extending from Mount

Melbourne, and are coincident with the boundary of the Area (Maps 1 and 3). The eastern boundary of the Restricted Zone is the mean low water level along the coastline of this ice-free area.

Access to the Restricted Zone is allowed only for compelling scientific reasons or management purposes (such as inspection or review) that cannot be served elsewhere within the Area.

9(ii) Structures within and near the Area

CEMP Site: A fibreglass cabin for field observation, containing instrumentation and APMS panel, and two Nunsen huts for 4 people were installed by PNRA in 1994/95 to support CEMP research. These structures are located on a rocky knoll at an elevation of 16 m, 80 m from the coast and 40 m south of the northern sub-colony of penguins (Maps 2 and 4). At the beginning of each field season a generator and a number of fuel drums are temporarily stored about 20 m from the camp and removed at the end of each season. Adjacent to the northern penguin sub-colony, fences of metal net (30-50 cm) have been installed to direct penguins over the APMS weigh bridge.

Other activities: Approximately 50 plastic cloches were installed at 10 locations throughout the Area in 1995-96 as part of BIOTEX-1 (Maps 2 and 4). A number of additional cloches were installed the previous year at four locations (Wynn-Williams, 1996). It is not precisely known how many of these cloches remain within the area. Temporary camp facilities were installed at the location of the designated camp site for the duration of the BIOTEX-1 programme, which have now been removed.

The nearest permanent stations are Mario Zucchelli Station at Terra Nova Bay (Italy) and Gondwana Station (Germany), which lie approximately 50 km and 45 km south respectively.

9(iii) Location of other protected areas within close proximity of the Area

The nearest protected areas to Edmonson Point are the summit of Mount Melbourne (ASPA No. 118), which lies 13 km to the west, and a marine area at Terra Nova Bay (ASPA No. 161), which lies approximately 52 km to the south (Map 1, Inset 2).

10. 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 research on the Area, or for compelling scientific reasons that cannot be served elsewhere; or
- it is issued for essential management purposes consistent with plan objectives such as inspection, maintenance or review;
- access to the Restricted Zone is allowed only for compelling scientific reasons or management purposes (such as inspection or review) that cannot be served elsewhere within the Area;
- the actions permitted will not jeopardise 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 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 stated period.

- The appropriate authority should be notified of any activities/measures undertaken that were not included in the authorised Permit.

10(i) Access to and movement within the Area

Access to the Area shall be by small boat, on foot or by helicopter. Movement over land within the Area shall be on foot or by helicopter. Access to the Area by vehicle is restricted according to the conditions described below.

Small boat access

The Edmonson Point part of the Area may be entered at any point where pinnipeds or seabird colonies are not present on or near the beach. Access for purposes other than CEMP research should avoid disturbing pinnipeds and seabirds (Map 1 and 2). There are no special restrictions on landings from the sea, although when accessing the main ice-free area of Edmonson Point visitors shall land at the northern cuspate foreland and avoid landing at breeding bird colonies (Map 2).

Restricted conditions of vehicle access

Use of vehicles within the Area is prohibited, except at the southern boundary of the Area where they may be used on sea ice to gain access to the shore, from where visitors shall proceed on foot. Thus, vehicle use shall avoid interference with animal feeding routes and the Adélie penguin colony. When using vehicles on sea ice care should be exercised to avoid Weddell seals which may be present: speed should be kept low and seals shall not be approached by vehicle closer than 50 m. Access over land by vehicles is allowed to the boundary of the Area. Vehicle traffic shall be kept to the minimum necessary for the conduct of permitted activities.

Aircraft access and overflight

All restrictions on aircraft access and overflight stipulated in this plan shall apply during the period 15 October – 20 February inclusive. Aircraft may operate and land within the Area according to strict observance of the following conditions:

(i) All overflight of the Area for purposes other than access shall be conducted according to the height restrictions imposed in the following table:

Minimum overflight heights within the Area according to aircraft type

Aircraft type	Number of Engines	Minimum height above ground	
		Feet	Metres
Helicopter	1	*2461*	750
Helicopter	2	*3281*	1000
Fixed-wing	1 or 2	*1476*	450
Fixed-wing	4	*3281*	1000

(ii) Helicopter landing is normally allowed at only three designated sites (Maps 1-4). The landing sites with their coordinates are described as follows:

(A) shall be used for most purposes, located on the northern cuspate foreland of Edmonson Point (Map 2) (74°19'24"S, 165°07'12"E);

(B) is allowed in support of the Adélie Penguin Monitoring Programme when necessary for transport of heavy equipment / supplies (Map 2) (74°19'43"S, 165°07'57"E); and

(C) is allowed for access to the Restricted Zone, located at the northern ice-free area (Colline Ippolito, Map 3) (74°18'50"S, 165°04'29"E).

(iii) In exceptional circumstances, helicopter access may be specifically authorised elsewhere within the Area for the purpose of supporting science or management according to conditions imposed by the Permit on access location(s) and timing. Landing of helicopters at sites of mammals and seabird sites and significant vegetation shall be avoided at all times (Maps 2-4).

(iv) The designated aircraft approach route is from the west of the Area, from over the lower eastern ice slopes of Mount Melbourne (Maps 1-3). Aircraft shall approach the main designated landing site (A) on the cuspate foreland from the north-west over or near Baia Siena (Siena Bay). When appropriate, access to landing site (B) should follow the same route and proceed a further 700 m SE. The departure route is identical in reverse.

(v) When appropriate, access to landing site (C) should be from the lower eastern ice slopes of Mount Melbourne and proceed directly to the landing site from the south over the land or where this is not feasible over Baia Siena (Siena Bay), avoiding skuas nesting to the north of the landing site;

(vi) Use of smoke grenades to indicate wind direction is prohibited within the Area unless absolutely necessary for safety, and any grenades used should be retrieved.

Foot access and movement within the Area

Movement on land within the Area shall be on foot. Visitors should move carefully so as to minimise disturbance to the breeding birds, soil, geomorphological features and vegetated surfaces, and should walk on rocky terrain or ridges if practical to avoid damage to sensitive plants and the often waterlogged soils. Pedestrian traffic should be kept to the minimum consistent with the objectives of any permitted activities and every reasonable effort should be made to minimise trampling effects. Pedestrians that are not undertaking research or management related to the penguins shall not enter the colonies and should maintain a separation distance from the breeding birds of at least 15 m at all times. Care should be exercised to ensure monitoring equipment, fences and other scientific installations are not disturbed.

Pedestrians moving between the helicopter landing sites (A) or (B) to the Adélie colony shall follow the preferred walking routes marked on Maps 2 and 4 or follow a route along the beach.

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

- The research programme associated with the CCAMLR CEMP
- Scientific research that will not jeopardise the ecosystem of the Area;
- Essential management activities, including monitoring.

10(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 to the Area. Removal of specific equipment for which the Permit has expired shall be a condition of the Permit. Permanent structures are prohibited.

10(iv) Location of field camps

Semi-permanent camps and temporary camping is permitted within the Area at the primary designated site on the cuspate foreland of Edmonson Point (Map 2). Camping at the CEMP Research camp (Maps 2 & 4) is permitted only for purposes of the Adélie Penguin Monitoring Programme. When necessary within the Restricted Zone for purposes specified in the Permit, temporary camping is permitted at the designated site (C) (74°18'51"S, 165°04'16"E) approximately 100 m west of helicopter landing site (Map 3).

10(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 the precautions listed in 7(ix) below shall be taken against accidental introductions. In view of the presence of breeding bird colonies at Edmonson Point, 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 is not to be stored in the Area, unless authorised by Permit for specific scientific or management purposes. Fuel spill clean-up equipment should be made available for use at locations where fuel is being regularly handled. Anything 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 any introduction into the environment is minimised. 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 anything released or not removed that was not included in the authorised Permit.

10(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.

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

Collection or removal of anything not brought into the Area by the Permit holder shall only be 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 rock, soil, native flora or fauna that their distribution or abundance on Edmonson Point would be significantly affected. Anything 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.

10(viii) Disposal of waste

All wastes, except human wastes, shall be removed from the Area. Human wastes shall either be removed from the Area, or incinerated using purpose-designed technologies such as a propane-burning toilet, or in the case of liquid human wastes may be disposed of into the sea.

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

1. Permits may be granted to enter the Area to carry out monitoring and site inspection activities, which may involve the small-scale collection of samples for analysis or review, or for protective measures.
2. Any specific long-term monitoring sites shall be appropriately marked.
3. To help maintain the ecological and scientific values of Edmonson Point special precautions shall be taken against introductions. Of concern are microbial, invertebrate or plant introductions from other Antarctic sites, including stations, or from regions outside Antarctica. All sampling equipment or markers brought into the Area shall be thoroughly cleaned. To the maximum extent practicable, footwear and other equipment used or brought into the Area (including backpacks, carry-bags and tents) shall be thoroughly cleaned before entering the Area.

10(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 the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas. 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.

Bibliography

Ainley, D.G. 2002. *The Adélie Penguin. Bellwether of climate change*. Columbia University Press, New York.

Alfinito, S., Fumanti, B. and Cavacini, P. 1998. Epiphytic algae on mosses from northern Victoria Land (Antarctica). *Nova Hedwigia* **66** (3-4): 473-80.

Ancora, S., Volpi, V., Olmastroni, S., Leonzio, C. and Focardi, S. 2002. Assumption and elimination of trace elements in Adélie penguins from Antarctica: a preliminary study. *Marine Environmental Research* **54**: 341-44.

Azzali M. and J. Kalinowski. 2000. Spatial and temporal distribution of krill *Euphausia superba* biomass in the Ross Sea. In: Ianora A. (ed). *Ross Sea Ecology*. Springer, Berlin, 433-455.

Azzali M., J. Kalinowski, G. Lanciani and G. Cosimi. 2000. Characteristic Properties and dynamic aspects of krill swarms from the Ross Sea. In: Faranda F. G.L., Ianora A. (Ed). *Ross Sea Ecology*. Springer, Berlin, 413-431.

Bargagli, R., Martella, L. and Sanchez-Hernandez, J.C. 1997. The environment and biota at EdmonsonPoint (BIOTEX 1): preliminary results on environmental biogeochemistry. In di Prisco, G., Focardi, S. and Luporini, P. (eds) *Proceed. Third Meet. Antarctic Biology,* Santa Margherita Ligure, 13-15 December 1996. Camerino University Press: 261-71.

Bargagli, R. 1999. Report on Italian activities. *BIOTAS Newsletter* No. 13. Austral Summer 1998/99. A.H.L. Huiskes (ed) Netherlands Institute of Ecology: 16-17.

Bargagli, R., Sanchez-Hernandez, J.C., Martella, L. and Monaci, F. 1998. Mercury, cadmium and lead accumulation in Antarctic mosses growing along nutrient and moisture gradients. *Polar Biology* 19: 316-322.

Bargagli, R., Smith, R.I.L., Martella, L., Monaci, F., Sanchez-Hernandez, J.C. and Ugolini, F.C. 1999. Solution geochemistry and behaviour of major and trace elements during summer in a moss community at Edmonson Point, Victoria Land, Antarctica. *Antarctic Science* 11(1): 3-12.

Bargagli, R., Wynn-Williams, D., Bersan, F., Cavacini, P., Ertz, S., Freckman, D. Lewis Smith, R., Russell, N. and Smith, A. 1997. Field Report – BIOTEX 1: First BIOTAS Expedition (Edmonson Point – Baia Terra Nova, Dec 10 1995 – Feb 6 1996). *Newsletter of the Italian Biological Research in Antarctica* 1 (Austral summer 1995-96): 42-58.

Baroni, C. and Orombelli, G. 1994. Holocene glacier variations in the Terra Nova Bay area (Victoria Land, Antarctica). *Antarctic Science* 6(4):497-505.

Broady, P.A. 1987. A floristic survey of algae at four locations in northern Victoria Land. *New Zealand Antarctic Record* 7(3): 8-19.

Borchgrevink, C. 1901. *First on the Antarctic Continent: Being an Account of the British Antarctic Expedition 1898-1900.* G. Newnes. Ltd, London.

Cannone, N. and Guglielmin, M. 2003. Vegetation and permafrost: sensitive systems for the development of a monitoring program of climate change along an Antarctic transect. In: Huiskes, A.H.L., Gieskes, W.W.C., Rozema, J., Schorno, R.M.L., Van der Vies, S.M., Wolff, W.J. (Editors) *Antarctic biology in a global context*. Backhuys, Leiden: 31-36

Cannone, N., Guglielmin, M., Ellis Evans J.C., and Strachan R. in prep. Interactions between climate, vegetation and active layer in Maritime Antarctica. (submitted to *Journal of Applied Ecology*)

Cannone, N., Guglielmin, M., Gerdol, R., and Dramis, F. 2001. La vegetazione delle aree con permafrost per il monitoraggio del Global Change nelle regioni polari ed alpine. Abstract and Oral Presentation, 96à Congresso della Societa Botanica Italiana, Varese, 26-28 Settembre 2001.Castello, M. 2004. Lichens of the Terra Nova Bay area, northern Victoria Land (continental Antarctica). *Studia Geobotanica* **22**: 3-54.

Cavacini, P. 1997. La microflora algale non marina della northern Victoria Land (Antartide). Ph.D. Thesis. Università "La Sapienza" di Roma. 234 pp.

Cavacini, P. 2001. Soil algae from northern Victoria Land (Antarctica). *Polar Bioscience* **14**: 46-61.

CCAMLR. 1999. Report of member's activities in the Convention Area 1998/99: Italy. CCAMLR-XVIII/MA/14.

Clarke, J., Manly, B., Kerry, K., Gardner, H., Franchi, E. and Focardi, S. 1998. Sex differences in Adélie penguin foraging strategies. *Polar Biology* **20**: 248-58.

Corsolini, S. and Trémont, R. 1997. Australia-Italy cooperation in Antarctica: Adélie Penguin monitoring program, Edmonson Point, Ross Sea Region. *Newsletter of the Italian Biological Research in Antarctica* 1 (Austral summer 1995-96): 59-64.

Corsolini, S., Ademollo, N., Romeo, T., Olmastroni, S. and Focardi, S. 2003. Persistent organic pollutants in some species of a Ross Sea pelagic trophic web. *Antarctic Science* **15**(1): 95-104.

Corsolini, S., Kannan, K., Imagawa, T., Focardi, S. and Giesy J.P. 2002. Polychloronaphthalenes and other dioxin-like compounds in Arctic and Antarctic marine food webs. *Environmental Science and Technolology* **36**: 3490-96.

Corsolini, S., Olmastroni, S., Ademollo, N. and Focardi, S. 1999. Concentration and toxic evaluation of polychlorobiphenyls (PCBs) in Adélie Penguin (*Pygoscelis adeliae*) from Edmonson Point (Ross Sea, Antarctica). Tokyo 2-3 December 1999.

Emison, W. B. 1968. Feeding preferences of the Adélie penguin at Cape Crozier, Ross Island. Antarctic Research Series 12: 191-212.

Ertz, S. 1996. BIOTEX field report: December 1995 – February 1996. Strategies of Antarctic terrestrial organisms to protect against ultra-violet radiation. Unpublished field report in BAS Archives AD6/2/1995/NT3.

Fenice M., Selbmann L., Zucconi L. and Onofri S. 1997. Production of extracellular enzymes by Antarctic fungal strains. *Polar Biology* 17:275-280.

Franchi, E., Corsolini, S., Clarke, J.C., Lawless R. and Tremont, R. 1996. The three dimensional foraging patterns of Adélie penguins at Edmonson Point, Antarctica. Third International Penguin Conference, Cape Town, South Africa, 2-6 September 1996.

Franchi, E., Corsolini, S., Focardi, S., Clarke, J.C., Trémont, R. and Kerry, K.K. 1997. Biological research on Adélie penguin (*Pygoscelis adeliae*) associated with the CCAMLR Ecosystem Monitoring Program (CEMP). In di Prisco, G., Focardi, S. and Luporini, P. (eds) *Proceed. Third Meet. Antarctic Biology,* Santa Margherita Ligure, 13-15 December 1996. Camerino University Press: 209-19.

Frati, F. 1997. Collembola of the north Victoria Land: distribution, population structure and preliminary data for the reconstruction of a molecular phylogeny of Antarctic collembola. *Newsletter of the Italian Biological Research in Antarctica* 1 (Austral summer 1995-96): 30-38.

Frati F. 1999. Distribution and ecophysiology of terrestrial microarthropods in the Victoria Land. *Newsletter of the Italian Biological Research in Antarctica* 3: 13-19.

Frati F., Fanciulli P.P., Carapelli A. and Dallai R. 1997. The Collembola of northern Victoria Land (Antarctica): distribution and ecological remarks. *Pedobiologia* 41: 50-55.

Frati F., Fanciulli P.P., Carapelli A., De Carlo L. and Dallai R. 1996. Collembola of northern Victoria Land: distribution, population structure and preliminary molecular data to study origin and evolution of Antarctic Collembola. Proceedings of the 3rd Meeting on Antarctic Biology, G. di Prisco, S. Focardi and P. Luporini eds., Camerino Univ. Press: 321-330.

Fumanti, B., Alfinito, S. and Cavacini, P. 1993. Freshwater algae of Northern Victoria Land (Antarctica). *Giorn. Bot. Ital.,* **127** (3): 497.

Fumanti, B., Alfinito, S. and Cavacini, P. 1994a. Freshwater diatoms of Northern Victoria Land (Antarctica). 13th International Diatom Symposium, 1-7 September 1994, Acquafredda di Maratea (PZ), Italy, Abstract book: 226.

Fumanti, B., Alfinito, S. and Cavacini, P. 1994b. Floristic survey of the freshwater algae of Northern Victoria Land (Antarctica). Proceedings of the 2nd meeting on Antarctic Biology, Padova, 26-28 Feb. 1992. Edizioni Universitarie Patavine: 47-53.

Guilizzoni P., Libera V., Tartagli G., Mosello R., Ruggiu D., Manca M., Nocentini A, Contesini M., Panzani P., Beltrami M. 1991. Indagine per una caratterizzazione limnologica di ambienti lacustri antartici. Atti del 1° Convegno di Biologia Antartica. Roma CNR, 22-23 giu. 1989. Ed. Univ. Patavine: 377-408.Given, D.R. 1985. Fieldwork in Antarctica, November – December 1984. Report 511b. Botany Division, DSIR, New Zealand.

Given, D.R. 1989. A proposal for SSSI status for Edmonson Point, north Victoria Land. Unpublished paper held in PNRA Archives.

Greenfield, L.G., Broady, P.A., Given, D.R., Codley, E.G. and Thompson, K. 1985. Immediate science report of NZARP Expedition K053 to RDRC. Botanical and biological studies in Victoria Land and Ross Island, during 1984–85.

Harris, C.M. and Grant, S.M. 2003. Science and management at Edmonson Point, Wood Bay, Victoria Land, Ross Sea: Report of the Workshop held in Siena, 8 June 2003. Includes Science Reviews by R. Bargagli, N. Cannone & M. Guglielmin, and S. Focardi. Cambridge, *Environmental Research and Assessment.*

Keys, J.R., Dingwall, P.R. and Freegard, J. (eds) 1988. *Improving the Protected Area system in the Ross Sea region, Antarctica*: Central Office Technical Report Series No. 2. Wellington, NZ Department of Conservation.

Kyle, P.R. 1990. A.II. Melbourne Volcanic Province. In LeMasurier, W.E. and Thomson, J.W. (eds) Volcanoes of the Antarctic Plate and Southern Oceans. *Antarctic Research Series* 48: 48-52.

La Rocca N., Moro I. and Andreoli, C. 1996. Survey on a microalga collected from an Edmonson Point pond (Victoria Land, Antarctica). *Giornale Botanico Italiano*, 130:960-962.

Lewis Smith, R.I. 1996. BIOTEX 1 field report: December 1995 – January 1996: plant ecology, colonisation and diversity at Edmonson Point and in the surrounding region of Victoria Land, Antarctica. Unpublished field report in BAS Archives AD6/2/1995/NT1.

Lewis Smith, R.I. 1999. Biological and environmental characteristics of three cosmopolitan mosses dominant in continental Antarctica. *Journal of Vegetation Science* 10: 231-242.

Melick D.R. and Seppelt R.D. 1997. Vegetation patterns in relation to climatic and endogenous changes in Wilkes Land, continetal Antarctica. *Journal of Ecology* **85**: 43-56.

Meurk, C.D., Given, D.R. and Foggo, M. N. 1989. Botanical investigations at Terra Nova Bay and Wood Bay, north Victoria Land. 1988–89 NZARP Event K271 science report.

Olmastroni S, Pezzo F, Bisogno I., Focardi S, 2004b. Interannual variation in the summer diet of Adélie penguin *Pygoscelis adeliae* at Edmonson Point . WG-EMM04/ 38.

Olmastroni S, Pezzo F, Volpi V, Corsolini S, Focardi S, Kerry K. 2001b. Foraging ecology of chick rearing of Adélie penguins in two colonies of the Ross Sea; 27/8-1/9 2001; Amsterdam, The Netherlands. SCAR.

Olmastroni, S. 2002. Factors affecting the foraging strategies of Adélie penguin (*Pygoscelis adeliae*) at Edmonson Point, Ross Sea, Antarctica. PhD Thesis, Università di Siena.

Olmastroni, S., Corsolini, S., Franchi, E., Focardi, S., Clarke, J., Kerry, K., Lawless, R. and Tremont, R. 1998. Adélie penguin colony at Edmonson Point (Ross Sea, Antarctica): a long term monitoring study. 31 August-September 1998; Christchurch, New Zealand. SCAR. p 143.

Olmastroni, S., Corsolini, S., Pezzo, F., Focardi, S. and Kerry, K. 2000. The first five years of the Italian-Australian Joint Programme on the Adélie Penguin: an overview. *Italian Journal of Zoology Supplement* **1**: 141-45.

Onofri, S. and Tofi, S. 1992. *Arthrobotrys ferox* sp. nov., a springtail-capturing hyphomycete from continental Antarctica. *Mycotaxon* 44(2):445-451.Orombelli, G. 1988. Le spiagge emerse oloceniche di Baia Terra Nova (Terra Vittoria, Antartide). Rend. Acc. Naz. Lincei.

Pezzo, F., Olmastroni, S., Corsolini, S., and Focardi, S. 2001. Factors affecting the breeding success of the south polar skua *Catharacta maccormicki* at Edmonson Point, Victoria Land, Antarctica. *Polar Biology* **24**:389-93.

Pilastro, A., Pezzo, F., Olmastroni, S., Callegarin, C., Corsolini, S. and Focardi, S. 2001. Extrapair paternity in the Adélie penguin *Pygoscelis adeliae*. *Ibis* **143**: 681-84.

Ricelli A., Fabbri A.A., Fumanti B., Cavacini P., Fanelli C. 1997. Analyses of effects of ultraviolet radiation on fatty acids and α-tocopherol composition of some microalgae isolated from Antarctica. In di Prisco, G., Focardi, S., and Luporini P. (eds.), Proceedings of the 3rd meeting on "Antarctic Biology", S. Margherita Ligure, December 13-15, 1996. Camerino University Press: 239-247.

Simeoni, U., Baroni, C., Meccheri, M., Taviani, M. and Zanon, G. 1989. Coastal studies in northern Victoria Land (Antarctica): Holocene beaches of Inexpressible Island, Tethys Bay and Edmonson Point. *Bollettino di Oceanologia Teorica ed Applicata* 7(1-2): 5-17.

Taylor, R.H., Wilson, P.R. and Thomas, B.W. 1990. Status and trends of Adélie Penguin populations in the Ross Sea region. *Polar Record* 26:293-304.

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

Wörner, G. and Viereck, L. 1990. A.I0. Mount Melbourne. In Le Masurier, W.E. and Thomson, J.W. (eds) Volcanoes of the Antarctic Plate and Southern Oceans. *Antarctic Research Series* 48: 72-78.

Wynn-Williams, D.D. 1996. BIOTEX 1, first BIOTAS expedition: field report: Taylor Valley LTER Dec 1995, Terra Nova Bay Dec 1995 – Jan 1996: microbial colonisation, propagule banks and survival processes. Unpublished field report in BAS Archives AD6/2/1995/NT2.

Zucconi L., Pagano S., Fenice M., Selbmann L., Tosi S., and Onofri S. 1996. Growth temperature preference of fungal strains from Victoria Land. *Polar Biology* **16**: 53-61.

Appendix 1

Recent bibliography and other publications of interest for the research activity at Edmonson Point (Ross Sea)

D. Ainley, V. Toniolo, G. Ballard, K. Barton, J. Eastman, B. Karl, S. Focardi, G. Kooyman, P. Lyver, S. Olmastroni, B.S. Stewart, J. W. Testa, P. Wilson, 2006. Managing ecosystem uncertainty: critical habitat and dietary overlap of top-predators in the Ross Sea. WG-EMM 06/29

Tosca Ballerini, Giacomo Tavecchia, Silvia Olmastroni, Francesco Pezzo, Silvano Focardi 2009. Nonlinear effects of winter sea ice on the survival probabilities of Adélie penguins. *Oecologia* 161:253–265.

F. Borghini, A. Colacevich, S. Olmastroni 2010. Studi di ecologia e paleolimnologia nell'area protetta di Edmonson Point (Terra Vittoria, Antartide). *Etruria Natura* Anno VII: 77-86.

Cincinelli A., Martellini T. and Corsolini S., 2011. Hexachlorocyclohexanes in Arctic and Antarctic Marine Ecosystems, Pesticides - Formulations, Effects, Fate, Edited by: Margarita Stoytcheva, ISBN: 978- 953-307-532-7, Publisher: InTech, Publishing, Janeza Trdine 9, 51000 Rijeka, Croatia, January 2011,453-476, available at http://www.intechopen.com/articles/show/title/hexachlorocyclohexanes- in-arctic and-antarctic-marine-ecosystems.

Corsolini S., 2011. Contamination Profile and Temporal Trend of POPs in Antarctic Biota. In Global contamination trends of persistent organic chemicals. Ed. B. Loganathan, P.K.S. Lam, Taylor & Francis, Boca Raton, FL, USA, in press.

Corsolini S., 2011. Antarctic: Persistent Organic Pollutants and Environmental Health in the Region. In: Nriagu JO (ed.) *Encyclopedia of Environmental Health*, volume 1, pp. 83–96 Burlington: Elsevier, NVRN/978-0-444-52273-3.

Corsolini S., Ademollo N., Mariottini M., Focardi S., 2004. Poly-brominated diphenyl-ethers (PBDEs) and other Persistent Organic Pollutants in blood of penguins from the Ross Sea (Antarctica). *Organohalogen Compd*., 66: 1695-1701.

Corsolini S, Covaci A, Ademollo N, Focardi S, Schepens P., 2005. Occurrence of organochlorine pesticides (OCPs) and their enantiomeric signatures, and concentrations of polybrominated diphenyl ethers (PBDEs) in the Adelie penguin food web, Antarctica. *Environ Pollut*., 140(2): 371 382.

Corsolini S., Olmastroni S., Ademollo N., Minucci G., Focardi S., 2003. Persistent organic pollutants in stomach contents of Adélie penguins from Edmonson Point (Victoria Land, Antarctica). In: Antarctic Biology in a global context, Ed. A.H.L. Huiskes, W.W.C. Gieskes, J. Rozema, R.M.L. Schorno, S.M. van der Vies, W.J. Wolff. Backhuys Publishers, Leiden, The Netherlands. pp. 296-300

Fuoco, R.; Bengtson Nash, S. M.; Corsolini, S.; Gambaro, A.; Cincinelli, A. *POPs in Antarctica; A Report to the Antarctic Treaty in Kiev 2-13 June, 2008*; Environmental Contamination in Antarctica (ECA) Pisa, 2008.

Sandra Lorenzini, Silvia Olmastroni, Francesco Pezzo, Maria Cristina Salvatore, Carlo Baroni 2009.Holocene Adélie penguin diet in Victoria Land, Antarctica. *Polar Biology* 32:1077–1086.

Irene Nesti, Yan Ropert-Coudert, Akiko Kato, Michael Beaulieu, Silvano Focardi, Silvia Olmastroni 2010. Diving behaviour of chick-rearing Adélie Penguins at Edmonson Point, Ross Sea. *Polar Biology* 33:969–978.

S. Olmastroni, F. Pezzo, V. Volpi, S. Focardi 2004a. Effects of weather and sea ice on Adélie penguin reproductive performance. *CCAMLR Science* 11:99-109

F. Pezzo, **S.** Olmastroni, V. Volpi, S. Focardi 2007. Annual variation in reproductive parameter of Adélie penguins at Edmonson Point, Victoria Land, Antarctica. *Polar Biology* **31**:39-45.

Appendix 2 Permits issued

During 2006-2011 Italian Antarctic Campaign have been issued the permits for the Interference or sampling of following living organisms into the Edmonson Point ASPA N° 165:

2006/2007 campaign

Organism denomination	Amount N° or Kg	Sampling System
Pygoscelis adeliae	2000	visual census
" " "	10	tagging
" " "	10	feathers
Stercorarius maccormicki	200	visual census

Have been carried out water sampling from lakes. Permit for entry in ASPA 165 have been performed for 40 days in the field camp.

2007/2008 campaign

Organism denomination	Amount N° or Kg	Sampling System

Have been issued permits for entry in ASPA 165 only for meteo station control for 2 times, 3hours each time

2008/2009 campaign

Organism denomination	Amount N° or Kg	Sampling System

No activity has been performed at Edmonson Point ASPA 165 during 2007/2008 campaign

2009/2010 campaign

Organism denomination	Amount N° or	Kg	Sampling System
Pygoscelis adeliae	2000		visual census
" " "	18		feathers and blood
Stercorarius maccormicki	120		visual census
" " "	10		feathers and blood
Mosses		200 g	sampling
Algae		200 g	manual sampling

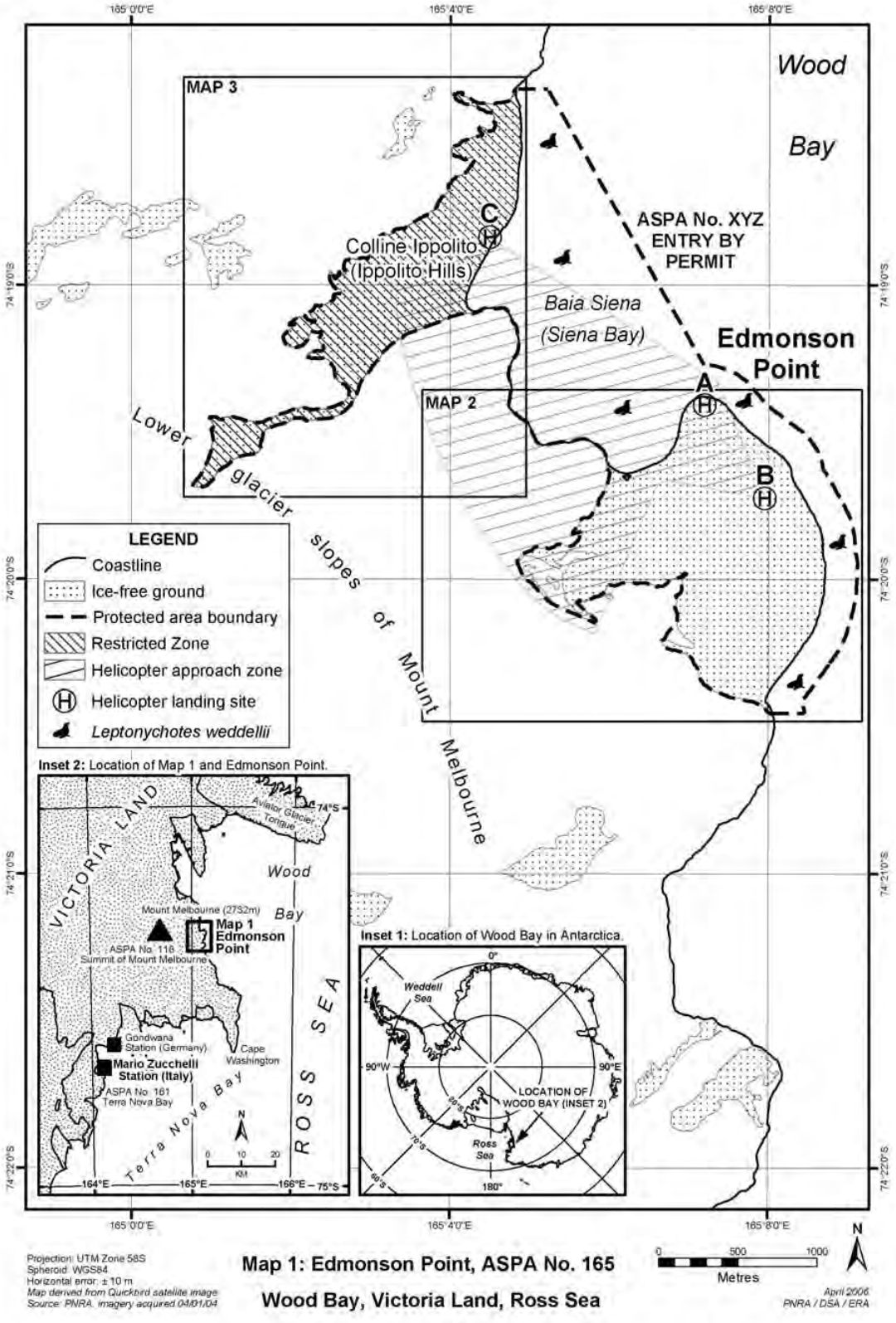
Have been carried out water sampling, mosses and algae from lakes. Permit for entry in ASPA 165 have been performed during 31 days in the field camp and for 3 hours for other sampling.

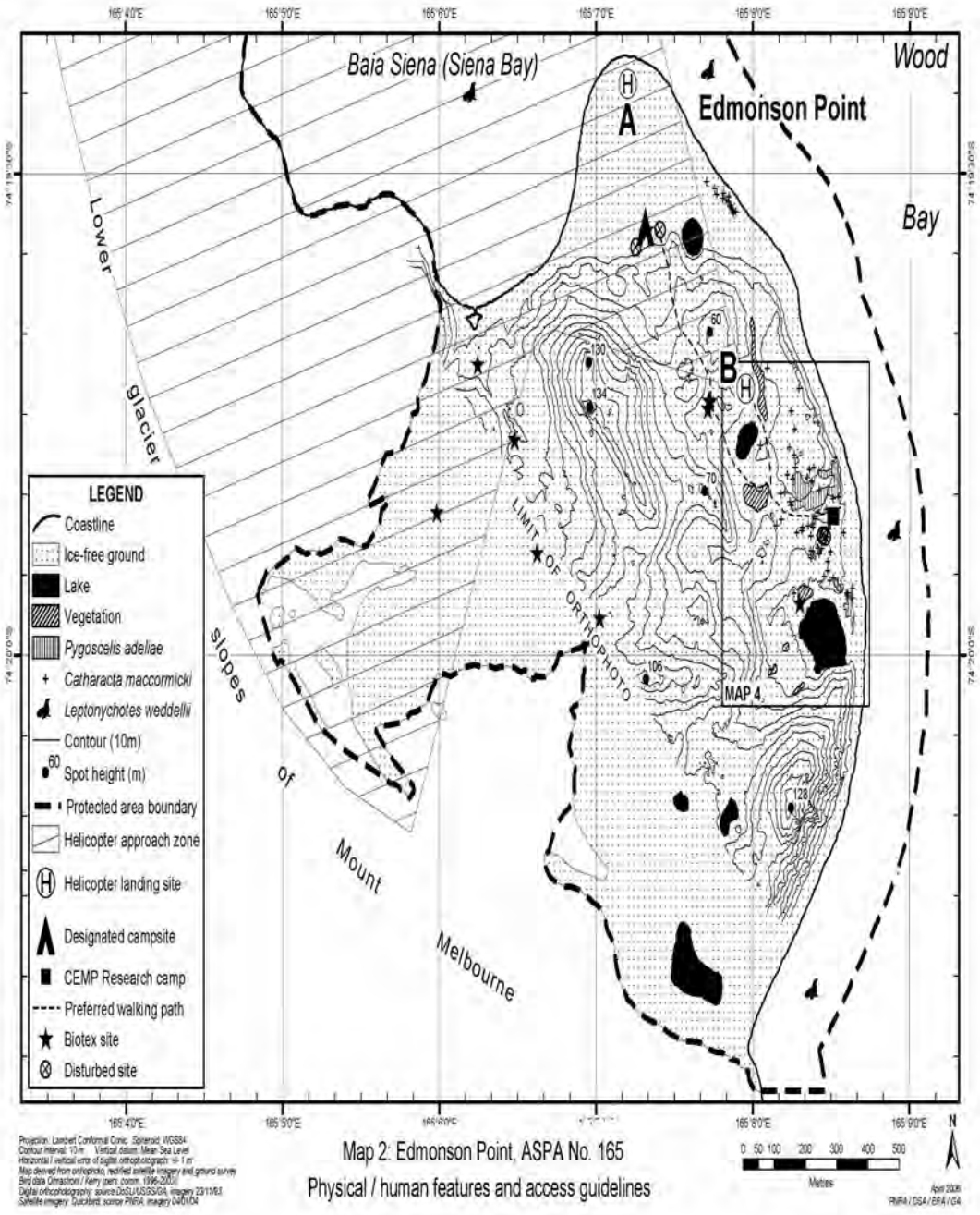
2010/2011 campaign

Organism denomination	Amount N° or Kg	Sampling System

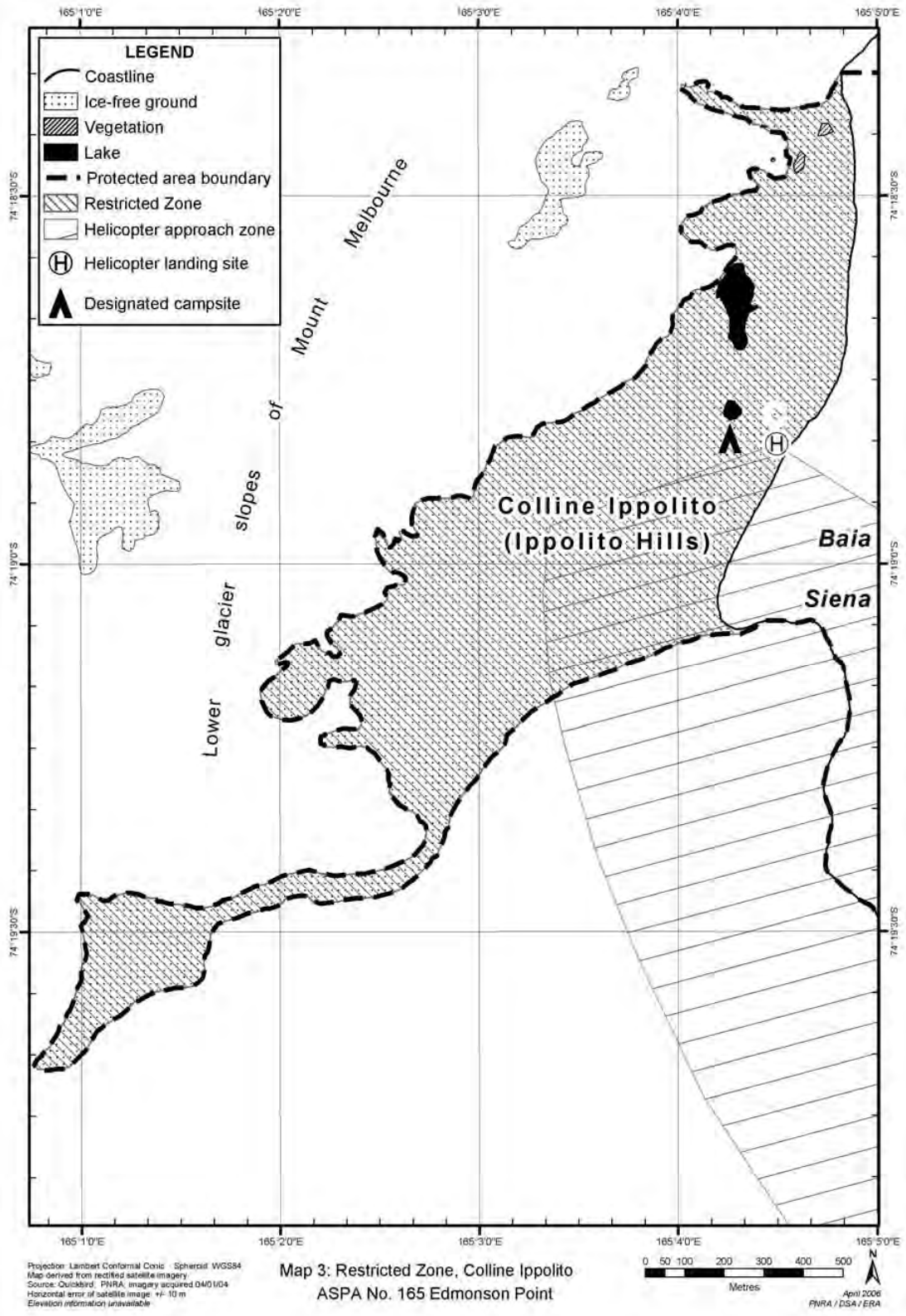
Mosses	600 g	manual sampling
Algae	400 g	manual sampling
Lichens on rocks and soils	600 g	manual sampling
Colonized rocks and soils by microorganisms and lichens	2 Kg	manual sampling

Sampling and studies activities into the ASPA area have been carried out in 12 different times for a total of 28 hours of work.

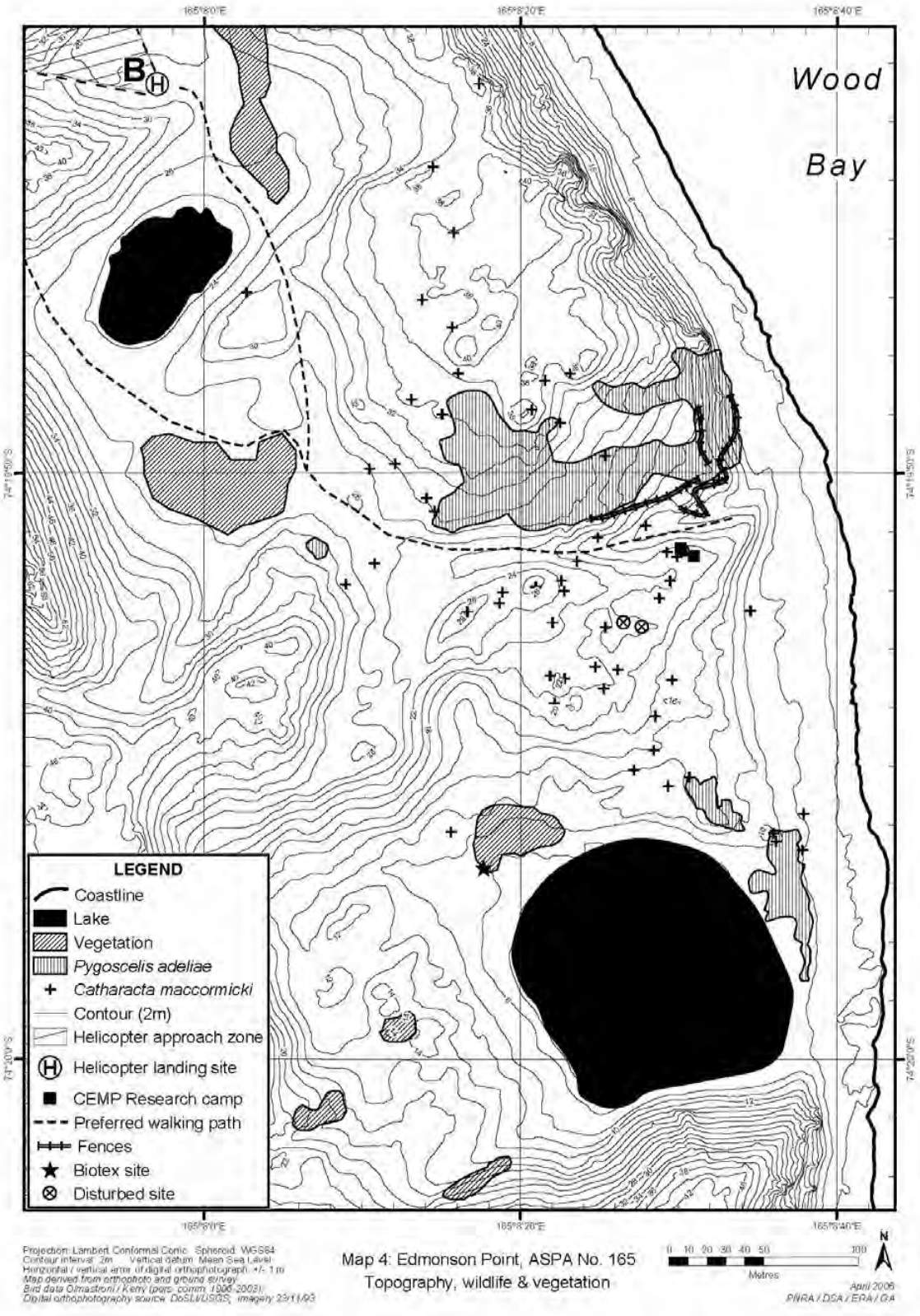

165°0'0"E
165°4'0"E
165°8'0"E
74°19'0"S
74°20'0"S
74°21'0"S
74°22'0"S
Wood
Bay
MAP 3
MAP 2
C
Colline Ippolito
(Ippolito Hills)
ASPA No. XYZ
ENTRY BY
PERMIT
Baia Siena
(Siena Bay)
Edmonson
Point
A
B
Lower glacier
slopes of Mount Melbourne
LEGEND
Coastline
Ice-free ground
Protected area boundary
Restricted Zone
Helicopter approach zone
Helicopter landing site
Leptonychotes weddellii
Inset 2: Location of Map 1 and Edmonson Point.
VICTORIA LAND
Aviator Glacier Tongue
74°S
Wood
Bay
Mount Melbourne (2732m)
Map 1
Edmonson
Point
ASPA No. 116
Summit of Mount Melbourne
Gondwana
Station (Germany)
Mario Zucchelli
Station (Italy)
Cape
Washington
ASPA No. 161
Terra Nova Bay
Terra Nova Bay
ROSS SEA
N
0 10 20
KM
164°E
165°E
166°E
75°S
Inset 1: Location of Wood Bay in Antarctica.
0°
Weddell
Sea
90°W
90°E
LOCATION OF
WOOD BAY (INSET 2)
Ross
Sea
180°
Projection: UTM Zone 58S
Spheroid: WGS84
Horizontal error: ± 10 m
Map derived from Quickbird satellite image
Source: PNRA, imagery acquired 04/01/04
Map 1: Edmonson Point, ASPA No. 165
Wood Bay, Victoria Land, Ross Sea
0 500 1000
Metres
N
April 2006
PNRA / DSA / ERA



Map 2: Edmonson Point, ASPA No. 165
Physical / human features and access guidelines



Map 3: Restricted Zone, Colline Ippolito
ASPA No. 165 Edmonson Point


165°8'0"E
165°8'20"E
165°8'40"E
Wood
Bay
B
H
74°19'50"S
74°20'0"S
LEGEND
Coastline
Lake
Vegetation
Pygoscelis adeliae
Catharacta maccormicki
Contour (2m)
Helicopter approach zone
Helicopter landing site
CEMP Research camp
Preferred walking path
Fences
Biotex site
Disturbed site
Projection: Lambert Conformal Conic Spheroid: WGS84
Contour interval: 2m Vertical datum: Mean Sea Level
Horizontal / vertical error of digital orthophotograph: +/- 1 m
Map derived from orthophoto and ground survey
Bird data Olmastroni / Kerry (pers. comm. 1996-2003)
Digital orthophotography source: DoSLI/USGS, imagery 23/11/93
Map 4: Edmonson Point, ASPA No. 165
Topography, wildlife & vegetation
0 10 20 30 40 50 100
Metres
N
April 2006
PNRA / DSA / ERA / GA

Antarctic Specially Protected Area No 167 (Hawker Island, Vestfold Hills, Ingrid Christensen Coast, Princess Elizabeth 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 those Areas;

Recalling Measure 1 (2006), which designated Hawker Island, Vestfold Hills, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica as ASPA 167 and annexed a Management Plan for the Area;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 167;

Desiring to replace the existing Management Plan for ASPA 167 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 167 (Hawker Island, Vestfold Hills, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica), which is annexed to this Measure, be approved; and
2. the Management Plan for ASPA 167 annexed to Measure 1 (2006) shall cease to be effective.

Management Plan for Antarctic Specially Protected Area No. 167

Hawker Island, Princess Elizabeth Land

Introduction

Hawker Island (68°38'S, 77°51'E, Map A) is located 7 km south-west from Davis station off the Vestfold Hills on the Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica. The island was designated as Antarctic Specially Protected Area (ASPA) No. 167 under Measure 1 (2006), following a proposal by Australia, primarily to protect the southernmost breeding colony of southern giant petrels (*Macronectes giganteus*) (Map B). The Area is one of only four known breeding locations for southern giant petrels on the coast of East Antarctica, all of which have been designated as ASPAs: ASPA 102, Rookery Islands, Holme Bay, Mac.Robertson Land (67º36'S, 62º53'E) – near Mawson Station; ASPA 160, Frazier Islands, Wilkes Land (66°13'S, 110°11'E) – near Casey station; and ASPA 120, Pointe Géologie, Terre Adélie (66º40'S, 140º01'E) – near Dumont d'Urville. Hawker Island also supports breeding colonies of Adélie penguins (*Pygocelis adeliae*), south polar skuas (*Catharacta maccormicki*), Cape petrels (*Daption capense*) and occasionally Weddell seals (*Leptonychotes weddellii*).

1. Description of values to be protected

The total population of southern giant petrels in East Antarctica represents less than 1% of the global breeding population. It is currently estimated at approximately 300 pairs, comprising approximately 45 pairs on Hawker Island (2010), 2-4 pairs on Giganteus Island (Rookery Islands group) (2007), approximately 250 pairs on the Frazier Islands (2001) and 8-9 pairs at Pointe Géologie (2005). Southern giant petrels also breed on other islands in the southern Indian and Atlantic Oceans and at the Antarctic Peninsula.

The southern giant petrel colony at Hawker Island was discovered in December 1963; at that time there were 40-50 nests present, "some with eggs" but it is unclear how many nests were occupied. Between 1963 and 2007, intermittent counts of adults, eggs or chicks were undertaken at various stages of the breeding cycle. Because of the variability in the timing of counts and the inconsistency of count units it is not possible to establish a long term trend for this population. Low numbers were previously reported for this colony because only the numbers of chicks banded in a given year rather than total chick numbers. The Area also supports a breeding colony of Adélie penguins, a limited number of flying birds and southern elephant seal haul out areas.

Southern giant petrels breeding in East Antarctica are sensitive to disturbance at the nest. Restrictions in activities permitted at breeding sites near Australian stations, including a prohibition of banding, were introduced in the mid-1980s.

At the South Shetland Islands and South Orkney Islands, the incidental bycatch of southern giant petrels in longline fisheries operating in the Southern Ocean is likely to have contributed to observed population decreases. Similar observations have not been made in East Antarctica. Until recently, southern giant petrels were listed as Vulnerable by the International Union for the Conservation of Nature (IUCN). However, a re-analysis of all data available for the global population indicated that the best case scenario over the past three generations or 64 years was a 17% increase of the total population, and the worst case scenario a 7.2% decrease. These figures are below the threshold set by the IUCN to be classified as Vulnerable. The conservation status for southern giant petrels has consequently been downgraded from Near Threatened to Least Concern.Hawker Island also supports breeding colonies of Adélie penguins (*Pygocelis adeliae*),

south polar skuas (*Catharacta maccormicki*), Cape petrels (*Daption capense*) and occasionally Weddell seals (*Leptonychotes weddellii)*.

2. Aims and objectives

Management of the Hawker Island ASPA aims to:

- protect the breeding colony of southern giant petrels and other wildlife colonies;
- avoid human disturbance or other adverse impacts on the values of the Area, while still allowing research or other activities consistent with this Plan;
- protect the values of Hawker Island 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 Hawker Island.

3. Management activities

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

- research visits to assess population levels and trends of the southern giant petrel colony and/or other wildlife shall be permitted. Wherever feasible, preference shall be given to activities and methodologies which minimise disturbance to the breeding colony (e.g. use of automated cameras);
- where practicable the Area shall be visited outside the breeding season of southern giant petrels (i.e. during the period mid-April to mid-September) as necessary, to assess whether it continues to serve the purposes for which it was designated and to ensure that management activities are adequate;
- information on the location of Hawker Island ASPA (stating the restrictions that apply) shall be produced and copies of this management plan shall be available at nearby stations. Informative material and the management plan should be provided to ships visiting the vicinity; and
- 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: Hawker Island Antarctic Specially Protected Area, Vestfold Hills, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica.

Map B: Hawker Island, Antarctic Specially Protected Area, Vestfold Hills, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica, Biota, Topography and Physical Features.

Specifications for maps:

Projection: UTM Zone 49
Horizontal Datum: WGS84

6. Description of the Area

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

Hawker Island is located at 68°38'S, 77°51'E, approximately 300 m offshore from the Vestfold Hills. The Vestfold Hills are roughly triangular ice-free area of approximately 512 km^2 of bedrock, glacial debris, lakes and ponds. The Vestfold Hills are bound by the ice plateau to the east, the Sørsdal Glacier to the south, and Prydz Bay to the west and contain low hills (maximum height 158 m at Boulder Hill) and valleys, and are penetrated deeply by fjords and lakes. Numerous islands fringe the coast of the Vestfold Hills, and Hawker Island lies in the south-west, between Mule Island and Mule Peninsula.

Hawker Island is an irregularly shaped island of low elevation (maximum elevation of nearly 40 m), with two parallel ranges of hills running in a north south direction terminating in two small southern peninsulas. A third peninsula lies directly west and terminates with a 40 m hill with steep cliffs to the sea on the western and southerly aspects. A number of small freshwater lakes lie between the ranges of hills on the northern part of the island, with a number of small lakes lying on the flatter terrain on the eastern sector of the island. At its maximum extent the island is 2 km north to south and 1.7 km east to west.

The Hawker Island ASPA comprises the entire terrestrial area of Hawker Island, with the seaward boundary at the low water mark (Map B). The total area of the Hawker Island ASPA is approximately 1.9 km². There are no boundary markers.

Environmental domains analysis

Based on the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)) Hawker Island is located within Environment T Inland continental geologic.

Human History

The first recorded sighting of the Vestfold Hills was by Douglas Mawson on the BANZARE voyage of the *'Discovery'* on 9 February 1931. Four years later, on 20 February 1935, Captain Klarius Mikkelsen of the tanker *Thorshavn* (Lars Christensen Company), sighted and landed in the area. He named many features in the area and in the Vestfold Hills after his home province in Norway. The Vestfold Hills were again visited by Mikkelsen in early 1937, while undertaking an aerial survey of the coast.

In January 1939, the American explorer, Lincoln Ellsworth, and his Australian adviser, Sir Hubert Wilkins were the next recorded visitors to the area in the motor ship *Wyatt Earp*. Ellsworth flew some 400 km inland. In early 1947, the *USS Currituck* visited the Ingrid Christensen Coast as part of Operation Highjump. Photographic flights were conducted to survey the coastline.

The first Australian National Antarctic Research Expeditions (ANARE) to the area was led by Dr Phillip Law on *Kista Dan* and reached the Vestfold Hills on 1 March 1954. During January 1956, members of the Soviet Antarctic Expedition landed on the Ingrid Christensen Coast in preparation for the International Geophysical Year and established Mirny Station 595 km to the east. Australia established Davis station in the Vestfold Hills in 1957. Hawker Island was named for A.C. Hawker, radio supervisor at Davis station in 1957.

Climate

Meteorological data for the Area are confined almost entirely to observations at Davis station, 7 km northwest of Hawker Island. The Vestfold Hills area has a polar maritime climate that is cold, dry and windy. Summer days are typically sunny, with a midday temperature from -1°C to +2.9°C and a summer maximum of +5°C, but temperatures are below 0°C for most of the year falling to as low as −40.7°C in winter. The maximum temperature recorded at Davis station from 1957 to 2001 was

+13°C. Long periods of relatively calm, fine conditions occur throughout the year. Winds are generally light. The yearly average is around 20 km/h. Violent winds and blizzards can commence with little warning, and gusts of over 200 km/h have been recorded. Snowfall averages 78 mm/yr, with the greater proportion of annual accumulation resulting from windblown drift. Apart from several permanent ice banks, the Vestfold Hills are virtually snow free in summer and lightly covered in winter. The record illustrates the seasonal climate expected for high latitudes, but on average Davis station is warmer than other Antarctic stations at similar latitudes. This has been attributed to the "rocky oasis" which results from the lower albedo of rock surfaces compared to ice, hence more solar energy is absorbed and re-radiated.

Geology

The Vestfold Hills consist of Archaean gneiss, upon which thin and often fossiliferous Pliocene and Quaternary sediments occupy depressions. The oldest known Cenozoic strata in the Vestfold Hills are the mid-Pliocene Sørsdal Formation, which contains a diverse marine fossil flora and fauna. Other younger Cenozoic strata attest to repeated glaciation, and several marine transgressions and regressions. The three major lithologies forming the Vestfold Hills are (in order of age) Chelnock Paragneiss, Mossel Gneiss and Crooked Lake Gneiss. This is repeated in units from east-north-east to west-south-west. Intruded into these, are groups of mafic dykes in a rough north-south orientation. The dykes are a major feature of the Vestfold Hills. Hawker Island comprises an extension of the Crooked Lake Gneiss of the northern portion of Mule Peninsula above Laternula Inlet. In common with the Archaean gneisses in the Vestfold Hills, the Hawker Island Crooked Lake Gneiss is cut by very distinctive, middle to early Proterozoic dolerite dykes.

Southern Giant Petrels

The Hawker Island southern giant petrel colony is situated on level ground about 20 m above sea-level at the northern end of the island (Map B). The same area has been used for breeding since the first records were made in 1963/64. The eastern side of the breeding area forms a slight ridge with the ground dropping away below, providing a good area for take-off into the prevailing north-easterly winds.

The breeding season for southern giant petrels on Hawker Island commences in late September/early October and eggs are laid during the second half of October. Following an incubation period of about 60 days, hatching starts in the second half of December. Hatching continues over a period of three to four weeks until mid-January. About 14 – 16 weeks after hatching, the fledglings leave the colony from late March to early May. From the analysis of year round automated cameras and visits during recent winters, it is known that a small number of birds are present outside the breeding season; hence the requirement that visits to the Area at any time of the year be conducted in a manner that ensures minimal disturbance.

In the mid 1980s, a management strategy was implemented for all three southern giant petrels breeding localities in the vicinity of the Australian stations, to minimise human disturbance. Previously the Australian Antarctic Division restricted census visits to one in every three to five year period and implemented tight administrative controls over all other visits. At this time, this level of visitation was considered an appropriate compromise between the risk of disturbing the birds and the need to obtain meaningful population data. However, this management regime impacted on the level of visitation needed to assess population levels (and trends) and did not appear to significantly benefit the breeding success of the southern giant petrels. With the development of new technology (such as automated cameras), detailed information can now be obtained with little or no human presence during the breeding period.

In March 2011, 23 chicks and 64 adults were observed in the Area. Of these, four banded birds were sighted consisting of two birds banded in the Casey region (dated 1985) and two birds banded at Hawker Island (dated 1986). The two Casey banded birds were observed remaining near the same chicks and appeared to be breeding.

Other Birds

Adélie penguins breed along the Vestfold Hills coastline and on at least 17 offshore islands, including Hawker Island. The total number of Adélie penguins in the Vestfold Hills has been estimated at 130000 pairs. The Hawker Island colony is located in the vicinity of a small hill midway on the western side of the island and has been estimated at 2500 to 7500 pairs. There is evidence that the colony or some of the
breeding groups within the colony have moved location periodically. The deserted areas are marked by deep deposits of guano, frozen eggs and the dehydrated carcasses of chicks. The first Adélie penguins usually appear in the area by the middle of October and eggs are laid about four weeks later. The interval between laying of the first and second egg is 2½ to 4½ days, and the incubation period is ranges from 32 to 35 days. The last moulted adults depart Hawker Island by the end of March.

A small colony of Cape petrels has been recorded on Hawker Island on the southern tip of the south western peninsula. Cape petrels are absent from the Area in winter; they return to their nesting sites during October, lay eggs from late November to early December and chicks fledge in late February and early March.

Seals

Weddell seals *(Leptonychotes weddellii*) breed in the Vestfold Hills and occasionally on the south-east part of Hawker Island. The seals start to appear inshore in late September and early October, and pupping occurs from mid-October until late November. Throughout summer, moulting Weddell seals continue to frequent firm sea-ice and haul out onto land. Most of the local population remains in the Vestfold Hills throughout the summer. Non-breeding groups of southern elephant seals (*Mirounga leonina*) haul out during the summer months in the vicinity of the south-western peninsula on Hawker Island. Their moulting areas contain deposits of hair and excrement that have accumulated over several thousand years, and could be considered as unique and sensitive areas.

Vegetation

The flora of the Vestfold Hills comprises at least 82 species of terrestrial algae, six moss species and at least 23 lichen species. The lichens and mosses are distributed chiefly in the eastern or inland sector and their distribution patterns reflect the availability of drift snow, time since exposure of the substrate from the ice plateau, time since the last glaciation, elevation and proximity to saline waters. Very few occurrences of lichens or mosses have been noted towards the salt-affected coastal margin including Hawker Island where the low terrain is densely covered with extensive sand and moraine deposits.

Terrestrial algae are widespread and are major primary producers in the Vestfold Hills. Sublithic (or hypolithic) algae have been reported from Hawker Island, developing on the undersurfaces of translucent quartz stones that are partially buried in soil. The dominant algae, Cyanobacteria, particularly oscillatoriacean species, *Chroococidiopsis sp*., and *Aphanothece sp.* occur with the greatest frequency together with the Chlorophyta species, *cf. Desmococcus sp. A* and *Prasiococcus calcarius*. The endaphic alga *Prasiola crispa* occurs as green crumpled sheet-like strands at melt flushes, usually associated with the diatom *Navicula muticopsis* and oscillatoriacean algae. The ornithocophilous lichen *Candelariella flava* has been reported from Hawker Island, associated with seabird nesting sites.

Invertebrates

An extensive survey of terrestrial tardigrades was undertaken in the Vestfold Hills in 1981 from which four genera and four species of tardigrade were recovered. Although no tardigrades were

recovered from the Hawker Island sample site it has been suggested that, as two species of tardigrade, *Hypsibius allisonii* and *Macrobiotus fuciger (?)* were recovered from Walkabout Rocks, they may be found in other coastal areas of similar ecology, associated with *Prasiola crispa*. The mite, *Tydeus erebus* is associated with breeding sites of Adélie penguins on the island.

6(ii) Access to the Area

Depending on sea ice conditions, the Area can be accessed by vehicle, small boat or aircraft, all of which must remain outside the Area. There are no designated landing sites.

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

There are no permanent structures within or adjacent to the Area. At the time of writing a number of automatic cameras were temporarily located in proximity to the southern giant petrel colony, for the purposes of ongoing population monitoring.

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

The following Protected Area is located near Hawker Island:

Marine Plain, Antarctic Specially Protected Area No. 143 (68°36'S, 78°07'E).

6(v) Special zones within the Area

There are no special zones within the Area.

7. Terms and conditions for entry permits

7(i) General conditions

Visits to Hawker Island ASPA are prohibited except in accordance with a permit issued by an appropriate national authority. Permits to enter the Area may only be issued for compelling scientific research that cannot be undertaken elsewhere, or for essential management purposes consistent with the objectives and provisions of the management plan. Permits are only to be issued for research that will not jeopardise the ecological or scientific values of the Area, or interfere with existing scientific studies.

Permits shall include a condition 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 is required to submit to the permit issuing authority a visit report detailing all activities undertaken within the Area, and all census data obtained during the visit.

Collaboration with other national programs is encouraged to reduce duplication of research and minimise disturbance of the southern giant petrels. National Antarctic programs planning research in this Area are encouraged to contact the Australian Antarctic Division, which maintains a regular population monitoring program on the island, to ascertain other projects that may be undertaken that season.

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

- Vehicles are prohibited within the Area.
- Access to the Hawker Island ASPA boundary may be by watercraft or vehicle depending upon seasonal conditions. Boats used to visit the islands must be left at the shoreline. Movement within the Area is by foot only. Only personnel who are required to carry out scientific/management work in the Area are to leave the landing/parking site. Quad-bikes or other land vehicles used to visit the Area shall not be taken into the Area. Vehicles shall remain on the sea-ice at least 150 m (quad-bike) or 250 m (other land- vehicles) from the edge of the southern giant petrel colony (see Table 1);
- The minimum (closest) approach distances to wildlife are set out in Table 1. If disturbance of wildlife if observed, separation distance should be increased or the activity modified until there is no visible disturbance, unless a closer approach distance is authorised in a permit.
- Persons authorised in a permit to approach southern giant petrels to obtain census data or

biological data, should maintain the greatest practical separation distance;

- 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 significant noise (thereby cause disturbance to nesting southern giant petrels and other nesting birds) is prohibited within the Area during the breeding period for southern giant petrels (mid-September to mid-April);
- Overflights of the island during the breeding season are prohibited, except where essential for scientific or management purposes and authorised in a permit. Such overflights are to be at an altitude of no less than 930 m (3050 ft) for single-engined helicopters and fixed-wing aircraft, and no less than 1500 m (5000 ft) for twin-engined helicopters; and
- Landing of aircraft within 930 m for single-engined helicopters and fixed-wing aircraft and 1500 m (5000 ft) for twin-engined helicopters of a wildlife concentration is prohibited at any time other than an emergency.

Table 1: Minimum distances to maintain when approaching wildlife at Hawker Island

Species	**Distances (m)**			
	People on foot / ski (unless a closer approach distance is authorised in a permit)	**Quad/ Skidoo**	**Hagglunds, etc.**	**Small watercraft**
Giant petrels	100 m	Not permitted inside the Area. Parking shall be on the sea-ice and no closer than 150 m from wildlife colonies.	Not permitted inside the Area. Parking shall be on the sea-ice and no closer than 250 m from wildlife colonies.	Watercraft should not be landed within 50 m of wildlife; in particular, the Adelie penguin colony on the eastern shore. Care shall be taken when in close proximity to the island.
Adelie penguins in colonies Moulting penguins Seals with pups Seal pups on their own South polar skua on nest	30 m			
Penguins on sea ice Non breeding adult seals	5 m			

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

The following activities may be conducted within the Area from 15 April to 15 September (southern giant petrel non-breeding period) as authorised in a permit:

- scientific research consistent with the provisions of this management plan which cannot be undertaken elsewhere or in the Area outside that period and which will not jeopardise the values for which the Area has been designated or the ecosystems of the Area;

- essential management activities, including monitoring; and

- sampling which should be the minimum required for approved research programs.

Activities undertaken within the breeding period of the southern giant petrel shall only be permitted if the activity is non-invasive and cannot reasonably be undertaken during the non-breeding period.

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

- Permanent structures or installations are prohibited.

- Temporary structures or equipment, including cameras, shall only be erected within the Area in accordance with in a permit.

- Small temporary refuges, hides, blinds or screens may be constructed for the purpose of scientific study.

- Installation (including site selection), removal, modification or maintenance of structures or equipment shall be undertaken in a manner that minimises disturbance to breeding birds and the surrounding environment.

- All scientific equipment or markers installed within the Area must be clearly identified by country, name of the principal investigator and year of installation.

- Markers, signs or other structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition and removed under permit when no longer required. All such items should be made of materials that pose minimal risk of harm to wildlife or of contamination of the Area.

7(v) Location of field camps

- Camping is prohibited within the Area except in an emergency. Any emergency camp should avoid areas of wildlife concentrations, if feasible.

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

- Fuel is not to be stored in the Area. Boat refuelling is permitted at landing sites. A small amount of fuel may be taken into the Area for an emergency stove.

- No poultry products, including dried food containing egg powder, are to be taken into the Area.

- 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

(particularly footwear) should be thoroughly cleaned before entering the Area.

- All material 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 as to minimise the risk of environmental impact.

7(vii) 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. Any such permit shall clearly state the limits and conditions for such activities which, except in an emergency, shall only occur following approval by an appropriate animal ethics committee.

- Ornithological research shall be limited to activities that are non-invasive and non-disruptive to the breeding seabirds present within the Area.

- Disturbance of southern giant petrels or other wildlife should be avoided or minimised.

7(viii) 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.

7(ix) Disposal of Waste

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

7(x) Measures that may be necessary to continue to meet the aims of the management plan

- GPS data shall be obtained for specific sites of long-term monitoring for lodgement with the Antarctic Master Directory through the appropriate national authority.

- Permits may be granted to enter the Area to carry out biological monitoring and management activities, which may involve the collection of samples for analysis or review; the erection or maintenance of temporary 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.

- To help maintain the ecological and scientific values of the Area, visitors shall take special precautions against introductions of non-indigenous organisms. Of particular concern are pathogenic, microbial or vegetation introductions sourced from soils, flora and 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, particularly sampling equipment and markers to be used in the Area.

7(xi) Requirement for reports

Parties shall ensure that the principal permit holder for each permit 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 the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas.

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, which shall be in sufficient detail to allow evaluation of the effectiveness of this management plan.

Parties shall, 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 plan of management and in organising the scientific use of the Area.

A copy of the report shall be forwarded to the national authority responsible for development of the management plan to assist in management of the Area, and monitoring of bird and other wildlife populations. Additionally visit reports shall provide detailed information such as 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.

7(xii) Emergency provisions

Exceptions to restrictions outlined in the management plan are in emergency as specified in Article 11 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty (the Madrid Protocol). A report of any such actions shall be provided to the relevant national authority.

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).

Adamson, D.A. and Pickard, J. (1986), Cainozoic history of the Vestfold Hills, In Pickard, J., ed. *Antarctic Oasis, Terrestrial environments and history of the Vestfold Hills*. Sydney, Academic Press, 63–97.

Adamson, D.A. and Pickard, J. (1986), Physiology and geomorphology of the Vestfold Hills, In Pickard, J., ed. *Antarctic oasis: terrestrial environments and history of the Vestfold Hills*. Sydney, Academic Press, 99–139.

Agreement on the Conservation of Albatrosses and Petrels (ACAP) (2010), ACAP Species assessment Southern Giant Petrels *Macronectes giganteus*.

ANARE (1968), Unpublished data.

Australian Antarctic Division (2010), Environmental Code of Conduct for Australian Field Activities, Territories, Environment and Treaties Section, Australian Antarctic Division.

Birdlife International (2000), *Threatened birds of the world*. Barcelona and Cambridge U. K, Lynx Edicions and Birdlife International.

BirdLife International (2011), *Macronectes giganteus*, In: IUCN 2011, 2011 IUCN Red List of Threatened Species, <http://www.iucnredlist.org/>, Downloaded on 17 January2011.

BirdLife International (2011), Species fact sheet: *Macronectes giganteus*, <http://www.birdlife.org/> Downloaded on 17 January 2011.

Cooper, J., Woehler, E., Belbin, L. (2000), Guest editorial, Selecting Antarctic Specially Protected Areas: Important Bird Areas can help, *Antarctic Science* 12: 129.

Environment Australia (2001), *Recovery Plan for Albatrosses and Giant Petrels*, Canberra.

Department of Sustainability, Environment, Water, Population and Communities (2011), *Draft National recovery plan for threatened albatrosses and giant petrels 2011-2016*, Commonwealth of Australia, Hobart.

Department of Sustainability, Environment, Water, Population and Communities (2011), *Background Paper, Population Status and Threats to Albatrosses and Giant Petrels Listed as Threatened under the Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth of Australia, Hobart.

Fabel, D., Stone, J., Fifield, L.K. and Cresswell, R.G. (1997), Deglaciation of the Vestfold Hills, East Antarctica; preliminary evidence from exposure dating of three subglacial erratics. In RICCI, C.A., ed. *The Antarctic region: geological evolution and processe*s, Siena: Museo Nazionale dell'Antartide, 829–834.

Garnett, S.T., Crowley, G.M. (2000), *The Action Plan for Australian Birds 2000*. Commonwealth of Australia, Environment Australia, Canberra

Gore, D.B. (1997), Last glaciation of Vestfold Hills; extension of the East Antarctic ice sheet or lateral expansion of Sørsdal Glacier. *Polar Record*, 33: 5–12.

Hirvas, H., Nenonen, K. and Quilty, P. (1993), Till stratigraphy and glacial history of the Vestfold Hills area, East Antarctica, *Quaternary International*, 18: 81–95.

IUCN (2001), *IUCN Red List Categories: Version 3.1*, 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.

Johnstone, Gavin W.; Lugg, Desmond 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.

Law P. (1958), Australian Coastal Exploration in Antarctica, *The Geographical Journal CXXIV*, 151-162.

Leishman, M.R. and Wild, C. (2001), Vegetation abundance and diversity in relation to soil nutrients and soil water content in Vestfold Hills, East, *Antarctic Science*, 13(2): 126-134

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.

Miller, J.D. et al. (1984), A survey of the terrestrial Tardigrada of the Vestfold Hills, Antarctica, In Pickard, J., ed. *Antarctic Oasis, Terrestrial environments and history of the Vestfold Hills*. Sydney, Academic Press, 197-208.

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. (2008), Breeding distribution and population status of the Northern Giant Petrel *Macronectes halli* and the southern giant petrel *M. Giganteus*, *Marine Ornithology* 36: 115-124.

Pickard, J. ed., 1986, *Antarctic oasis: terrestrial environments and history of the Vestfold Hills*. Sydney, Academic Press.

Puddicombe, R.A.; and Johnstone, G.W. (1988), Breeding season diet of Adélie penguins at Vestfold Hills, East Antarctica, In *Biology of the Vestfold Hills*, Antarctica, edited by J.M. Ferris, H.R. Burton, G.W. Johnstone, and I.A.E. Bayly.

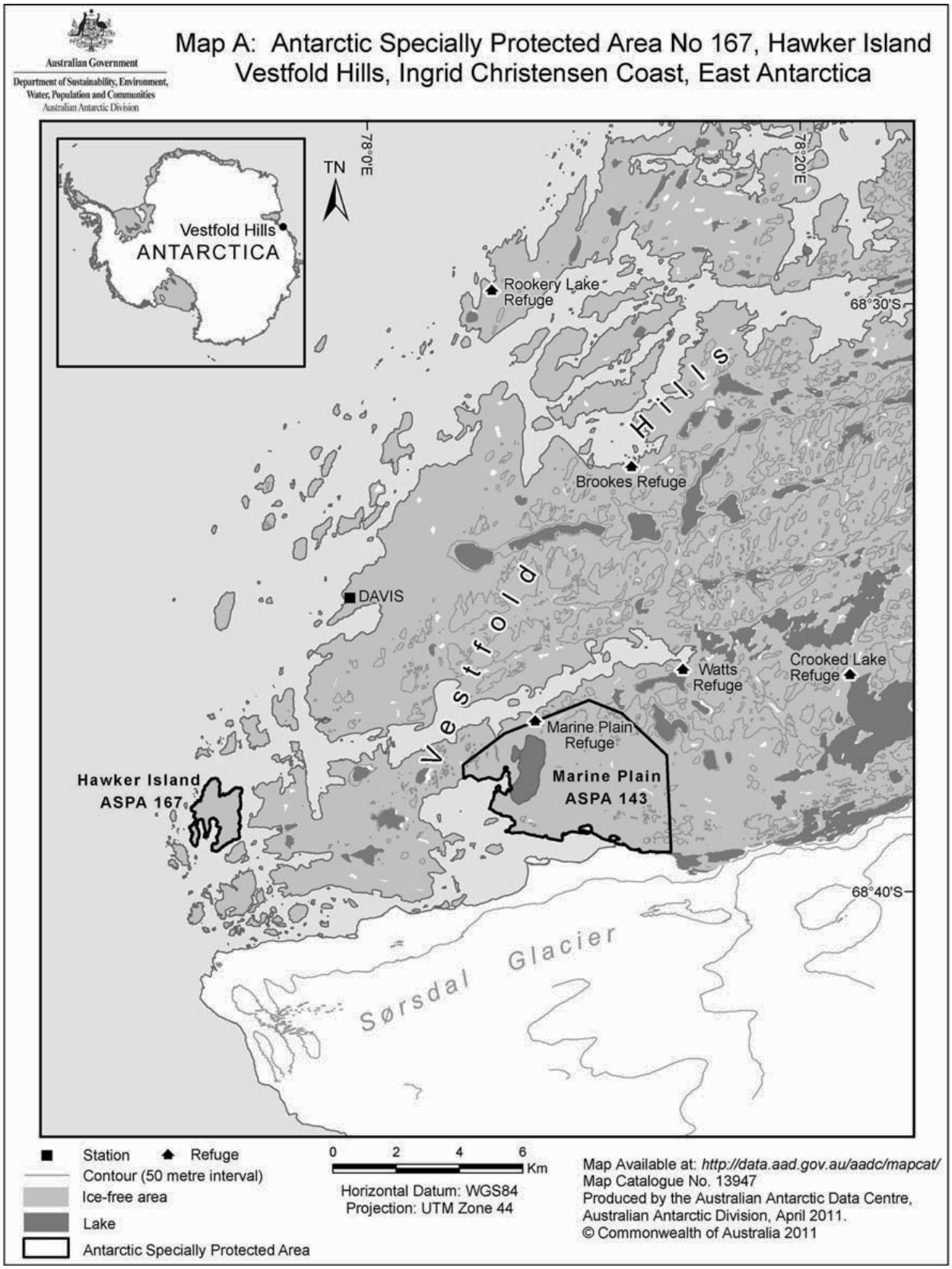
Rounsevell, D.E., and Horne, P.A. (1986), Terrestrial, parasitic and introduced invertebrates of the Vestfold Hills. *Antarctic oasis; terrestrial environments and history of the Vestfold Hills*, Sydney: Academic Press, 309-331.

Stattersfield, A.J., Capper, D.R. (2000), Threatened Birds of the World. *Birdlife International*, Lynx Publications.

Wienecke, B., Leaper, R., Hay, I., van den Hoff, J. (2009), Retrofitting historical data in population studies: southern giant petrels in the Australian Antarctic Territory, *Endangered Species Research* Vol. 8: 157-164.

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.

Woehler, E. (2001), Breeding populations of Southern Giant Petrels at Heard Island, the McDonald Islands and within the AAT, Australian Antarctic Data Centre, SnoWhite Metadata <http://aadc-maps.aad.gov.au/aadc/metadata/metadata_redirect.cfm?md=AMD/AU/SOE_seabird_candidate_sp_SGP>, Downloaded on 17 January 2011.


Australian Government
Department of Sustainability, Environment, Water, Population and Communities
Australian Antarctic Division
Map A: Antarctic Specially Protected Area No 167, Hawker Island
Vestfold Hills, Ingrid Christensen Coast, East Antarctica
Vestfold Hills
ANTARCTICA
TN
78°0'E
78°20'E
68°30'S
68°40'S
Rookery Lake Refuge
Brookes Refuge
DAVIS
Watts Refuge
Crooked Lake Refuge
Marine Plain Refuge
Marine Plain ASPA 143
Hawker Island ASPA 167
Sørsdal Glacier
Station
Refuge
Contour (50 metre interval)
Ice-free area
Lake
Antarctic Specially Protected Area
0 2 4 6 Km
Horizontal Datum: WGS84
Projection: UTM Zone 44
Map Available at: http://data.aad.gov.au/aadc/mapcat/
Map Catalogue No. 13947
Produced by the Australian Antarctic Data Centre, Australian Antarctic Division, April 2011.
© Commonwealth of Australia 2011


Australian Government
Department of Sustainability, Environment, Water, Population and Communities
Australian Antarctic Division
Map B: Antarctic Specially Protected Area No 167, Hawker Island
Vestfold Hills, Ingrid Christensen Coast, East Antarctica
Topography and Fauna Distribution
TN
77°50'0"E
77°52'0"E
68°38'0"S
68°38'30"S
Hawker Island
ASPA 167
Contour (5 metre interval)
Ice-free area
Lake
Antarctic Specially Protected Area
Adélie penguin colony
Southern giant-petrel colony
Southern elephant seal haulout area (Jan-May)
0 100 200 300 400
Metres
Horizontal Datum: WGS84
Projection: UTM Zone 44
Map Available at: http://data.aad.gov.au/aadc/mapcat/
Map Catalogue No. 13948
Produced by the Australian Antarctic Data Centre, Australian Antarctic Division, April 2011.
© Commonwealth of Australia 2011

Measure 10

Antarctic Specially Managed Area No 2 (McMurdo Dry Valleys, Southern Victoria Land): Revised Management Plan

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 Measure 1 (2004), which designated McMurdo Dry Valleys, Southern Victoria Land as ASMA 2 and annexed a Management Plan for the Area;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASMA 2;

Desiring to replace the existing Management Plan for ASMA 2 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 Managed Area No 2 (McMurdo Dry Valleys, Southern Victoria Land), which is annexed to this Measure, be approved; and
2. the Management Plan for ASMA 2 annexed to Measure 1 (2004) shall cease to be effective.

Management Plan for
Antarctic Specially Managed Area No. 2
MCMURDO DRY VALLEYS, SOUTHERN VICTORIA LAND

Introduction

The McMurdo Dry Valleys are the largest relatively ice-free region in Antarctica with approximately thirty percent of the ground surface largely free of snow and ice. The region encompasses a cold desert ecosystem, whose climate is not only cold and extremely arid (in the Wright Valley the mean annual temperature is –19.8°C and annual precipitation is less than 100 mm water equivalent), but also windy. The landscape of the Area contains mountain ranges, nunataks, glaciers, ice-free valleys, coastline, ice-covered lakes, ponds, meltwater streams, arid patterned soils and permafrost, sand dunes, and interconnected watershed systems. These watersheds have a regional influence on the McMurdo Sound marine ecosystem. The Area's location, where large-scale seasonal shifts in the water phase occur, is of great importance to the study of climate change. Through shifts in the ice-water balance over time, resulting in contraction and expansion of hydrological features and the accumulations of trace gases in ancient snow, the McMurdo Dry Valley terrain also contains records of past climate change. The extreme climate of the region serves as an important analogue for the conditions of ancient Earth and contemporary Mars, where such climate may have dominated the evolution of landscape and biota.

The Area was jointly proposed by the United States and New Zealand and adopted through Measure 1 (2004). This Management Plan aims to ensure the long-term protection of this unique environment, and to safeguard its values for the conduct of scientific research, education, and more general forms of appreciation. The Management Plan sets out the values, objectives and general rules for conduct within the region, and includes a number of maps and appendices that provide more specific guidelines for particular activities and designated zones within the Area, arranged according to the following structure:

Contents

1. Values to be protected and activities to be managed

The McMurdo Dry Valleys are characterized by unique ecosystems of generally low macrobiotic biodiversity and reduced food web complexity, although recent research has shown evidence of highly diverse microbial communities across relatively small areas, as well as between valleys. Moreover, as the largest ice-free region in Antarctica, the McMurdo Dry Valleys also contain relatively diverse habitats compared with other ice-free areas. The Area contains unusual microhabitats and biological communities (such as endolithic and cryoconite systems) as well as rare glaciological and geological features (for example, a brine-rich sub- glacial lake, hyper-saline surface lakes, unique marine deposits and undisturbed desert pavements). These glaciological and geological features are of value because they contain an extremely long record of natural events. The McMurdo Dry Valleys contain indicators of past and present regional climate change, as well as features that play a role in influencing local climate change. A Long Term Ecological Research (LTER) site was established in the Taylor Valley in 1993, and substantial research has been conducted by the program every season for almost twenty years, not only in the Taylor Valley but also more generally across the McMurdo Dry Valleys. The long-term environmental data sets that have been collected through this program, and through a range of other research initiatives in the McMurdo Dry Valleys, are some of the longest in Antarctica. These scientific values are of global and regional importance.

The Area is a valuable resource for understanding landscape processes and the stability of Antarctic ice sheets. The McMurdo Dry Valleys contain unique surface deposits including glacially deposited and modified sediments, sand dunes, desert pavement, glacio-lacustrine sediments, and marine fjord sediments containing

valuable records of planetary change. The soil, rock, water, and ice environments and their associated biota are of scientific value as model ecosystems that allow deep insights into natural processes operating throughout the biosphere. Finally, the

species that reside in the McMurdo Dry Valleys provide a biological resource for understanding adaptation to extreme environments, and are true end members of ecological continua.

The isolation of the McMurdo Dry Valleys and the extreme environment has generally protected it from human introductions of species from outside of Antarctica. Many parts of the Area are only rarely visited, and one (the Barwick and Balham Valleys protected area) has been set aside as a reference area where entry has been very strictly controlled for almost 40 years and overflight is prohibited. The relatively pristine condition of the McMurdo Dry Valleys, and the relative lack of introduced species established within the Area, are rarely observed elsewhere in the world and have both high scientific and ecological value, especially for comparative studies.

Sites of historic value originating from early exploration of the Area have also been noted, such as 'Granite House' at Botany Bay, Granite Harbor, which was constructed by members of the 1910-1913 British Antarctic Expedition and is designated as Historic Site No. 67.

The McMurdo Dry Valleys are also valued for their aesthetic and wilderness qualities. They represent a relatively pristine environment largely undisturbed and uncontaminated by humans. The dramatic landscape, composed of precipitous mountains, high ridges and sweeping valleys, imposing layered geological formations of dark dolerite set against pale sandstones, and contrasts of ice-free and glacier-covered terrain creates unique vistas with high aesthetic value.

Activities conducted in the area include a variety of scientific research, operations in support of science, media, arts, education and other official National Program visitors, and tourism.

The Area requires special management to ensure that its scientific, environmental, ecological, historic, aesthetic and wilderness values are protected, including that data sets collected over the last 100 years will continue to be of high value. Increasing human activity and potentially conflicting interests have made it necessary to manage and coordinate activities more effectively within the Area.

2. Aims and objectives

The aim of this Management Plan is to conserve and protect the unique and outstanding environment of the McMurdo Dry Valleys by managing and coordinating human activities in the Area such that the values of the McMurdo Dry Valleys are protected and sustained in the long term, especially the value of the extensive scientific datasets that have been collected.

The specific objectives of management in the Area are to:

- Facilitate scientific research while maintaining stewardship of the environment;
- Assist with the planning and coordination of human activities in the McMurdo Dry Valleys to manage actual or potential conflicts among different values (including

those of different scientific disciplines), activities and operators;

- Ensure the long-term protection of scientific, ecological, aesthetic, wilderness and other values of the Area by minimizing disturbance to or degradation of these values, including disturbance to natural features and fauna and flora, and by minimizing the cumulative environmental impacts of human activities;
- Prevent the unintended introduction of species not native to the Area, and minimize as far as practicable the unintended transfer of native species within the Area;
- Minimize the footprint of all facilities and scientific experiments established in the Area, including the proliferation of field camps;
- Minimize any physical disturbance, contamination and wastes produced within the Area, and take all practical steps to contain, treat, remove or remediate these whether produced in the course of normal activities or by accident;
- Promote use of energy systems and modes of transport within the Area that have the least environmental impact, and minimize as far as practicable the use of fossil fuels for the conduct of activities within the Area;
- Improve the understanding of natural processes and human impacts in the Area, including through the conduct of monitoring programs; and
- Encourage communication and co-operation 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 convene as required, and at least annually, a McMurdo Dry Valleys Management Group (hereafter the Management Group) to oversee coordination of activities in the Area, including to:
    - facilitate and ensure effective communication among those working in or visiting the Area;
    - provide a forum to resolve any actual or potential conflicts in use;
    - help minimize the duplication of activities;
    - maintain a record of activities and, where practical, impacts in the Area;
    - develop strategies to detect and address cumulative impacts;
    - disseminate information on the Area, in particular on the activities occurring and the management measures that apply within the Area, including through maintaining this information electronically at http://www.mcmurdodryvalleys.aq/;
    - review past, existing, and future activities and evaluate the effectiveness of management measures; and
    - make recommendations on the implementation of this Management Plan.
- National Programs operating within the Area shall maintain copies of the current version of the management plan and supporting documentation in appropriate stations and research hut facilities and make these available to all persons in the Area, as well as electronically at http://www.mcmurdodryvalleys.aq/;
- National Programs operating within the Area and tour operators visiting should ensure that their personnel (including staff, crew, passengers, scientists and any other visitors) are briefed on, and are aware of, the requirements of this

Management Plan, and in particular the *General Environmental Guidelines* (Appendix A) that applies within the Area;

- Tour operators and any other group or person responsible for planning and / or conducting non-governmental activities within the Area should coordinate their activities with National Programs operating in the Area in advance to ensure they do not pose risks to the values of the Area and that they comply with the requirements of the Management Plan;
- National Programs operating within the Area should seek to develop best practices with a view to achieving the objectives of the Management Plan, and to exchange freely such knowledge and information;
- Signs and / or markers should be erected where necessary and appropriate to show the location or boundaries of zones, research sites, landing sites or campsites within the Area. Signs and markers 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 evaluate whether the Management Plan is effective and to ensure management measures are adequate. The Management Plan, Code of Conduct and Guidelines shall be revised and updated as necessary; and
- National Programs operating within the Area shall take such steps as are necessary and practical to ensure the requirements of the Management Plan are observed.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

Table 1: List of maps included in the Management Plan

Map	Title	Source Scale	Estimated Error (+/- m)
Overviews			
Map 1	Overview-ASMA No.2 McMurdo Dry Valleys: boundary and zones	1:900,000	200
Map 2	Overview-Central Dry Valleys	1:400,000	200
Facilities Zones			
Map 3	Explorers Cove, New Harbor	1:25,000	2
Inset:	New Harbor Camp Facilities Zone	1:3000	2
Map 4	Lake Fryxell – Commonwealth Glacier	1:25,000	2
Inset:	F-6 Camp Facilities Zone	1:3000	2
Map 5	Lake Fryxell – Canada Glacier	1:25,000	2
Inset:	Lake Fryxell Camp Facilities Zone	1:3000	2
Map 6	Lake Hoare, Canada Glacier	1:25,000	2
Map 7	Lake Hoare Camp Facilities Zone	1:3000	2
Map 8	Lake Bonney, Taylor Valley	1:25,000	2
Inset:	Lake Bonney Camp Facilities Zone	1:3000	2
Map 9	Mount Newall, Asgard Range	1:25,000	50
Inset:	Mount Newall Radio Repeater Facilities Zone	1:3000	2
Map 10	Marble Point, McMurdo Sound	1:35,000	5
Inset:	Marble Point Refueling Station Facilities Zone	1:5000	2
Map 11	Lower Wright Valley	1:25,000	50
Inset:	Lower Wright Hut Facilities Zone	1:3000	2
Map 12	Lake Vanda, Wright Valley	1:25,000	50
Inset 1:	Lake Vanda Hut Facilities Zone	1:3000	2
Inset 2:	Bull Pass Hut Facilities Zone	1:3000	2
Map 13	Cape Roberts, Granite Harbor	1:10,000	10
Inset:	Cape Roberts Hut Facilities Zone	1:3000	10
Scientific Zones			
Map 14	Explorers Cove Scientific Zone	1:3000	2
Map 15	Boulder Pavement, Wright Valley	1:30,000	50
Inset:	Boulder Pavement Scientific Zone	1:10,000	50
Restricted Zones			
Map 16	Trough Lake Catchment Restricted Zone	1:70,000	10
Map 17	Mount Feather – Beacon Valley	1:130,000	50
Inset:	Mount Feather Sirius Deposit Restricted Zone	1:25,000	50
Map 18	Don Juan Pond, Wright Valley	1:50,000	50
Inset:	Don Juan Pond Restricted Zone	1:12,500	50
Map 19	Argo Gully, Wright Valley	1:30,000	50
Inset:	Argo Gully Restricted Zone	1:3000	15
Map 20	Prospect Mesa, Wright Valley	1:30,000	50
Inset:	Prospect Mesa Restricted Zone	1:5000	50
Map 21	Hart Glacier, Wright Valley	1:25,000	50
Inset:	Hart Ash Deposit Restricted Zone	1:3000	50

Map	Title	Source Scale	Estimated Error (+/- m)
Map 22	Victoria Valley Sand Dunes Restricted Zone	1:50,000	50
Map 23	Battleship Promontory Restricted Zone	1:50,000	50
Visitor Zones			
Map 24	Taylor Valley, Lake Fryxell	1:25,000	2
Inset:	Taylor Valley Visitor Zone	1:5000	2

6. Description of the Area

The McMurdo Dry Valleys are located in southern Victoria Land along the western coast of McMurdo Sound, southern Ross Sea, at approximately 77°30'S, 162°00'E. An area of approximately 17,500 km^2 is designated as an Antarctic Specially Managed Area (hereafter referred to as the 'Area') to manage human activities in the region for the protection of scientific, environmental, ecological, historic, aesthetic and wilderness values.

Based on the Environmental Domains Analysis for Antarctica (Resolution 3(2008)) the McMurdo Dry Valleys are located within Environment S – McMurdo – South Victoria Land geologic**.**

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

All geographic coordinates in this Management Plan are given in degrees and decimal minutes (dd mm.mm) format.

The Area boundaries have been defined primarily on the basis of the hydrological catchments in the McMurdo Dry Valleys, including all of the ice-free ground and adjacent areas within these catchments, all of the Convoy Range in the north, and bounded by the Koettlitz Glacier in the south (Map 1). Offshore islands, except Tripp Island in the north and Heald Island in the south, are not included within the Area. Proceeding clockwise from the northeast, the boundary of the Area is defined as follows:

From the northeastern extremity of Tripp Island (76°38.09'S, 162°42.90'E) the boundary extends southward following the coastline at the mean low tide level to DeMaster Point (situated east of Marshall Valley at 78°04.20'S, 164°25.43'E), a distance of approximately 170 km. The boundary thence follows the northwestern margin of the Koettlitz Glacier in a southwesterly direction for approximately 25 km to Walcott Bay and Trough Lake, including within the Area all of the streams and lakes along the glacier margin (Map 16). The boundary thence follows the approximate southern grounding line of the Koettlitz Glacier margin in Walcott Bay, extending east towards The Bulwark and encompassing all of Trough Lake. The boundary thence continues east following Bulwark Stream for approximately 1.5 km to the northern extremity of The Bulwark. The boundary thence extends 3 km in a straight line northeast to the northwestern coastline of Heald Island, following around the northern coastline to the eastern extremity of the island at 78°15.00'S, 163°57.80'E.

The boundary extends from Heald Island approximately 14.8 km southwest to the summit of The Pyramid (854 m) (78°20.64'S, 163°29.95'E). The boundary thence continues southwest approximately 13.3 km to the foot of Highway Ridge

(78°23.97'S, 162°58.57'E), from where it follows up the ridgeline in a northwesterly direction approximately 3.8 km to the summit of Shark Fin (2242 m) (78°22.11'S, 162°54.66'E). The boundary extends from Shark Fin northwest approximately 6.7 km to the summit of Mount Kempe (3004 m) (78°19.35'S, 162°43.18'E). The boundary continues northwest in a straight line from the summit of Mount Kempe approximately 83 km to the summit of Mount Wisneski (2320 m) (77°57.65'S, 159°33.73'E), which is the most southerly peak of the Lashley Mountains.

From Mount Wisneski, the boundary extends northwards for approximately 8.7 km to Mount Crean (2550 m) (77°53.00'S, 159°30.66'E), the highest peak in the Lashley Mountains. The boundary continues 5.6 km northward to the summit of Mount Koger (2450 m) (77°50.05'S, 159°33.09'E), the most northerly peak in the Lashley Mountains.

The boundary thence extends northeast approximately 15.3 km to Depot Nunatak (1980 m) (77°44.88'S, 160°03.19'E), and thence northwest approximately 19.6 km to the western extremity of the ice-free ground at Horseshoe Mountain (77°34.52'S, 159°53.72'E). The boundary continues north approximately 40 km to the summit of Mount DeWitt (2190 m) (77°13.05'S, 159°50.30'E), thence extends northwest approximately 38.4 km to the summit of Carapace Nunatak (2321 m) (76°53.31'S, 159°23.76'E), and continues a further 39 km north to the summit of Battlements Nunatak (2128 m) (76°32.27'S, 159°21.41'E).

The boundary extends east from Battlements Nunatak approximately 51 km to the summit of Mount Douglas (1750 m) (76°31.25'S, 161°18.64'E), and thence approximately 18 km in a southeasterly direction to the summit of Mount Endeavour (1870 m) (76°32.49'S, 161°59.97'E). The boundary extends southeast from Mount Endeavour approximately 21.3 km to the northeastern extremity of Tripp Island.

The principal basis for the coordinates given above is the USGS / LINZ 1:50,000 digital base map prepared for the McMurdo Dry Valleys, which has an estimated maximum error of +/-50 m. Because this map does not extend to cover the western boundary, coordinates in these areas are from the USGS 1:250,000 map, with an estimated maximum error of +/- 200 m. Accurate mapping with a maximum error of +/- 2 m is available for a limited number of sites within the Area (see Table 1), mostly in the Taylor Valley, and accurate GPS coordinates are available to describe only parts of the boundaries. The 1:50,000 series was selected as the primary map base for boundary coordinates to ensure that these are given using a map datum that is defined to a consistent standard over most of the Area. For these reasons, GPS coordinates for the boundaries are likely to differ from the coordinates given above by up to 50 m, or in the west by up to ~200 m.

6(ii) Restricted and managed zones within the Area

This Management Plan establishes four types of zones within the Area: Facilities, Scientific, Restricted and Visitor. The management objectives of the different types of zones are set out in Table 2. Maps 1 and 2 show the location of the different types of zones, and Maps 3-24 (which appear in the relevant appendices) show each zone in its context of surrounding geography and the detailed features or infrastructure present at each site (usually shown within an inset). A new zone or zone type may be considered by the Management Group as the need arises, and those no longer needed may be delisted. Zoning updates should be given particular consideration at the time of Management Plan reviews.

Table 2: Management Zones designated within the Area and their specific objectives.

Management Zones	Specific Zone Objectives	Plan Appendix
Facilities Zone	To ensure that science support facilities and related human activities within the Area are contained and managed within designated areas.	C
Scientific Zone	To ensure those planning science or logistics within the Area, and all visitors to the Area, are aware of sites of current or long-term scientific investigation that may be sensitive to disturbance or have sensitive scientific equipment installed, so these may be taken into account during the planning and conduct of activities within the Area.	D
Restricted Zone	To restrict access into a particular part of the Area and/or activities within it for a range of reasons, e.g. owing to special scientific or ecological values, because of sensitivity, presence of hazards, or to restrict emissions or constructions at a particular site. Access into Restricted Zones should normally be for compelling reasons that cannot be served elsewhere within the Area.	E
Visitor Zone	To provide a means of managing the activities of visitors, including program personnel and/or tourists, so their impacts may be contained and, as appropriate, monitored and managed.	F

The overall policies applying within the zones are outlined in the sections below, while site- specific guidelines for the conduct of activities at each zone are found in Appendices D to F.

Facilities Zones

Facilities Zones have been established to contain temporary and semi-permanent facilities within pre-defined areas and thereby control their distribution and footprint. Facilities Zones may be areas where human presence is intended to be semi-permanent or for a defined period of time in which significant activity is occurring. They may also be areas where human presence is expected to have regular occupation and/or repetitive activity such as field camps. The establishment of new Facilities Zones should be designed to minimize the footprint of facilities and associated materials.

The following provisions should be observed for Facilities Zones:

- Substantial and repeatedly used facilities, camping sites, helicopter pads, and materials / supplies stores should be located within the boundaries of the Facilities Zones;

- Existing infrastructure, camping and storage sites within the Facilities Zones should be re-used where practicable;

- Provisions for fuel storage and handling within the Facilities Zones should take account of the requirements set out in the *General Environmental Guidelines for the McMurdo Dry Valleys* (Appendix A) by providing secondary containment, appropriate equipment for refilling, decanting or servicing operations, secure storage and appropriate spill response materials;

- Alternative energy sources and energy efficiency should be considered in the planning and maintenance of activities within the Facilities Zones;

- Waste minimization and management should be considered in the planning and maintenance of activities within the Facilities Zone and all waste should be stored securely and then be removed; and

- Contingency plans for emergencies should be developed as appropriate, to take into account the special needs of specific Facilities Zones.

Facilities Zones should not be located within Restricted Zones or Antarctic Specially Protected Areas (ASPAs), or at sites that could otherwise jeopardize the values of the Area.

Facilities Zones are listed in Appendix C with locations, boundary and infrastructure descriptions, designated landing sites, and maps.

Scientific Zones

The Scientific Zones listed in Appendix D have been designated to raise visitor awareness of specific sites of current and on-going scientific research in order to help ensure important scientific values or experiments are not disturbed. There are no general access restrictions that apply within Scientific Zones, although visitors should familiarize themselves with the provisions set out in Appendix D prior to visiting or planning work at these zones.

Restricted Zones

Restricted Zones have been designated at sites of high scientific value and which are particularly sensitive to human disturbance. Restricted Zones are outlined in Appendix E with a brief description of the boundaries, site features, impacts, and any specific guidelines for access and activities. Access to Restricted Zones should be for compelling reasons that cannot be served elsewhere within the Area, and any additional measures to ensure their protection as specified in Appendix E should be strictly observed when visits are made.

Visitor Zones

The Taylor Valley Visitor Zone is designated in order to manage visits by tourists or non- governmental expeditions to the Area within a defined area where the exceptional aesthetic and wilderness values of the McMurdo Dry Valleys can be appreciated at the same time as ensuring that potential impacts by tourist visits on other values present within the Area, particularly scientific and environmental values, are minimized.

The Taylor Valley Visitor Zone is located in the Taylor Valley near the Canada

Glacier terminus (Map 24), at a site where safe and relatively easy access and movement can be reasonably assured with minimal impact to science activities or the environment. This site was selected following consultation among the National Programs operating in the Area, tour operators and International Association of Antarctic Tour Operators (IAATO). Specific guidelines for the conduct of activities within the Visitor Zone are included in Appendix F as the Antarctic Treaty Visitor Site Guide: Taylor Valley, Southern Victoria Land, Ross Sea.

6(iii) Structures within and near the Area

The main structures within the Area are located in the Facilities Zones designated within the central McMurdo Dry Valleys (Maps 2 and 13). The Taylor Valley has five semi-permanent field camps (Maps 3-8), and three semi-permanent field camps are present in the Wright Valley (Maps 11 and 12). The most substantial structures are located at the Marble Point Refueling Facility (Map 10), and buildings are also located at Mount Newall (Map 9) and at Cape Roberts (Map 13).

There are a number of sites of scientific and operational instrumentation located throughout the Area outside of Facilities Zones, the most substantial of which are listed in Table 3. Other structures not listed include several Automatic Weather Stations (AWS), radio repeater sites (Mount Cerverus, Mount JJ Thompson), stream weirs and glacier mass balance devices.

Table 3: Structures within the Area outside of Facilities Zones.

Name	**MP**[1]	**Location**[2]	**Location Description**	**Structures**
Mount Coates Radio Repeater	US	77° 47.16'S 161° 58.23'E	Near summit of Mount Coates (1894 m), Kukri Hills. ~14 km from Lake Bonney Facilities Zone, Taylor Valley.	Radio repeater and associated equipment contained in two orange plastic cases. There is one antenna at the site.
Hjorth Hill Radio Repeater	US	77° 30.97'S 163° 37.22'E	Near summit of Hjorth Hill (790 m) ~ 6 km from Cape Bernacchi, northeast of Explorers Cove and the Taylor	Radio repeater and associated equipment at small hut (2.4m x 2.6m). The antenna is installed on the hut.

Name	**MP**[1]	**Location**[2]	**Location Description**	**Structures**
			Valley.	

1. Maintaining Party
2. Coordinates approximate

There are also several sites in the McMurdo Dry Valleys where semi-permanent camps have been decommissioned and removed (Table 4).

Table 4: Known sites of decommissioned semi-permanent camps in the Area.

Decommissioned site	**RP**[1]	**Geographic coordinates**[2]
Asgard Hut	NZ	77° 35′S, 161° 36′E
Brownworth Hut	NZ	77° 27′S, 162° 53′E
Bull Pass Hut (US structures at Bull Pass Hut Facilities Zone remain)	NZ	77° 31.01′S, 161° 51.08′E
Meserve Glacier Camp	US	77° 30.8′S, 162° 17′E
Miers Valley Hut	NZ	78° 08′S, 163° 50′E
Old Lake Bonney Hut	US	77° 42.2′S, 162° 30.6′E
Lake Fryxell Hut	NZ	77° 37′S, 163° 03′E
Vanda Station (some structures relocated to Lake Vanda Hut Facilities Zone)	NZ	77° 31.6′S, 161° 40.1′E
Commonwealth Glacier Camp	NZ	77° 34.94′S, 163° 35.81′E
Old New Harbor Camp	US	77° 34.5′S, 163° 29.9′E
Odell Glacier Camp	US	76° 40.86′S, 159° 54.8′E

1. Responsible Party
2. Coordinates approximate

Eight sites within the Area were drilled, several with multiple boreholes, as a part of the McMurdo Dry Valley Drilling Project (DVDP) carried out between 1971 and 1975. Drill sites for the project are located at Lake Vanda (DVDP 4) (drilled 85.8 m below ice surface), Don Juan Pond (DVDP 5, 3.4 m; DVDP 13, 75 m),Wright Valley North Fork basin (DVDP 14, 78 m), Lake Vida (DVDP 6, 305.8 m; permanently capped and closed by the US Program in 2006-07 and now several meters below the lake surface), Lake Fryxell (DVDP 7, 11.1 m), New Harbor (DVDP 8, 157.5 m; DVDP 9, 38.3 m; DVDP 10, 187 m), Commonwealth Glacier (DVDP 11, 328 m), and Lake Hoare (DVDP 12, 185 m).

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

Entry to an Antarctic Specially Protected Area (ASPA) is prohibited unless a permit for entry has been issued by a national authority. Four ASPAs are designated within the Area (Maps 1 and 2):

ASPA No. 123 Barwick and BalhamValleys, Southern Victoria Land (Maps 1, 2);

ASPA No. 131 Canada Glacier, Lake Fryxell, Taylor Valley, Victoria Land (Maps 2, 5, 24); ASPA No. 138 Linnaeus Terrace, Asgard Range, Victoria Land (Maps 2, 18);

ASPA No. 154 Botany Bay, Cape Geology, Victoria Land (Map 1).

7. 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.

In addition, further guidance is provided in the *General Environmental Guidelines for the McMurdo Dry Valleys* (Appendix A), *Environmental Guidelines for Scientific Research*

(Appendix B), and in the List of Facilities Zone (Appendix C), Scientific Zones (Appendix D), Restricted Zones (Appendix E), and the Visitor Zone (Appendix F). All visitors to the McMurdo Dry Valleys should be aware of the *General Environmental Guidelines* in Appendix A, as a minimum, before entering the Area.

7(i) Access to and movement within the Area

The Area is large and has numerous potential access points. Access to the Area is normally made by helicopter from Ross Island, or over sea ice via New Harbor or Marble Point. Where practical, designated helicopter landing sites should be used: these are listed and shown on maps in Appendices C-F describing the management zones. Designated landing sites within ASPAs are defined and mapped in their relevant Management Plans. Where designated landing sites are unavailable, previously used landing sites should be selected when possible. Where it is expected that helicopters will be used for repetitive access to a particular location, consideration should be given to establishing a designated site for landing. Such suggestions should be referred to the Management Group. Overflight restrictions apply over ASPA No. 123 in the Barwick and Balham Valleys, ASPA No. 131 at Canada Glacier, ASPA No. 154 at Botany Bay, and over the Don Juan Pond and Victoria Valley Sand Dunes Restricted Zones.

All pedestrian access routes and movement within the Area should be undertaken so as to minimize disturbance to the soil and vegetated surfaces. There are a number of walking routes in the Area. In the Taylor Valley, these include routes between F-6 Camp and Lake Fryxell Camp, F-6 Camp and Lake Hoare Camp, Lake Hoare Camp and Lake Fryxell Camp, and Lake Hoare Camp and Lake Bonney Camp. There is a route from the edge of Lake Fryxell to the weir at Canada Stream. There are also routes outside the immediate vicinity of F-6, Lake Fryxell, Lake Bonney, and Lake Hoare camps. A route is defined to manage pedestrian movements within the Taylor Valley Visitor Zone (Appendix F). In the Wright Valley, there is a route between the Vanda Weir and the Vanda Huts. A loosely defined route exists along the Onyx River between Lake Vanda and Lake Brownworth, and tracks from overland vehicles moving along this route in the 1970's remain in evidence.

In some places where there has been sustained activity, foot tracks have developed in loose moraine soils, forming well-defined routes such as may be found near Facilities Zones and at field sites such as along the northern margin of the lower Taylor Glacier. In such cases, pedestrians should by preference use the existing tracks, unless it becomes evident that to do so would be either unsafe or result in greater impact than following an alternative route.

The use of vehicles within the Area should be restricted to lake ice or sea ice except where specifically authorized to operate on land at Marble Point (Map 11), New Harbor (Maps 3 and 14), and Cape Roberts (Map 13), where vehicles should use existing vehicle tracks.

Access into Restricted Zones should be avoided unless required for compelling reasons, and should be coordinated with National Programs operating within the Area.

Access by tourists and non-governmental expeditions should only be made to the Taylor Valley Visitor Zone in accordance with the guidelines adopted in Appendix F, and shall be coordinated in advance with National Programs operating within the Area.

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

Activities which may be conducted in the area include scientific research; operations in support of science; media, arts, education or other official national program visitors; management activities including maintenance or removal of facilities; and tourism visits within the Visitor Zone, where these activities do not jeopardize the values of the Area.

All activities in the McMurdo Dry Valleys should be conducted in such a manner as to minimize impacts on the environment. Alternative energy sources (e.g. solar, wind, fuel cells) should be used wherever practicable in order to minimize fossil fuel usage. Specific guidelines for the conduct of activities in the Area are provided in Appendices A-E.

Tourism and non-governmental expeditions should additionally ensure their activities have minimal impact on the scientific activities being conducted within the Area, and are carried out in accordance with the Antarctic Treaty Visitor Site Guide: Taylor Valley (Appendix F).

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

Care should be exercised when locating and establishing installations to minimize their impact on the environment. Consideration should be given to maximizing the use of existing facilities or sharing those of other programs before new facilities are constructed, and the footprint of all installations should be kept to the minimum practicable. Past installation sites should be re-used where possible and appropriate. In general, permanent or semi-permanent structures should not be installed outside of Facilities Zones, unless they are small in size and pose no significant threat to the values of the Area (e.g. an Automatic Weather Station (AWS) or a small solar- and battery-powered radio repeater with minimal associated infrastructure).

All installations should be maintained while operational and removed when no longer necessary. Installations should be identified by the National Program responsible, name of the principal investigator and year of installation. The types of installations and their coordinates should be recorded, with information provided to the responsible National Program and then shared by the Management Group.

National Programs should exchange information though the Management Group on proposals for new installations in advance of their construction, with the aim of coordinating activities and minimizing the need for new or potentially disruptive or duplicative installations.

7(iv) Field camps

In the McMurdo Dry Valleys, a field camp is considered to be a small temporary camp set up for research in a field season, and generally may comprise a number of tents and include temporary shelters for laboratory work or cooking. Field camps should generally only be established when the work they are intended to support cannot be accomplished practically by access from within one of the Facilities Zones.

Care should be exercised when locating and establishing field camps to minimize their impact on the environment. Consideration should be given to maximizing the use of past or existing field camp sites, or sharing those of other programs before

new field camps are established, and the footprint of all field camps should be kept to the minimum practicable.

All field camps should be maintained while operational and removed when no longer necessary. Special care should be taken to secure camp equipment from dispersal by wind.

The coordinates of field camp sites should be recorded, with information provided to the responsible National Program and then shared by the Management Group.

Designated field camp sites outside of Facilities Zones or other zones within the Area are listed in Table 5.

Table 5: Designated field camp sites outside of Facilities Zones or other zones within the Area.

Name	**MP**[1]	**Location**	**Location Description**	**Field camp description**
Blood Falls field camp site	US	77°43.24' S 162°16.29' E 1 helicopter landing site at above location	Northwestern shore of Lake Bonney ~100 m from the terminus of Taylor Glacier and Blood Falls.	Slopes extending ~100 m upslope above the lake shoreline and for ~200 m northeast from Lawson Creek to a permanent survey benchmark (TP02) ~20 m from the lake shore. Tent sites are marked by stone circles. The designated helicopter landing site is located close to a cluster of tent sites in the southwest part of the field camp site.

1. Maintaining Party

7(v) 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 permit issued under Article 3 of Annex II to the Protocol by the appropriate national authority specifically for that purpose. Where animal taking or harmful interference is involved, this should, as a minimum standard, be in accordance with the Scientific Committee on Antarctic Research (SCAR) Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica.

To help maintain the ecological and scientific values of the Area visitors should take special precautions against the introduction of non-native species. Of particular concern are introductions from other Antarctic sites, including stations, or from regions outside Antarctica. Visitors should ensure that sampling equipment and markers brought into the Area are clean. Visitors should thoroughly clean all equipment (including backpacks, carry-bags and tents), clothing and footwear before entering the Area. Visitors should also be aware of the risk of transfer of species from one part of the Dry Valleys to another, which may also affect the values of the Area. In particular, visitors should aim to minimize the movement of soils from one site to another within the Dry Valleys

by cleaning their equipment (e.g. camping and sampling equipment, vehicles, footwear) before transfer to another site.

7(vi) Collection or removal of material found in the Area

Material not covered by 7(v) above should only be collected or removed from the Area for scientific and associated educational purposes or essential management purposes and should be limited to the minimum necessary for those needs. Any meteorites taken are to be collected and curated according to accepted scientific standards, and made available for scientific purposes. Material of human origin likely to compromise the values of the Area should 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.

7(vii) Waste management

All materials taken into the Area should, to the maximum extent practicable, be collected and removed from the Area when no longer required. Water used for any human purposes, including scientific purposes, should be removed and/or treated in a gray water evaporator (and residuals removed). All human wastes should be removed from the Area, including residues from incineration.

In accordance with Article 4 of Annex III to the Protocol, wastes shall not be disposed of onto ice-free areas, into freshwater systems or onto snow or in deep ice pits in ice which terminates in ice free areas or in areas of high ablation.

7(viii) Requirements for reports

Reports of activities in the Area should be maintained by the Management Group to the maximum extent practicable, and made available to all Parties.

In accordance with Article 10 of Annex V to the Protocol, arrangements shall 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 incidents in the Area, and submit these data in accordance with the procedures for reporting on expeditions adopted by the Antarctic Treaty Parties and IAATO.

8. Provisions for the exchange of information in advance of proposed activities

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 Council of Managers of National Antarctic Programs (COMNAP), Parties operating in the Area should exchange information through the Management Group.

9. Supporting documentation

Electronic information

National Programs operating within the Area have established a website for the purpose of providing additional information and supporting documentation on the McMurdo Dry Valleys, including up-to-date management documents, protected area management plans, maps, descriptions and policies. This information may be

accessed at http://www.mcmurdodryvalleys.aq

Management Plans

Management Plan for Antarctic Specially Protected Area No. 123 Barwick and Balham Valleys, South Victoria Land.

Management Plan for Antarctic Specially Protected Area No. 131 Canada Glacier, Taylor Valley, Victoria Land.

Management Plan for Antarctic Specially Protected Area No. 138 Linnaeus Terrace, Asgard Range, Victoria Land.

Management Plan for Antarctic Specially Protected Area No. 154 Botany Bay, Cape Geology, Victoria Land.

APPENDIX A:

General Environmental Guidelines for the McMurdo Dry Valleys

Why are the McMurdo Dry Valleys considered to be so important? The McMurdo Dry Valleys ecosystem contains geological and biological features that date back thousands to millions of years. Many of these ancient features could be easily and irreversibly damaged by human actions. Unusual communities of microscopic life forms, low biodiversity, simple food webs with limited trophic competition, severe temperature stress, aridity and nutrient limitations are other characteristics that make the McMurdo Dry Valleys unique. This ancient desert landscape and its biological communities have very little natural ability to recover from disturbance. Research in such systems must aim to minimize impacts to protect the environment for future generations.

Before you travel to the Area:

- Ensure that your planned activities follow the requirements of the Code of Conduct in the Management Plan, the Environmental Guidelines in Appendices A and B, and any specific guidelines that apply within management zones (Appendices C-F).
- Plan all activities such as travel, camp set up, fuel handling and secondary containment, and waste management (and minimisation), with the aim of minimizing environmental impacts. Individuals or groups should ensure sufficient equipment and survival gear is brought into the Area or available on-site for safety.
- To help prevent the unintended introduction of non-native species to the McMurdo Dry Valleys, thoroughly clean all equipment (including backpacks, carry-bags and tents), clothing and footwear before travel to the Area.

Travel and activities within the Area:

- To reduce the risk of transfer of species from one part of the Dry Valleys to another, clean equipment, vehicles, clothing and footwear before travel to another site.
- Be aware of the site-specific guidelines in Appendices C-F, and avoid Restricted Zones unless access is required for a compelling reason that cannot be served elsewhere within the Area.
- Stream crossings should be avoided; when it is necessary to cross streams, designated crossing points should be used whenever possible.
- Avoid swimming or diving in lakes, unless authorized by a National Program for scientific purposes.
- Avoid disturbing mummified seals or birds.
- Cairns should not be built in the Area unless authorized by a National Program.
- Do not leave any travel equipment behind (e.g. ice screws, pitons).

Pedestrian travel:

- Some biological communities and geological formations are especially fragile, even when concealed by snow; be alert and avoid such features when travelling within

the Area. For example, avoid walking on vegetated areas, in streams or on stream bank sides, on dunes, through long-term soil experiments, on raised delta surfaces,
on delicate rock formations, or over other sensitive features.

- Where practicable, keep to designated or established tracks. Please refer to site- specific guidelines for Zones (Appendices C-F) for further guidance.

Vehicle use:

- Vehicle use should be restricted to ice surfaces unless specifically authorized to do otherwise, or at Marble Point, Cape Roberts, and New Harbor.
- Vehicles should keep to established tracks wherever these are present.
- Vehicles should always be parked over a secondary containment unit or a drip tray.
- Vehicles should be used on lake ice only when essential, and they should be parked on permanent lake ice rather than moat ice during the period of summer melt.

Helicopter use:

- Designated helicopter pads should be used for helicopter landings where available. Otherwise, known previous landing sites should be used when possible. Designated helicopter pads are listed in Appendices C-F and are shown on Maps 3-24.
- Designated helicopter pads should be marked so they are clearly visible from the air and markers used should be well-secured and durable.
- Helicopter landings on lakes should be avoided as far as practicable.
- Helicopter operations should not use smoke bombs, except for essential safety purposes.
- Care should be taken to ensure that helicopter sling loads are properly secured. Trained personnel should supervise these operations.

Field camps: location and set up

- Before new campsites are established, use designated, former or existing campsites, or share those of other programs to the maximum extent practicable.
- Minimize the footprint of all campsites.
- Campsites should be located as far as practical from lakeshores, streambeds, and long- term experiments to avoid damage or contamination. Do not camp in streambeds, even if they are dry.
- Rocks moved for new campsites or other activities in areas not previously disturbed should be replaced after the activity in their original footprint, if possible, and at a minimum should be placed with the salt-encrusted side faced-down. If the campsite is intended for multi-year activity additional guidance should be sought from the supporting National Program.
- The location of field camps should be recorded and submitted to the supporting National Program.
- Ensure that equipment and supplies are properly secured at all times to avoid dispersion by high winds.

Energy use:

- As far as practicable use energy systems and modes of travel within the Area that have the least environmental impact and minimize the use of fossil fuels.

Use of Materials:

- Everything taken into the Area should be removed and returned to the appropriate National Program station for proper handling.
- Activities that could result in the dispersal of foreign materials should be avoided (e.g. do not use spray paint to mark rocks) or should be conducted inside a hut or tent (e.g. all cutting, sawing and unpacking).
- Explosives should not be used within the Area, unless approved by a National Program for use in support of essential scientific or management purposes.
- Where possible, ensure that nothing is left frozen into glaciers, snow or lake ice that may ablate out and cause later contamination.

Fuel and chemicals:

- Avoid all fuel and chemical spills as far as possible.
- Steps should be taken to prevent the accidental release of chemicals including laboratory reagents and isotopes (stable or radioactive). Chemicals of all kinds should be dispensed over drip trays or other forms of containment. When permitted to use radioisotopes, safety and handling instructions should be followed precisely.
- When using chemicals or fuels, ensure that spill kits and secondary containment units appropriate to the volume of the substance are available. Those working with chemicals and fuels should be familiar with their use and with appropriate spill response procedures.
- Chemical and fuel containers should be securely positioned and capped, particularly on lake ice.
- All fuel drums should be stored with secondary containment.
- Fuel cans with spouts should be used when refueling generators.
- Generators and vehicles should be refueled over drip trays with absorbent spill pads.
- Vehicle oil should not be changed except over a drip tray.

Waste and spills:

- Water used for ANY human purpose should be removed and/or treated in a gray water evaporator (and residuals removed).
- All human waste should be collected and removed.
- Individuals or groups should always carry proper containers for human waste and gray water so that they may be properly and safely transported for disposal.
- Clean up any spills and/or releases to the maximum extent possible and report the location(s) including coordinates, to the appropriate National Program.

APPENDIX B:

Environmental Guidelines for Scientific Research

Scientific activities in the McMurdo Dry Valleys include research on climate, glaciers, streams, lakes, soils, and local geology and geomorphology. The following environmental guidelines for scientific research seek to reduce the impact of research activities specific to key environments in the Area. These guidelines are based on the report McMurdo Dry Valley Lakes: Impacts of Research Activities (Wharton, R.A. and Doran, P.T., 1998), the product of an international workshop of scientists conducting research in the Area.

General requirements

- Do not displace or collect specimens of any kind, including fossils, except under permit for scientific and associated educational purposes.
- The location of sampling (including biological transects), drilling and soil excavation sites, and of any installations (e.g. stream control structures and instrumentation) should be recorded, and the coordinates submitted to the supporting National Program.
- Installations and equipment should pose minimal risk of harmful emissions to the environment (e.g. use gel cells or other non-spill batteries).
- Ensure all installations, materials and equipment are securely stored when not in use and are removed when no longer required.
- Any markers installed should be durable and fastened securely.
- Metadata records describing data collected should be submitted to the supporting National Program and included within the Antarctic Master Directory.

Sampling and experimental sites

- All scientific equipment, particularly equipment used for sampling and drilling, should be clean before being brought into the Area, and cleaned before being transferred to other sites for re-use within the Area.
- Securely tether all sampling equipment where there is a reasonable risk that it could be irretrievably lost.
- Sample sizes of all biomass and non-biological materials should be limited to the minimum required for effective completion of the planned analyses and archiving.
- Sampling sites (e.g. in lake ice, on glaciers or in soils) should be kept clean.
- Minimize, and where possible avoid, the use of drilling fluids.
- Experimental or monitoring sites intended to be used for more than one season should be clearly identified by country, name of the principal investigator and year of installation.

Scientific installations

For scientific installations, including meteorological stations, geographic monuments, communication repeaters, lake monitoring systems, and level recorders:

- Installations should be sited carefully, should be easily retrievable when required, and properly secured at all times to avoid dispersal by high winds.

- All installations in the Area should be clearly identified by country, name of the principal investigator and year of installation.
- Installations should be as energy-efficient as possible and use renewable energy sources wherever practicable.
- Installations should pose minimal risk of harmful emissions to the environment (e.g. use gel cells or other non-spill batteries).
- Installations should be periodically evaluated for deterioration, usefulness, and potential removal. The frequency of evaluation may depend on installation characteristics and the site, although in general this is likely to be needed at least once every 3-5 years.
- Installations should be designed and constructed so they can be decommissioned and removed at the end of their use.

Scientific equipment, fuels and materials

- Minimize the use of fossil-fuel-powered equipment; use solar-powered and hand devices when possible.
- Properly tune generators to minimize emissions and use only when necessary. Always place generators and fuel cans in drip pans.
- Carefully manage fuels, glycol, chemical waste, and all other liquids to avoid spills.
- Always refuel using drip pans.
- Ensure spill kits are always available on-site where liquid fuels or wastes (including chemicals and water extracted from lakes) are present.
- Materials liable to shatter at low temperatures, for example many polyethylene based plastics, should be avoided. Wooden and fabric components in semi-permanent structures should be avoided as these are subject to wind abrasion and occasional failure.

Streams

- Use flumes rather than weirs.
- To the extent practicable, use local materials to construct water measuring and control structures.
- Limit the number of tracer and manipulative experiments. Whenever possible, use modeling approaches to extend the application of experimental results to other streams and lake basins.
- Use only naturally occurring tracers and document tracer use.
- Design tracer experiments to limit the movement of tracers in lakes. The incremental flux from the experiment should be appropriately small in proportion to the average annual total flux for that solute from streams. Choose an experimental site with a long enough reach such that reactions will be completed by the end of the reach.
- Establish specific sites for biomass sampling and document geographic locations, sampling extent, and frequency.
- Develop and apply methods (e.g. spectral analysis) that do not rely on removal of samples for quantifying changes in biomass in streams.

Lakes

- Minimize the duration and extent to which structures are placed on the ice. When

placing structures on the ice near shore, place them on the perennial ice rather than the moat (the moat is highly susceptible to rapid melting). Document the geographic location of the placement of structures on the ice.

- Use barriers (e.g. drip pans) between equipment (e.g. motors, tools) and ice to minimize the potential for hydrocarbon introduction into the ice as well as the physical melting of the ice surface.
- Document the area and the extent to which lake ice has been excavated, taking geographic coordinates. Areas that have been used for sampling or accessing the lake should be reused to the greatest extent possible.
- Minimize the use of motorized vehicles. All-terrain vehicles with four-stroke engines are preferable to snowmobiles with two-stroke engines (less efficient combustion in two- stroke engines causes an increase in the release of hydrocarbons and particulates).
- Use extreme caution when driving motorized vehicles to avoid rolling the vehicle or breaking through the ice cover.
- Remove materials brought up from beneath the ice. Do not dump or deposit water and sediment samples on the lake ice.
- Reduce helicopter overflights after the ice surfaces begin to melt and keep landings on lakes to a minimum.
- Avoid storage of materials on the lake ice surface.
- Use separate samplers (e.g. water collectors, plankton nets) and instruments, if feasible, for each lake to avoid cross contamination. Samplers or instruments used in more than one lake should be thoroughly cleaned (sterilize if possible) prior to reuse in a different lake.
- Carefully manage gray water extracted from lakes to avoid spills.
- Consider laboratory-based alternatives to *in situ* experiments involving any radioisotope, stable isotope, or other tracer in view of the future integrity of the biological and chemical properties of the lakes. Complete preliminary calculations to ascertain the potential impact of isotope experiments. Document and record any introductions.
- Incorporate metal-free haul lines and sampling containers such as “go-flow” bottles into sampling protocols to minimize metal contamination of the lakes.
- Promote use of an environmentally friendly substitute for glycol for use in melting access holes (e.g. a biodegradable antifreeze).
- Minimize the amount of gray water waste by collecting the least volume of water and sediment needed for research purposes.
- Train individuals working on the lake ice to take steps to reduce the loss of equipment through ice holes.
- Provide adequate training for research divers and support teams so that impacts to the lake environment are minimized.
- Prior to conducting diving or ROV operations in a particular lake, consider previous diving history at the proposed research site, the proximity of other areas of interest, and the vulnerability of the water column and benthos to disturbance. These considerations should also be applied to other sampling and measuring activities.
- Assemble and maintain records of diving and ROV activities, including timing, intensity, and duration.
- Use technological developments (e.g. rebreather apparatus, push-pull systems) that mitigate the environmental impacts of diving.

Soils

- Minimize surface and subsurface disturbance to the maximum extent practicable
- Restore disturbed surfaces as close as possible to their natural state upon completion of the work. For larger-scale excavations (greater than 1 m^2), take photographs prior to breaking ground to provide a basis for restoration. Record the location of the remediated site.
- Place excavated soil on mats or groundsheets during soil sampling.
- Backfill all excavations to approximate original contour and replace desert pavement where possible. The desert pavement can be skimmed from the surface prior to digging and kept aside for replacement.
- Conduct thorough environmental assessment of proposed exogenous amendment experiments.
- Limit use of mechanical equipment (e.g. Cobra drills, soil augers).

Glaciers

- Minimize the use of liquid water (e.g. with hot water drills).
- Avoid the use of chemicals and chemical solutions on the ice.
- If stakes or other markers are placed on a glacier, use the minimum number of stakes required to meet research needs; where possible, label these with event number and project duration.
- Use electric chainsaws powered by a four-stroke generator whenever possible for large- scale sawing operations (less contamination than from two-stroke engines). Avoid the use of chainsaw blade lubricants when cutting cold ice.
- Upon completion of a research project, remove all materials – wood, metal, and sensors – embedded in the ice to minimize contamination.

APPENDIX C:

Guidelines for Facilities Zones

Facilities Zones include a designated area around the following facilities operated by National Programs in the Area:

- New Harbor Camp, Taylor Valley;
- F-6 Camp, Taylor Valley;
- Lake Fryxell Camp, Taylor Valley;
- Lake Hoare Camp, Taylor Valley;
- Lake Bonney Camp, Taylor Valley;
- Mount Newall Radio Repeater, Asgard Range;
- Marble Point Refueling Station, Marble Point;
- Lower Wright Camp, Wright Valley;
- Lake Vanda Hut, Wright Valley;
- Bull Pass Hut, Wright Valley;
- Cape Roberts Camp, Granite Harbor.

The locations, boundaries, helicopter landings sites, and infrastructure at Facilities Zones, together with an identification of the Maintaining Party are listed in Table C-1, which is followed by maps of the Facilities Zones and their local geographical context (Maps 3-13).

Table C-1: Description of Facilities Zones within the McMurdo Dry Valleys.

Facilities Zone	Map No.	Boundary Description	Boundary Coordinates	Helicopter Landing Site Coordinates	MP[1]	Structures in Zone
New Harbor Camp	3	The boundary goes from a point northwest of the generator shed (on the bank edge), southwest beyond the sling load area, east to a point south of the helicopter pad, northeast to a point east of the main Jamesways, northwest to a point north of the lab building, southwest to a point just north of the old bore hole, and southwest along the bank edge back to the point by the generator shed.	77° 34.66′S, 163° 31.05′E 77° 34.71′S, 163° 30.98′E 77° 34.70′S, 163° 31.19′E 77° 34.67′S, 163° 31.34′E 77° 34.63′S, 163° 31.19′E 77° 34.64′S, 163° 31.11′E	77° 34.692′S, 163° 31.165′E 1 helicopter landing pad plus sling load area.	US	Main building consists of two Jamesways connected by a wooden passageway, one 42 m^2 (448 sq. ft.) and the other 30 m^2 (320 sq. ft.). Adjacent to the main building are a 3 m^{2S} (32 sq. ft.) storage shed and a 1.5 m^2 (16 sq. ft.) outhouse. The camp also includes a 21 m^2 (224 sq. ft.) James ways that serves as a laboratory, an 8.9 m^2 (96 sq. ft.) generator shack, and a 1.5 m^2 (16 sq. ft.) diving equipment storage box. One survival cache box and one wind generator tower.
F-6 Camp	4	The boundary goes from a point southwest of the helicopter pad, northeast to a point just east of the emergency cache (survival box), north around the northern-easternmost tent site, west to a point northwest of the tent sites (by the lake), south around the stream weir, and southeast to the original point by the helicopter pad.	77° 36.53'S, 163° 15.32'E 77° 36.50'S, 163° 15.43'E 77° 36.46'S, 163° 15.46'E 77° 36.46'S, 163° 15.40'E 77° 36.46'S, 163° 15.21'E 77° 36.50'S, 163° 15.19'E	77° 6.514′S, 163° 15.343′E 1 helicopter landing pad.	US	A 42 m^2 (448 sq. ft.) main building with outhouse adjacent. Emergency cache.
Lake Fryxell Camp	5	The boundary follows the lake edge in the southeast corner to a point southwest of the helicopter pad, up to the small plateau below a hill, behind the farthest tent site in the northwest	77° 36.38'S, 163° 07.60'E 77° 36.40'S, 163° 07.37'E 77° 36.34'S, 163° 07.31'E	77° 36.383′S, 163° 07.430′E 2 helicopter landing pads plus sling load	US	A 62.7 m^2 (675 sq. ft.) Jamesway (main building), four 13.9 m^2 (150 sq. ft.) laboratories, and one 13.9 m^2 (150 sq. ft.) generator

Table C-1: Description of Facilities Zones within the McMurdo Dry Valleys.

Facilities Zone	Map No.	Boundary Description	Boundary Coordinates	Helicopter Landing Site Coordinates	MP[1]	Structures in Zone
		corner, east to the stream, southeast along the stream bank to the eastern most tent and south back to original point by the lake.	77° 36.34'S, 163° 07.26'E 77° 36.29'S, 163° 07.27'E 77° 36.29'S, 163° 07.51'E 77° 36.31'S, 163° 07.59'E 77° 36.38'S, 163° 07.60'E	area. Secondary pad is 32 m NW of the main pad.		building. Wind generator tower, solar panel and one outhouse. Emergency cache.
Lake Hoare Camp	6 & 7	The boundary goes from the rocky area southeast of the helicopter pads, north around the emergency cache, northeast to a rock northwest of the westernmost tent site, northeast to a point north of another tent site, northeast again to the northeastern most tent site, south along the stream/glacier to a point east of the old Lake Hoare facilities (shower and dive storage buildings), southwest to the end of the spit, northwest to the beach below the main building, and northwest to the original point by the helicopter pads.	77° 37.40'S, 162° 53.87'E 77° 37.39'S, 162° 53.86'E 77° 37.35'S, 162° 53.87'E 77° 37.31'S, 162° 53.96'E 77° 37.26'S, 162° 54.28'E 77° 37.26'S, 162° 54.35'E 77° 37.39'S, 162° 54.40'E 77° 37.47'S, 162° 54.34'E 77° 37.41'S, 162° 54.05'E	77° 373.72′S, 162° 53.989′E 2 helicopter landing pads plus sling load area. Secondary pad is 46 m SW of the main pad.	US	A 55.7 m^2 (600 sq. ft.) main building, three 13.9 m^2 (150 sq. ft.) labs, a generator building (96 sq. ft.), a tool shed (96 sq. ft.), and three outhouses: two 2.2 m^2 (24 sq. ft.) and one 1.7 m^2 (18 sq. ft.). Below the active camp are the old Lake Hoare Camp buildings, which are still in use. These include a 37 m^2 (400 sq. ft.) Jamesway used primarily for storage, a 6 m^2 (64 sq. ft.) generator shed, and a 7.5 m^2 (81 sq. ft.) old laboratory used as a shower room. Emergency cache.

Lake Bonney Camp	8	The boundary goes from a point west of the generator shed by the lake, southeast up to a boulder behind a tent site, northeast to a hill above a tent site, northeast to a point northeast of the easternmost tent site,	77° 42.96'S, 162° 27.37'E 77° 42.99'S, 162° 27.56'E 77° 42.97'S, 162° 27.79'E 77° 42.95'S, 162° 27.93'E	77° 42.95′S, 162° 27.65′E 1 helicopter landing pad.	US	A 55.7 m^2 (600 sq. ft.) Jamesway, a 2.2 m^2 (24 sq. ft.) outhouse, an 8.9 m^2 (96 sq. ft.) generator building, and three 8.9 m^2 (96 sq. ft.) laboratories.

Table C-1: Description of Facilities Zones within the McMurdo Dry Valleys.

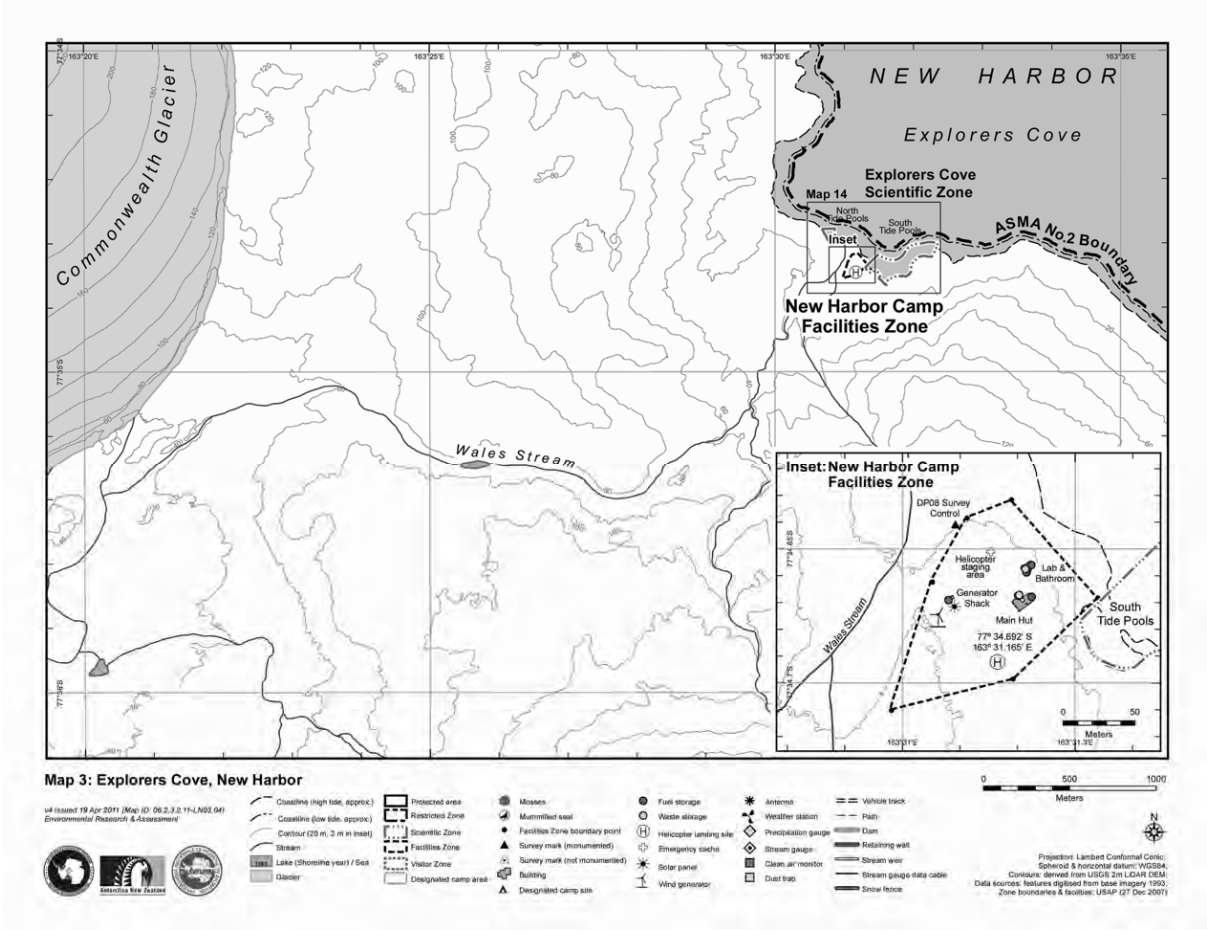
Facilities Zone	Map No.	Boundary Description	Boundary Coordinates	Helicopter Landing Site Coordinates	MP[1]	Structures in Zone
		west to the shoreline, southwest along the shoreline passing north of the helicopter landing pad, continuing southwest along the lake shore to a point northwest of the meteorological station and back to the original point below the generator shed.	77° 42.90'S, 162° 27.73'E 77° 42.92'S, 162° 27.61'E			Emergency cache. For 2010 - Two outhouses (5.6 m^2).
Mount Newall Radio Repeater	9	The boundary goes from the northeastern most point northeast of the green equipment shelter, southwest along the southeastern side of the ridge around the green equipment shelter, the NZ Repeater, the wind turbine, the AFTEC Hut, the antenna, the survival camp hut, the survival cache, around the helicopter landing pad, northeast along the north western side of the ridge around the camp hut, the antenna, the AFTEC Hut, the wind turbine, the NZ Repeater, and the green equipment shelter back to the original point.	77° 30.23'S, 162° 37.60'E 77° 30.25'S, 162° 37.60'E 77° 30.26'S, 162° 37.55'E 77° 30.27'S, 162° 37.52'E 77° 30.27'S, 162° 37.52'E 77° 30.29'S, 162° 37.46'E 77° 30.31'S, 162° 37.33'E 77° 30.29'S, 162° 37.28'E 77° 30.28'S, 162° 37.40'E 77° 30.26'S, 162° 37.49'E 77° 30.23'S, 162° 37.56'E	77° 30.295′S, 162° 37.340′E 1 helicopter landing pad.	US / NZ	The site includes both a US and a NZ radio repeater. There are three huts on Mt. Newall, including an 8.9 m^2 (96 sq. ft.) survival hut, a 22.3 m^2 (240 sq. ft.) shed encompassing a hybrid power system (both US), and a green equipment shelter 2.2 m^2 (24 m^2.) housing the NZ repeater. US repeater equipment contained in two orange plastic cases. There are two antennae (one US, one NZ) and a wind turbine (US) at the site.
Marble Point Refueling Station	10	The boundary goes from the easternmost point (east of soil pits), northwest around the main facilities area, northwest around the fuel storage tanks and pipe, northwest along the road, southwest around the end of the road and staging area, southeast along the road and around the	77° 24.86'S, 163° 41.41'E 77° 24.82'S, 163° 41.22'E 77° 24.81'S, 163° 41.02'E 77° 24.80'S, 163° 40.81'E 77° 24.71'S, 163° 40.25'E 77° 24.74'S,	77° 24.82′S, 163° 40.76′E 4 helicopter landing pads. The four pads are in close proximity (~25 m – 30 m apart). Coordinates are given for	US	A 69.7 m^2 (750 sq. ft.) main building, a 41.8 m^2 (450 sq. ft.) bunkhouse, a 55.7 m^2 (600 sq. ft.) bunkhouse, a 7.4 m^2 (80 sq. ft.) fuel shack, 6 fuel storage tanks (25,000 gallons each), a 2.2 m^2 (24 sq. ft.)

Table C-1: Description of Facilities Zones within the McMurdo Dry Valleys.

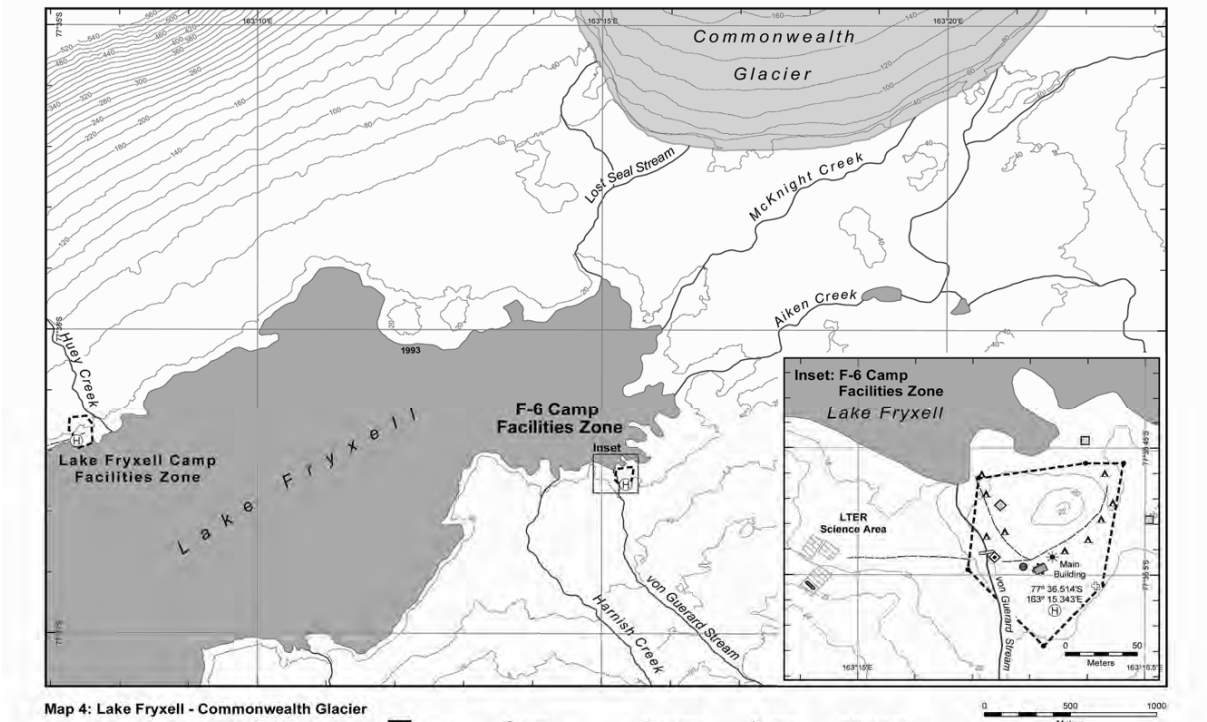
Facilities Zone	Map No.	Boundary Description	Boundary Coordinates	Helicopter Landing Site Coordinates	MP[1]	Structures in Zone
		helicopter pads, southeast around the pond, and northeast back to the point east of the soil pits.	163° 40.15'E 77° 24.86'S, 163° 40.74'E 77° 24.89'S, 163° 41.27'E	the central pad (second from main fuel tanks).		outhouse and incinerator for solid waste, a 1.9 m^2 (20 sq. ft.) storage shed, a 21 m^2 (224 sq. ft.) generator shed, a 27 m^2 (288 sq. ft.) workshop and storage building, and a 7 m^2 (76 sq. ft.) ASOS weather station. Fuel shed and outhouse at refuelling station.
Lower Wright Hut	11	The boundary encompasses the hut, a marked helicopter landing site, and an emergency box and is bounded by rising slopes on the western and eastern sides, a large pavement crack at the southern end and rocky areas at the northern end. A met screen and weir are outside the zone within walking distance of the site.	77° 26.56'S, 162° 39.04'E 77° 26.53'S, 162° 39.02'E 77° 26.53'S, 162° 39.13'E 77° 26.55'S, 162° 39.15'E	77° 26.537′S, 161° 39.070′E 1 helicopter landing pad.	NZ	One small hut with accommodation for 2 people with a floor area of 6 m^2 (65 sq. ft.). Emergency cache.
Lake Vanda Hut	12 Inset 1	The boundary follows the edge of the flat area on which the huts, AWS, marked helicopter landing site and tent sites are located.	77° 31.42'S, 161° 41.15'E 77° 31.40'S, 161° 41.17'E 77° 31.34'S, 161° 41.45'E 77° 31.34'S, 161° 41.51'E 77° 31.36'S, 161° 41.51'E 77° 31.41'S, 161° 41.25'E	77° 31.361′S, 161° 41.442′E 1 helicopter landing pad.	NZ	Three interconnected huts with a total floor area of 30 m^2 (323 sq. ft.). Automatic Weather Station (AWS).
Bull Pass Hut	12 Inset 2	The boundary encompasses the pebbly flat ground on which the huts and tent sites are situated, and is bounded by a large boulder to the north, small rocky ridges	77° 31.09'S, 161° 51.23'E 77° 31.07'S, 161° 50.96'E 77° 30.98'S,	77° 31.056′S, 161° 51.048′E 1 helicopter landing pad.	US	Two shelters located at this site, an equipment shelter and an environmental shelter approximately

Table C-1: Description of Facilities Zones within the McMurdo Dry Valleys.

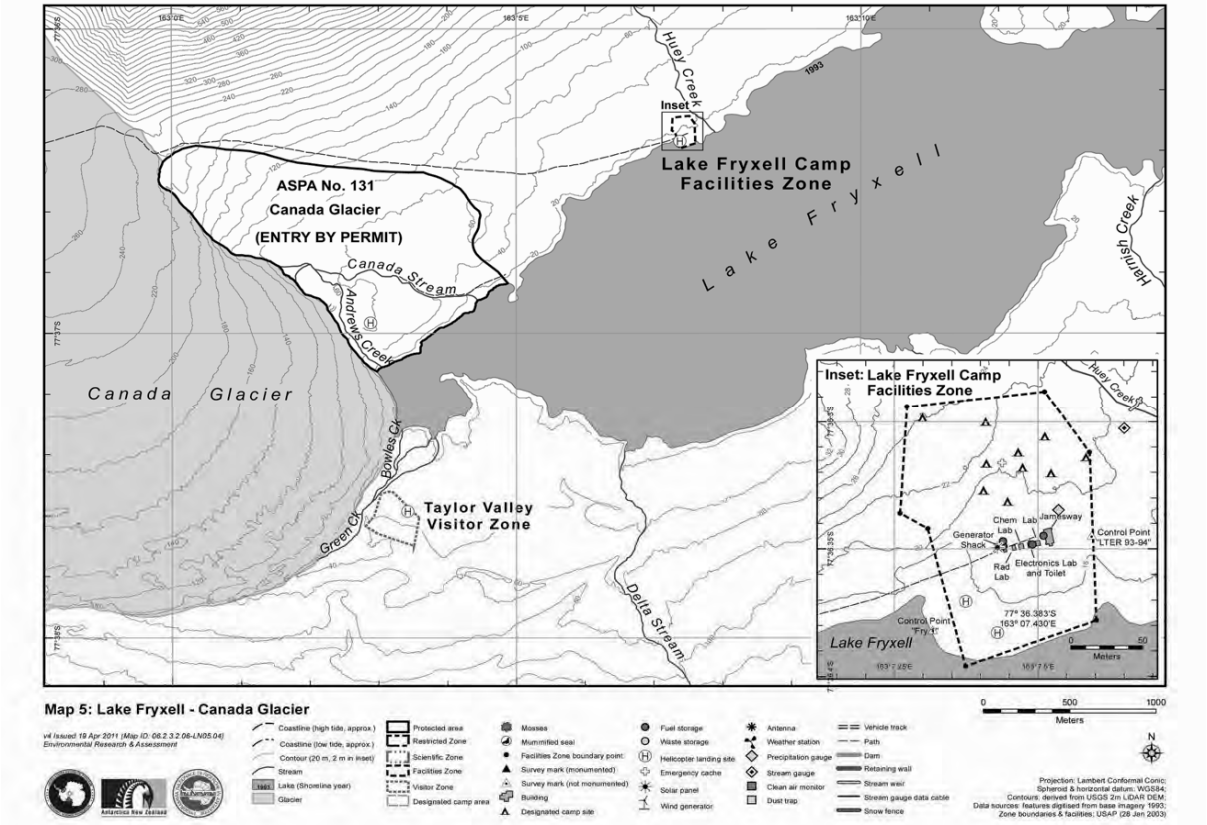
Facilities Zone	Map No.	Boundary Description	Boundary Coordinates	Helicopter Landing Site Coordinates	MP[1]	Structures in Zone
		to the east and west, and a line between ridge ends to the south. An AWS is established well to the west of the zone boundary.	161° 51.11'E 77° 31.00'S, 161° 51.35'E			28.7 m^2 (290 sq. ft.) which houses a hybrid power system.
Cape Roberts Camp	13	The boundary encompasses all of the flat area between north and south beaches on Cape Roberts, including the two huts and fuel rack. The southeast corner of the zone is at the fuel rack, and the boundary continues north along the edge of a bouldery slope, west along the edge of a rocky area, and south behind the huts along the edge another rocky slope. The zone is bounded to the south by the shoreline of a small bay.	77° 2.08'S, 163° 10.73'E 77° 2.08'S, 163° 10.79'E 77° 2.09'S, 163° 10.84'E 77° 2.16'S, 163° 10.79'E	No helicopter landing pads.	NZ	Two huts on the ice-free area of Cape Roberts with accommodation for four people (approximately 10 m^2.) as well a living hut 19 m^2 (205 sq. ft.). A storage rack for drummed fuel is also at the site.

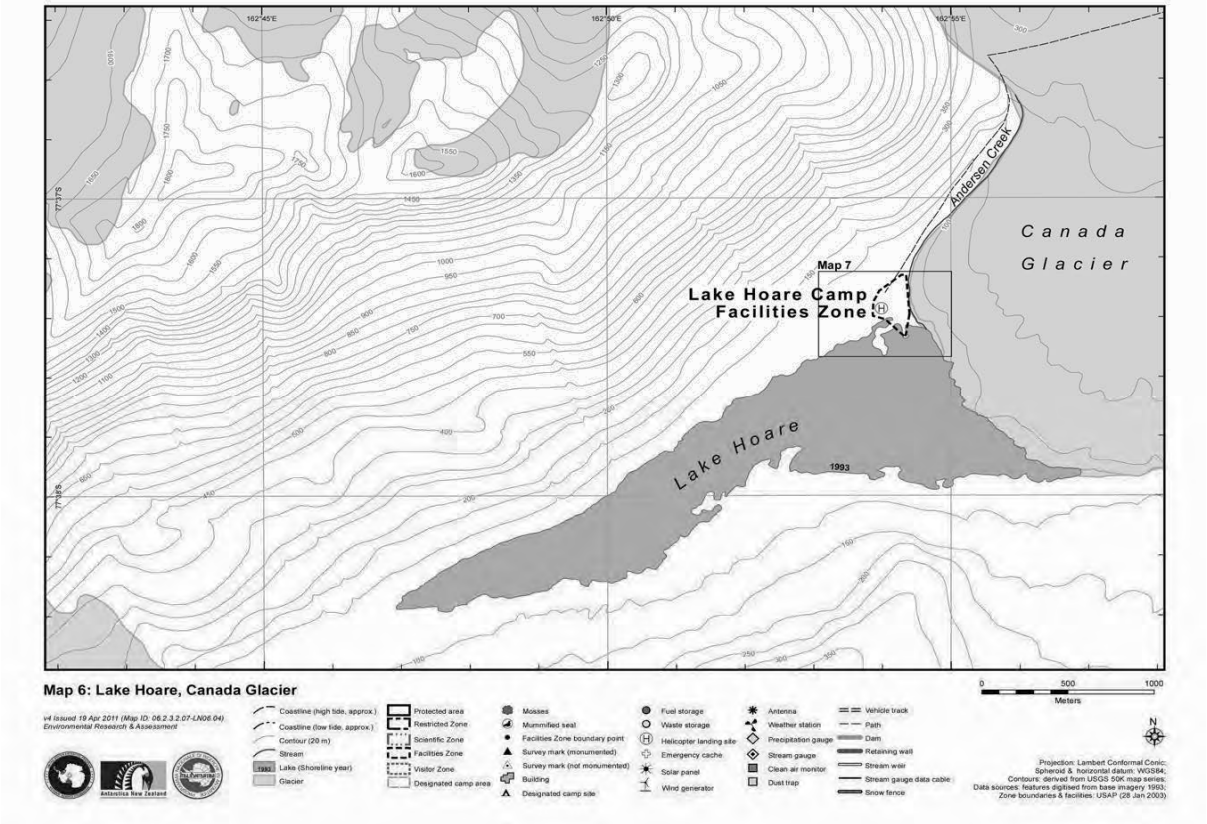


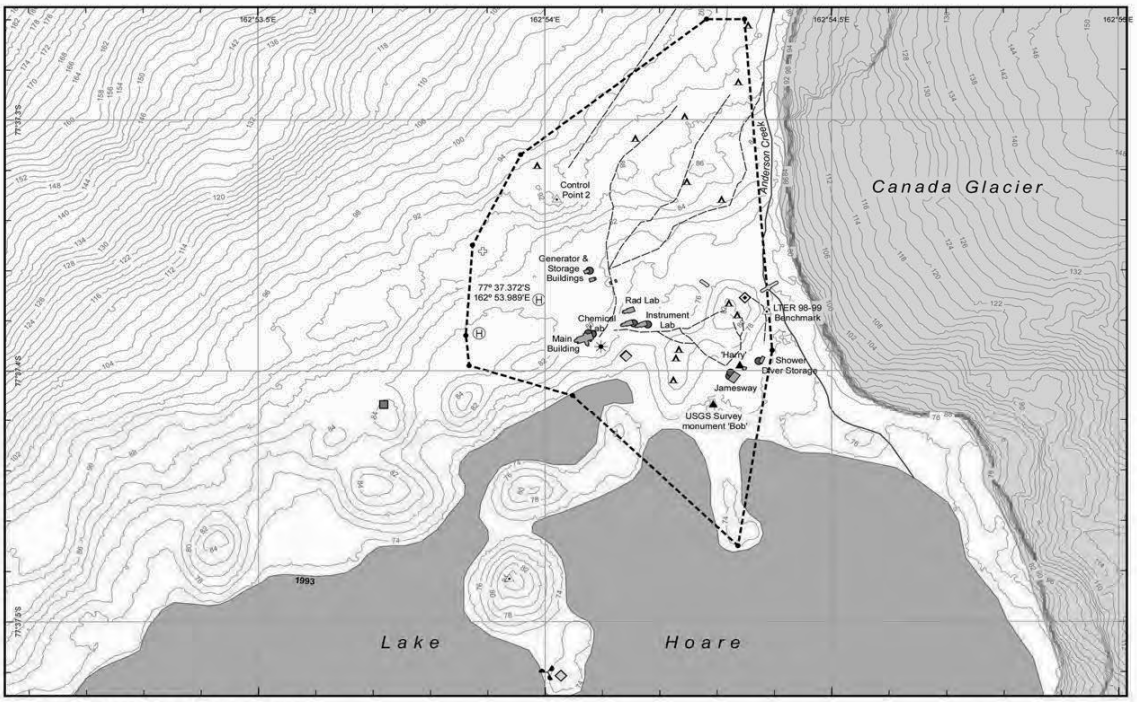
Map 3: Explorers Cove, New Harbor



Map 4: Lake Fryxell - Commonwealth Glacier


Huey Creek
Inset
1993
Lake Fryxell Camp
Facilities Zone
Lake Fryxell
Hanson Creek
ASPA No. 131
Canada Glacier
(ENTRY BY PERMIT)
Canada Stream
Andrews Creek
Canada Glacier
Bowles Ck
Green Ck
Taylor Valley
Visitor Zone
Delta Stream
Inset: Lake Fryxell Camp
Facilities Zone
Huey Creek
Chem Lab
Jamesway
Generator Shack
Control Point
LTER 93-94
Rad Lab
Electronics Lab and Toilet
77° 36.383'S
163° 07.430'E
Control Point
Fry 1
Lake Fryxell
Meters
Map 5: Lake Fryxell - Canada Glacier
v4 Issued 19 Apr 2011 (Map ID: 06.2.3.2.06-LN05.04)
Environmental Research & Assessment
Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (20 m, 2 m in inset)
Stream
Lake (Shoreline year)
Glacier
Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area
Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site
Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence
0 500 1000
Meters
N
Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Contours: derived from USGS 2m LiDAR DEM;
Data sources: features digitised from base imagery 1993;
Zone boundaries & facilities: USAP (28 Jan 2003)


Andersen Creek
Canada Glacier
Map 7
Lake Hoare Camp
Facilities Zone
Lake Hoare
1993
Map 6: Lake Hoare, Canada Glacier
v4 Issued 19 Apr 2011 (Map ID: 06.2.3.2.07-LN06.04)
Environmental Research & Assessment
Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (20 m)
Stream
Lake (Shoreline year)
Glacier
Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area
Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site
Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence
0 500 1000
Meters
N
Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Contours: derived from USGS 50K map series;
Data sources: features digitised from base imagery 1993;
Zone boundaries & facilities: USAP (28 Jan 2003)



Map 7: Lake Hoare Camp Facilities Zone

v3 Issued 19 Apr 2011 (Map ID: 06.2.3.2.07-LN07.03)
Environmental Research & Assessment

Coastline (high tide, approx.) | Coastline (low tide, approx.) | Contour (2 m) | Stream | 1993 Lake (Shoreline year) | Glacier

Protected area | Restricted Zone | Scientific Zone | Facilities Zone | Visitor Zone | Designated camp area

Mosses | Mummified seal | Facilities Zone boundary point | Survey mark (monumented) | Survey mark (not monumented) | Building | Designated camp site

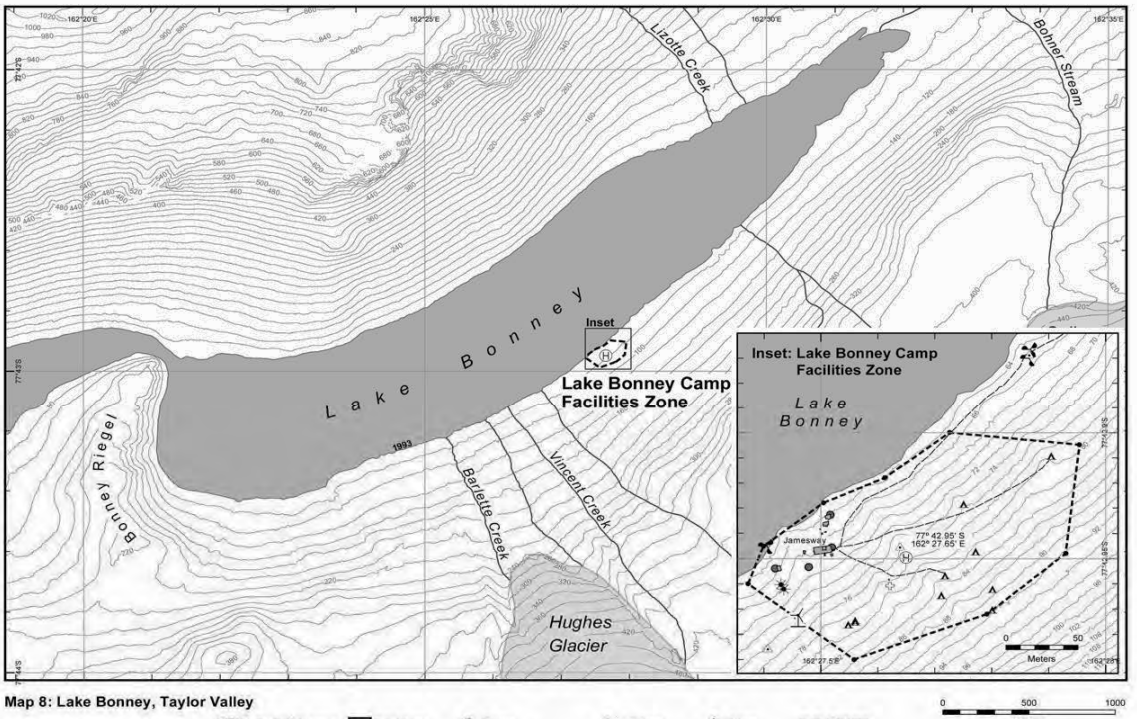
Fuel storage | Waste storage | Helicopter landing site | Emergency cache | Solar panel | Wind generator

Antenna | Weather station | Precipitation gauge | Stream gauge | Clean air monitor | Dust trap

Vehicle track | Path | Dam | Retaining wall | Stream weir | Stream gauge data cable | Snow fence

0 50 100 Meters

Projection: Lambert Conformal Conic; Spheroid & horizontal datum: WGS84;
Contours: derived from USGS 2m LiDAR DEM;
Data sources: features digitised from base imagery 1993;
Zone boundaries & facilities: USAP (28 Jan 2003)



Map 8: Lake Bonney, Taylor Valley

v4 Issued 19 Apr 2011 (Map ID: 06.2.3.2.02-LN08.04)
Environmental Research & Assessment

Coastline (high tide, approx.) | Coastline (low tide, approx.) | Contour (20 m, 2 m in inset) | Stream | 1992 Lake (Shoreline year) | Glacier

Protected area | Restricted Zone | Scientific Zone | Facilities Zone | Visitor Zone | Designated camp area

Mosses | Mummified seal | Facilities Zone boundary point | Survey mark (monumented) | Survey mark (not monumented) | Building | Designated camp site

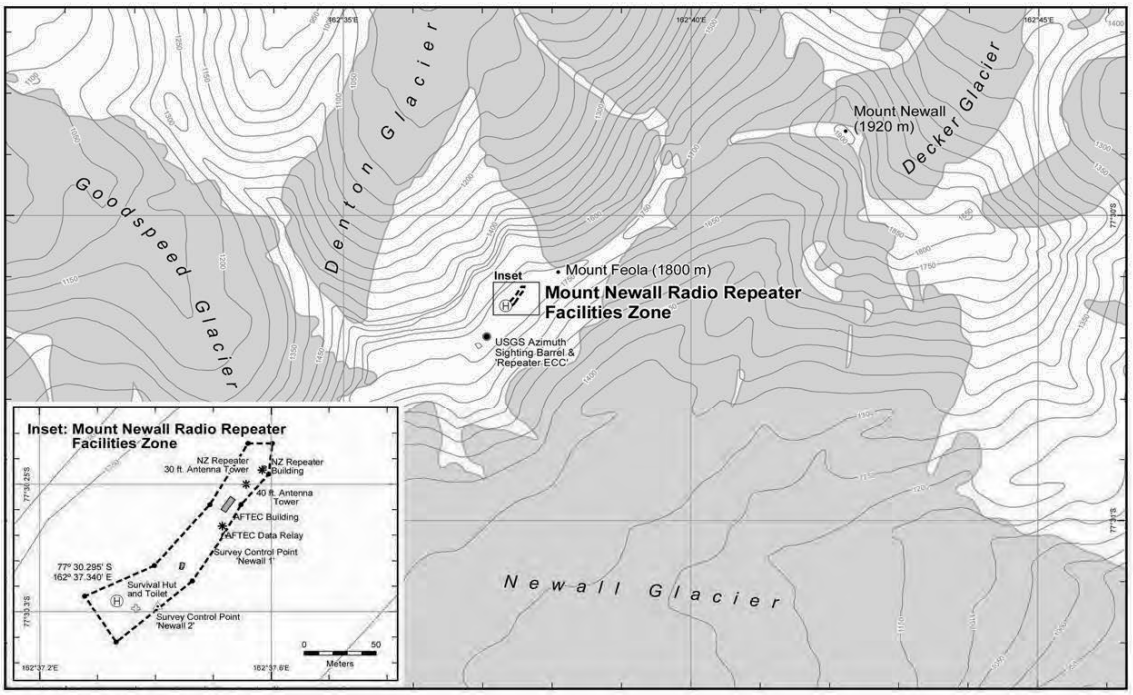
Fuel storage | Waste storage | Helicopter landing site | Emergency cache | Solar panel | Wind generator

Antenna | Weather station | Precipitation gauge | Stream gauge | Clean air monitor | Dust trap

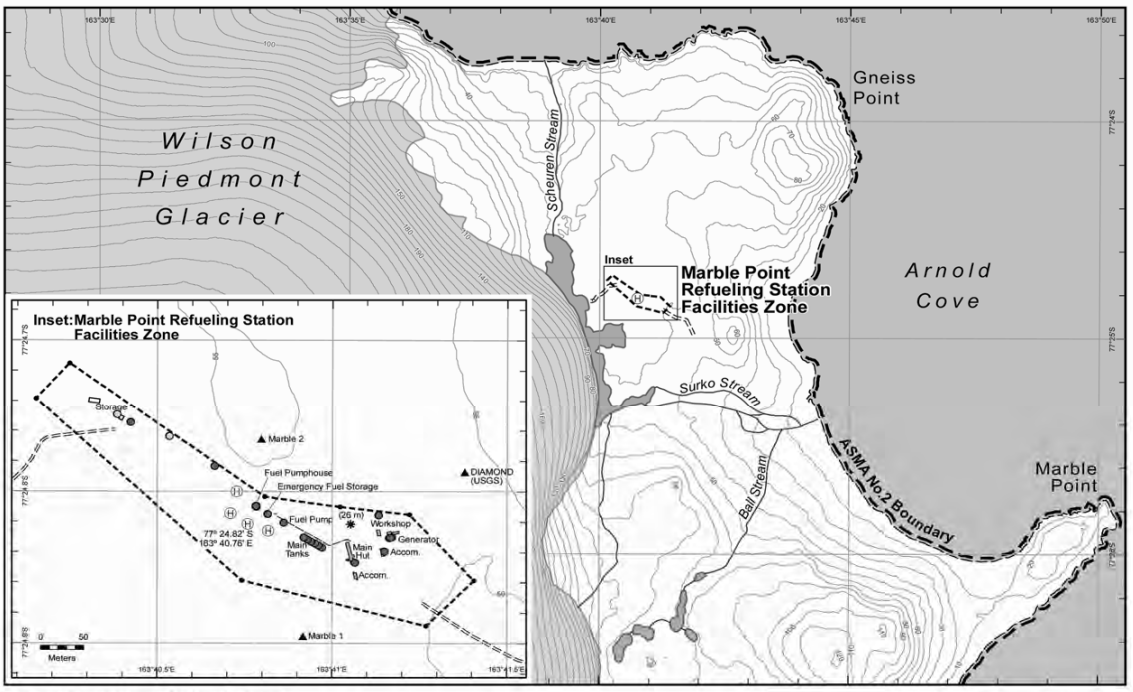
Vehicle track | Path | Dam | Retaining wall | Stream weir | Stream gauge data cable | Snow fence

0 500 1000 Meters

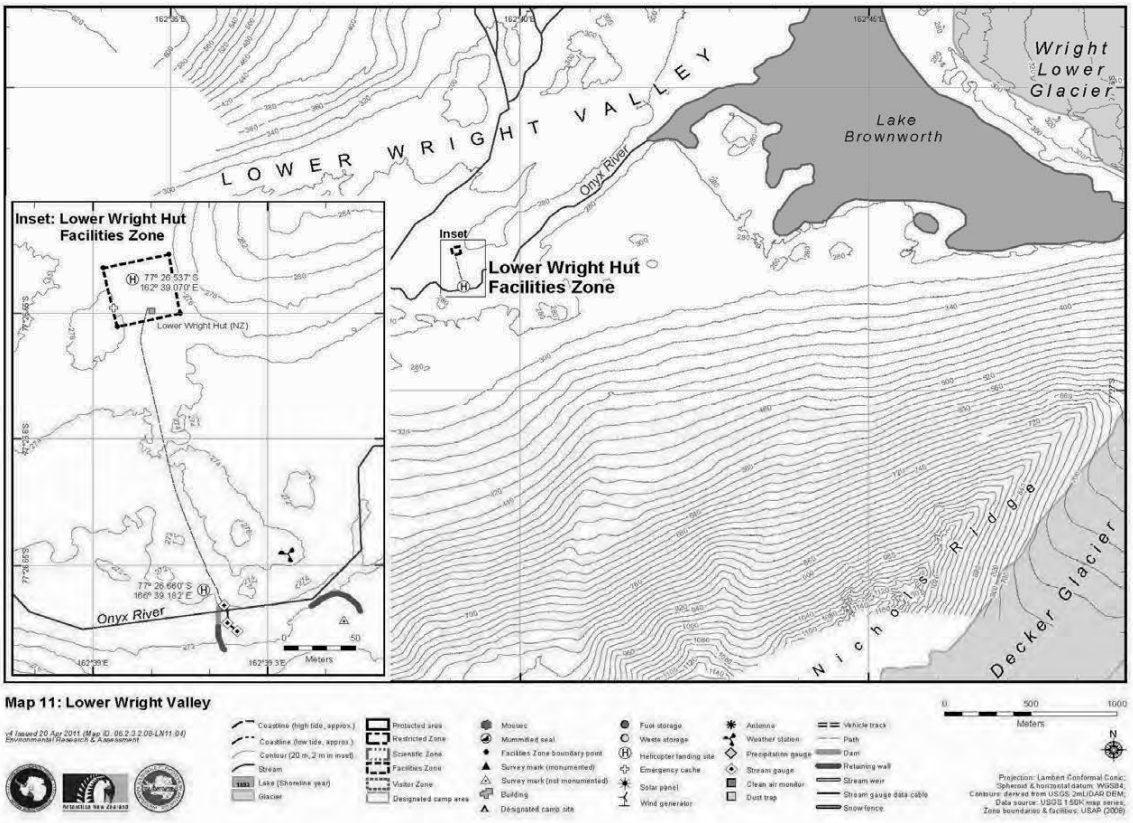
Projection: Lambert Conformal Conic; Spheroid & horizontal datum: WGS84;
Contours: in meters derived from USGS 2m LiDAR DEM;
Data sources: features digitised from base imagery 1993;
Zone boundary & facilities: USAP (2008)



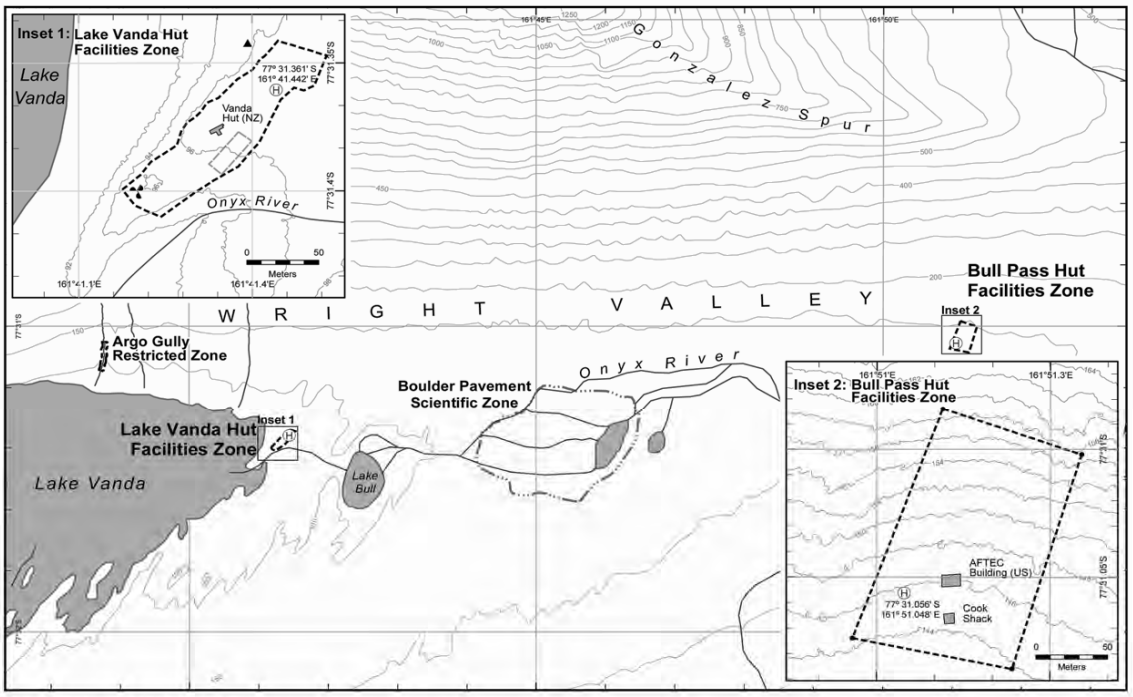
Map 9: Mount Newall, Asgard Range



Map 10: Marble Point, McMurdo Sound



Map 11: Lower Wright Valley



Map 12: Lake Vanda, Wright Valley

v4 28 Apr 2011 (Map ID: 06.2.3.2.09-LN12.04)
Environmental Research & Assessment

Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (50 m, 2 m in inset)
Stream
Lake (Shoreline year)
Glacier

Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area

Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site

Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator

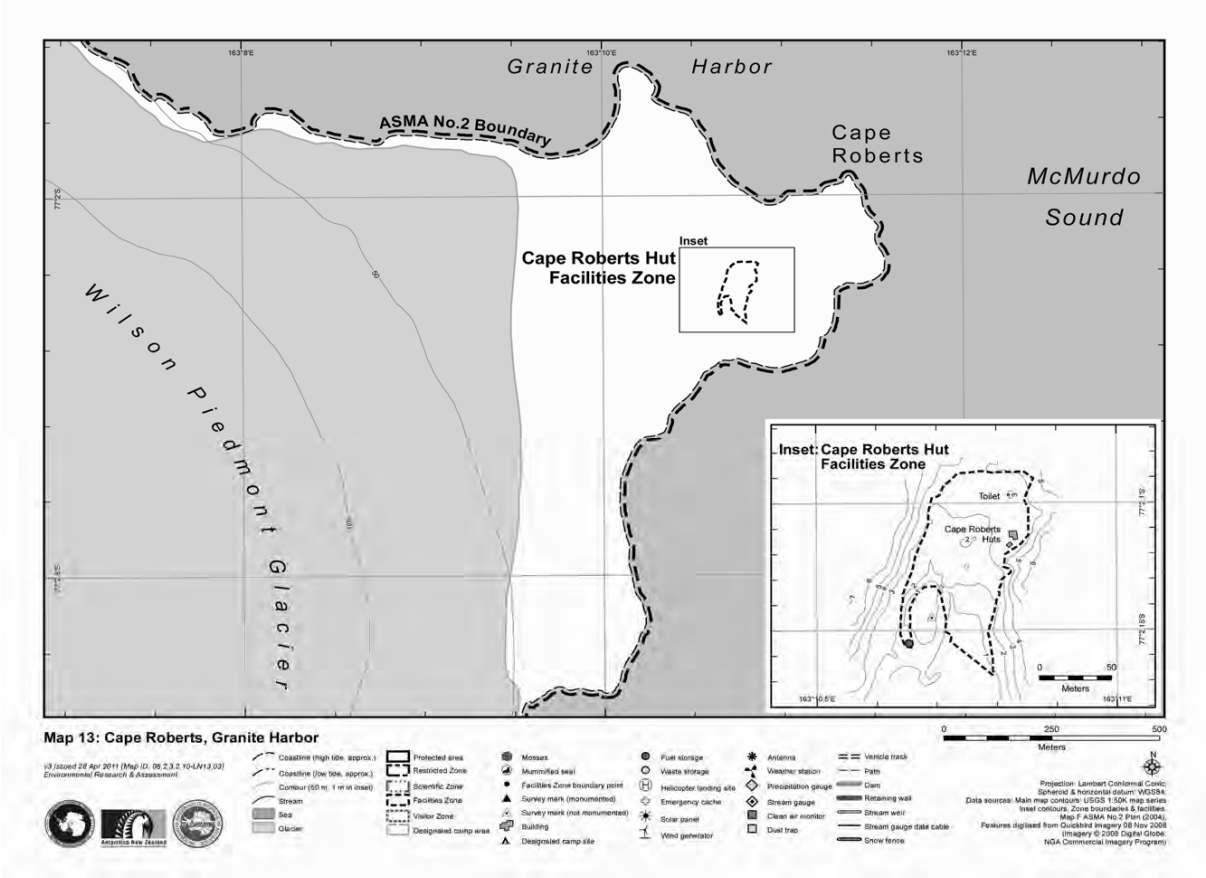
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap

Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence

0 500 1000
Meters

N

Projection: Lambert Conformal Conic; Spheroid & horizontal datum: WGS84; Main map contours: USGS 1:50K map series Inset contours: OSU / NASA / USGS 2m LiDAR DEM; Data sources: USGS 1:50K map series; Zone boundaries & Features: USAP / Antarctica NZ.


Granite Harbor
ASMA No.2 Boundary
Cape Roberts
McMurdo Sound
Inset
Cape Roberts Hut Facilities Zone
Wilson Piedmont Glacier
Inset: Cape Roberts Hut Facilities Zone
Toilet
Cape Roberts Huts
0 50
Meters
0 250 500
Meters
Map 13: Cape Roberts, Granite Harbor
v3 issued 28 Apr 2011 (Map ID: 06.2.3.2.10-LN13.03)
Environmental Research & Assessment
Coastline (high tide, approx.)
Coastline (low tide, approx.)
Contour (50 m; 1 wi in inset)
Stream
Sea
Glacier
Protected area
Restricted Zone
Scientific Zone
Facilities Zone
Visitor Zone
Designated camp area
Mosses
Mummified seal
Facilities Zone boundary point
Survey mark (monumented)
Survey mark (not monumented)
Building
Designated camp site
Fuel storage
Waste storage
Helicopter landing site
Emergency cache
Solar panel
Wind generator
Antenna
Weather station
Precipitation gauge
Stream gauge
Clean air monitor
Dust trap
Vehicle track
Path
Dam
Retaining wall
Stream weir
Stream gauge data cable
Snow fence
Projection: Lambert Conformal Conic; Spheroid & horizontal datum: WGS84;
Data sources: Main map contours: USGS 1:50K map series
Inset contours, Zone boundaries & facilities:
Map F ASMA No.2 Plan (2004);
Features digitised from Quickbird imagery 08 Nov 2008
(Imagery © 2008 Digital Globe;
NGA Commercial Imagery Program)

Appendix D:

Guidelines for Scientific Zones

The following sites within the Area are designated Scientific Zones:

- Explorers Cove, New Harbor, Taylor Valley;
- Boulder Pavement, Wright Valley.

Brief site descriptions, guidelines for activities within each Scientific Zone, and Maps 14 and 15 showing the zone boundaries are attached.

Scientific Zone

Explorers Cove

Location: New Harbor, Taylor Valley
Two components centered on: North tide pools (490 m^2):
77° 34.57' S, 163° 30.79' E; and
South tide pools (4360 m^2):
77° 34.66' S, 163° 31.82' E.

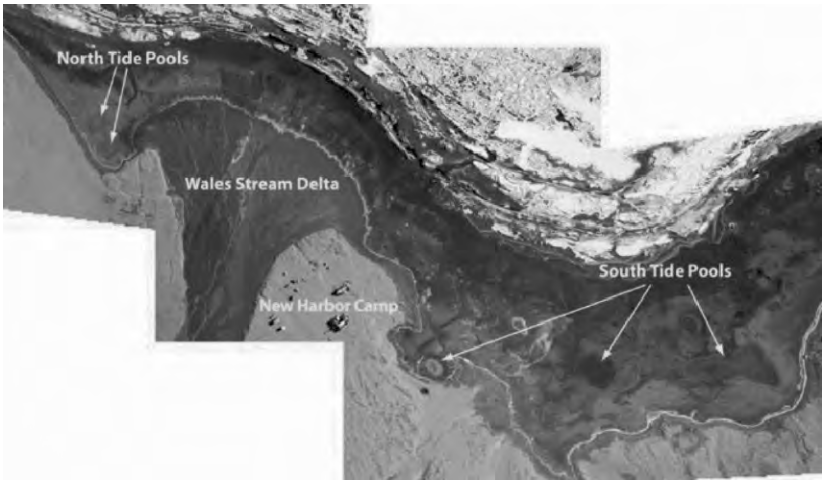


Photo montage: S. Bowser, USAP (28 Jan 2005)

Purpose

To avoid disturbance to local marine environment and ecology which are the subject of long-term scientific studies.

Description

Zone area: 4850 m^2

The Scientific Zone comprises two tide pool systems on the coast of Explorers Cove, both located close to the New Harbor Camp Facilities Zone and extending ~ 75 – 100 m offshore (Map 14). The southern component lies immediately east of New Harbor Camp, extending along the coast for ~ 500 m. The smaller northern component lies ~ 200 m northwest of New Harbor Camp, immediately west of the Wales Stream delta, and extends along the coast for ~ 100 m. These tidally inundated sand flats are characterized by tide pools containing benthic mats of diatoms and cyanobacteria, a significant source of nutrients for the Explorers Cove near-shore marine ecosystem.

Boundaries

The coastline boundary of both tide pools follows the mean high water mark, while the seaward boundary extends parallel to the coast following the approximate grounding line of sea ice pressure ridges (when present), which occur ~ 75 – 100 m offshore (see Map 14).

South Tide Pools: The western boundary extends 100 m NE from the coast at the NE corner of the New Harbor Camp Facilities Zone. The eastern extent of the Scientific Zone is marked on the shore of a small coastal promontory ~ 500 m east of the Facilities Zone by a small rock cairn, from which the eastern boundary extends due north ~ 30 m offshore.

North Tide Pools: The western boundary extends 100 m along the coast from a small embayment west of the Wales Stream delta. The northern boundary thence extends ~ 80 m due east from the coast, while the eastern boundary extends 70 m due north from the coast at the edge of the Wales Stream delta.

Impacts

KNOWN IMPACTS None.
POTENTIAL IMPACTS Shoreline sediments are soft and easily disturbed when not frozen.

Access requirements

HELICOPTER ACCESS Use designated helicopter landing site at New Harbor Facilities Zone: 77° 34.692' S, 163° 31.165' E

SURFACE ACCESS Access to the New Harbor Facilities Zone over sea ice may pass through the southern component of the Scientific Zone.

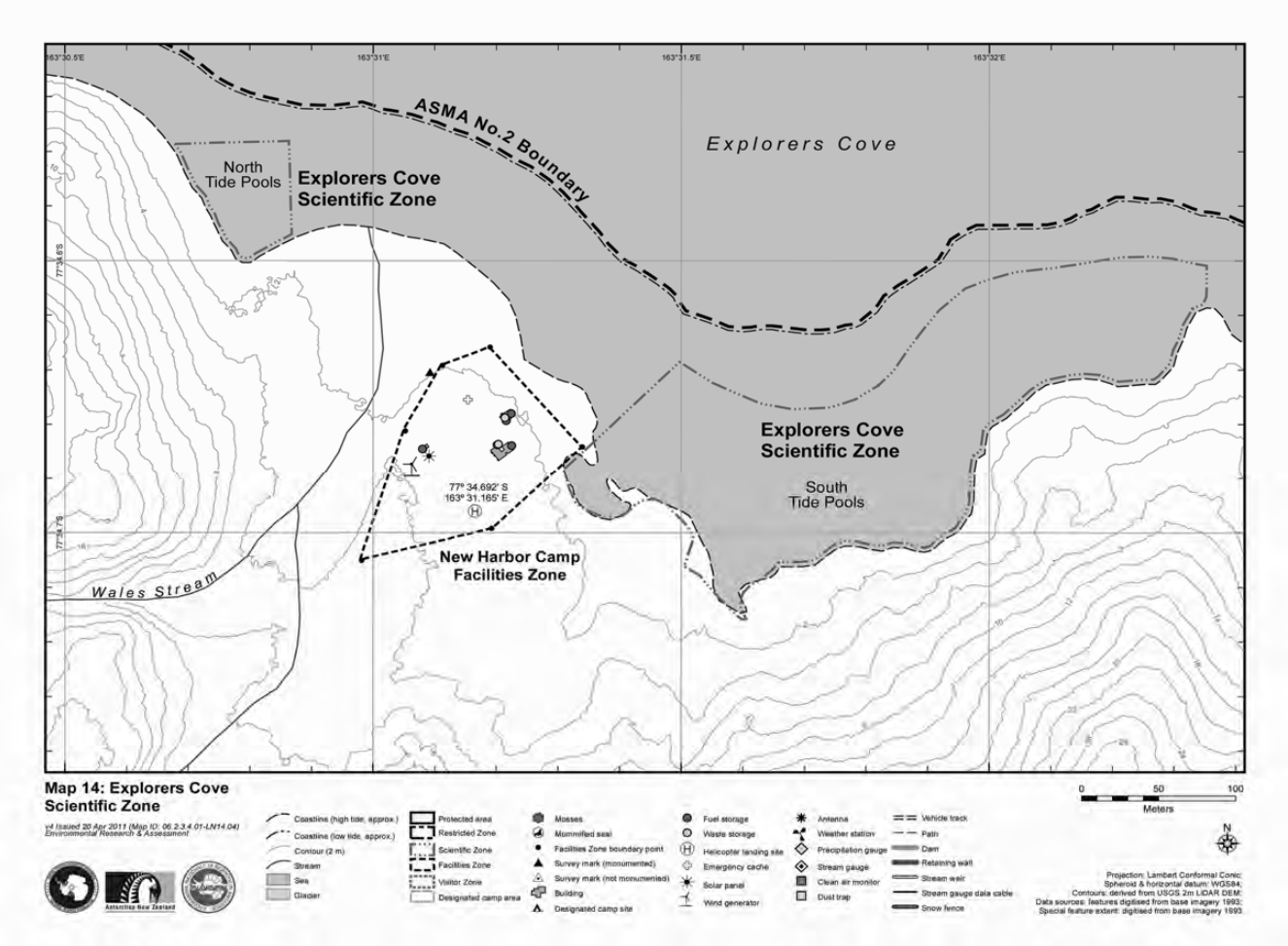
Special site guidance

- Avoid walking in the zone unless conducting scientific research, especially when the ice has thawed.
- Sterilize all sampling equipment before sampling at the site to avoid introducing non-native species.

Key references

Gooday, A.J., Bowser, S.S. & Bernhard, J.M. 1996. Benthic foraminiferal assemblages in Explorers Cove, Antarctica: A shallow-water site with deep-sea characteristics. *Progress in Oceanography* **37**: 117-66.

Site Map – Map 14.



Scientific Zone

Boulder Pavement

Location: Onyx River, central Wright Valley, 4 km east and upstream from Lake Vanda:
77° 31.33' S; 161° 54.58' E

Boulder Pavement: N. Biletnikoff, USAP (29 Jan 2009)

Purpose

To avoid disturbance to extensive microbial mats and ecology which are the subject of long-term scientific studies.

Description **Zone area:** 0.47 km^2 The Scientific Zone comprises a part of the Onyx River which fans out and flows slowly through an extensive and relatively flat area of boulders, where conditions are favorable for the growth of algae and cyanobacteria, forming the most extensive microbial mats in the Wright Valley and a biofilter for Lake Vanda.

Boundaries

The Scientific Zone extends to the perimeter of the extensive flat boulder pavement that is typically inundated by the Onyx River, which comprises an area ~ 0.8 km wide and 1.5 km long (Map 15).

Impacts

KNOWN IMPACTS None.

POTENTIAL IMPACTS Trampling may damage the microbial mats. The mats may be difficult to identify when the site is frozen. Activities within the zone increase the risk of the introduction of non-native species.

Access requirements

HELICOPTER ACCESS Helicopter landings within the Scientific Zone should be avoided. Where practicable, visitors should use the designated helicopter landing sites at Lake Vanda Hut Facilities Zone (77° 31.361' S; 161° 41.442' E) or Bull Pass Hut Facilities Zone (77° 31.056' S 161° 51.048' E) (Maps 12 & 15).

SURFACE ACCESS The zone should be accessed on foot. Avoid walking in this area unless necessary for scientific or management purposes.

Special site guidance

- Avoid crossing the Scientific Zone unless necessary for scientific purposes, such as sampling.
- Walk only on the rocks and avoid trampling the microbial mats.
- Avoid the introduction of non-native species by sterilizing all sampling equipment before use at this site.

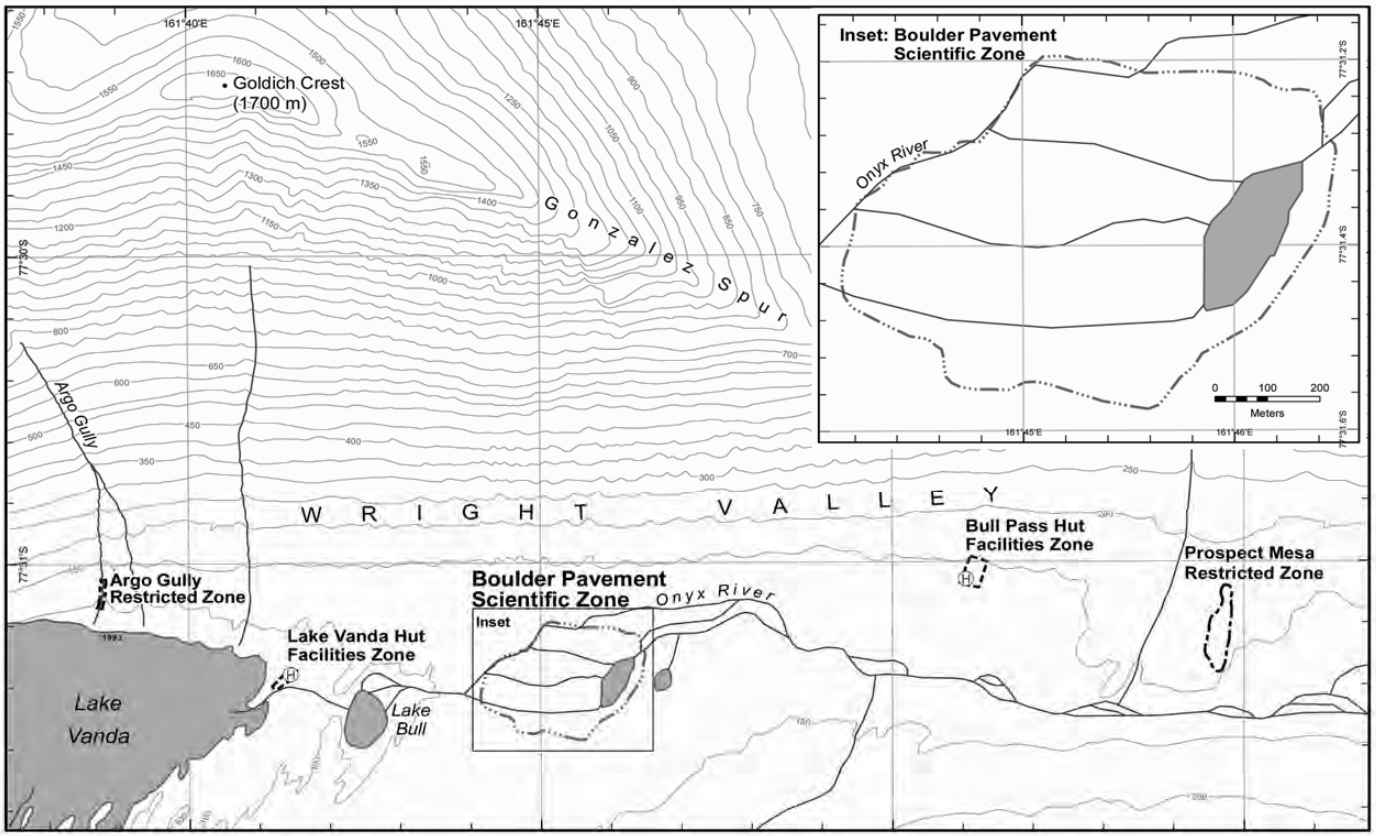
Key references

Howard-Williams, C., Vincent, C.L., Broady, P.A. & Vincent, W.F. 1986. Antarctic stream ecosystems: variability in environmental properties and algal community structure. *International Revue der gesamten Hydrobiologie und Hydrographie* **71**(4): 511-44.

Howard-Williams, C., Hawes, I., Schwarz, A.M. & Hall, J.A. 1997. Sources and sinks of nutrients in a polar desert stream, the Onyx River, Antarctica. In: Lyons, W.B., Howard-Williams, C. & Hawes, I. (Eds) *Ecosystem processes in Antarctic ice-free landscapes*. Proceedings of an International Workshop on Polar Desert Ecosystems, Christchurch, New Zealand: 155-70.

Green, W.J., Stage, B.R., Preston, A., Wagers, S., Shacat, J. & Newell, S. 2005. Geochemical processes in the Onyx River, Wright Valley, Antarctica: major ions, nutrients, trace metals. *Geochimica et Cosmochimica Acta* **69**(4): 839-50.

Site Map – Map 15.



APPENDIX E:

Guidelines for Restricted Zones

The following sites within the Area are designated Restricted Zones:

- Trough Lake catchment, Pyramid Trough, Royal Society Range;
- Mount Feather Sirius Deposit, Mount Feather;
- Don Juan Pond, South Fork, Wright Valley
- Argo Gully, Lake Vanda, Wright Valley;
- Prospect Mesa, Wright Valley;
- Hart Ash Deposit, Wright Valley;
- Victoria Valley sand dunes, Victoria Valley;
- Battleship Promontory, Alatna Valley, Convoy Range.

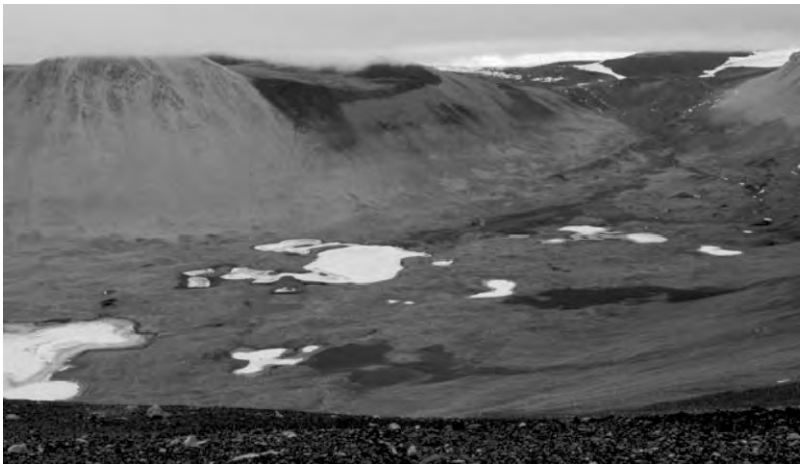
Brief site descriptions, guidelines for activities within each Restricted Zone, and maps showing the zone boundaries (Maps 16 – 23) are attached.

Restricted Zone

Trough Lake Catchment

Location

Trough Lake catchment, Royal Society Range, several km northwest of the Koettlitz Glacier and southwest of Walcott Bay: 78° 18.17' S, 163° 20.57' E



Pyramid Trough: C. Harris, ERA / USAP (09 Dec 2009)

Purpose

To avoid disturbance to a pristine hydrological catchment and its ecology, and to ensure the aesthetic and wilderness values of the zone are maintained.

Description **Zone area:** 79.8 km²

The Trough Lake catchment is enclosed by Mount Dromedary (2485 m), The Pyramid (854 m), The Bulwark (~ 600 m) and Seahorse (1008 m), and comprises a network of four main drainage systems feeding into Trough Lake (Map 16). The valley floor of Pyramid Trough contains a significant wetland system comprising a variety of pond and stream habitats in a confined area that support a range of rich biological communities that are representative of the region. Sparse communities of bryophytes and lichens are present. The catchment also contains some unique features, most notable of which are the presence of groups of cyanobacteria that are rare in other wetland systems in the region. Specifically, in addition to the common oscillatorian cyanobacteria, microbial mats in ponds and streams contain *Dichothrix* and *Schizothrix*, and a range of coccoid taxa. Trough Lake catchment has been visited infrequently compared to the other Dry Valleys, and the ecosystem is considered to be almost pristine.

Boundaries

The Restricted Zone boundary is defined by the Trough Lake catchment. Clockwise from The Pyramid, the boundary crosses a small tongue of the Koettlitz Glacier extending into the catchment, thence follows Backdrop Ridge to an unnamed peak (1618 m) at the top of West Aisle Ridge, thence northwest following the ridge to Mount Dromedary, from where it follows a ridge northeast to Seahorse. The boundary thence follows a ridge eastward and descends to Walcott Bay. The boundary proceeds due east ~800 m from the shoreline of Walcott Bay to the approximate grounding line of the Koettlitz Glacier, and thence follows the ASMA boundary to Bulwark Stream to the foot of the northeast ridge of The Bulwark. The boundary proceeds southward following The Bulwark ridge crest, crosses the head of the Upper Alph River, and follows the Koettlitz Glacier margin to ascend the northeastern ridge of The Pyramid.

Impacts

KNOWN IMPACTS	Rocks have been moved at the campsite, where an iron survey marker is installed on a small knoll at: 78° 17.17' S, 163° 27.83' E (18 m). Sampling has been undertaken at a number of lakes in the catchment.
POTENTIAL IMPACTS	Disturbance to water bodies, terrestrial ecology and sensitive soils by sampling or trampling. Introduction of non-native species.

Access requirements

HELICOPTER ACCESS	Helicopters should land at the designated site at: 78° 17.16' S, 163° 27.84' E (11 m).
SURFACE ACCESS	Movement within the zone should generally be on foot. Helicopters may be used for essential travel to sites that would be impracticable to access on foot from the campsite.

Special site guidance

- Visits to this catchment should be minimized and semi-permanent structures should not be installed within the zone.
- Avoid the introduction of non-native species by sterilizing all sampling equipment before visiting this site.
- Camping within the Restricted Zone should be at the site previously used (adjacent to the designated helicopter landing site) at: 78° 17.15' S, 163° 27.79' E (11 m).

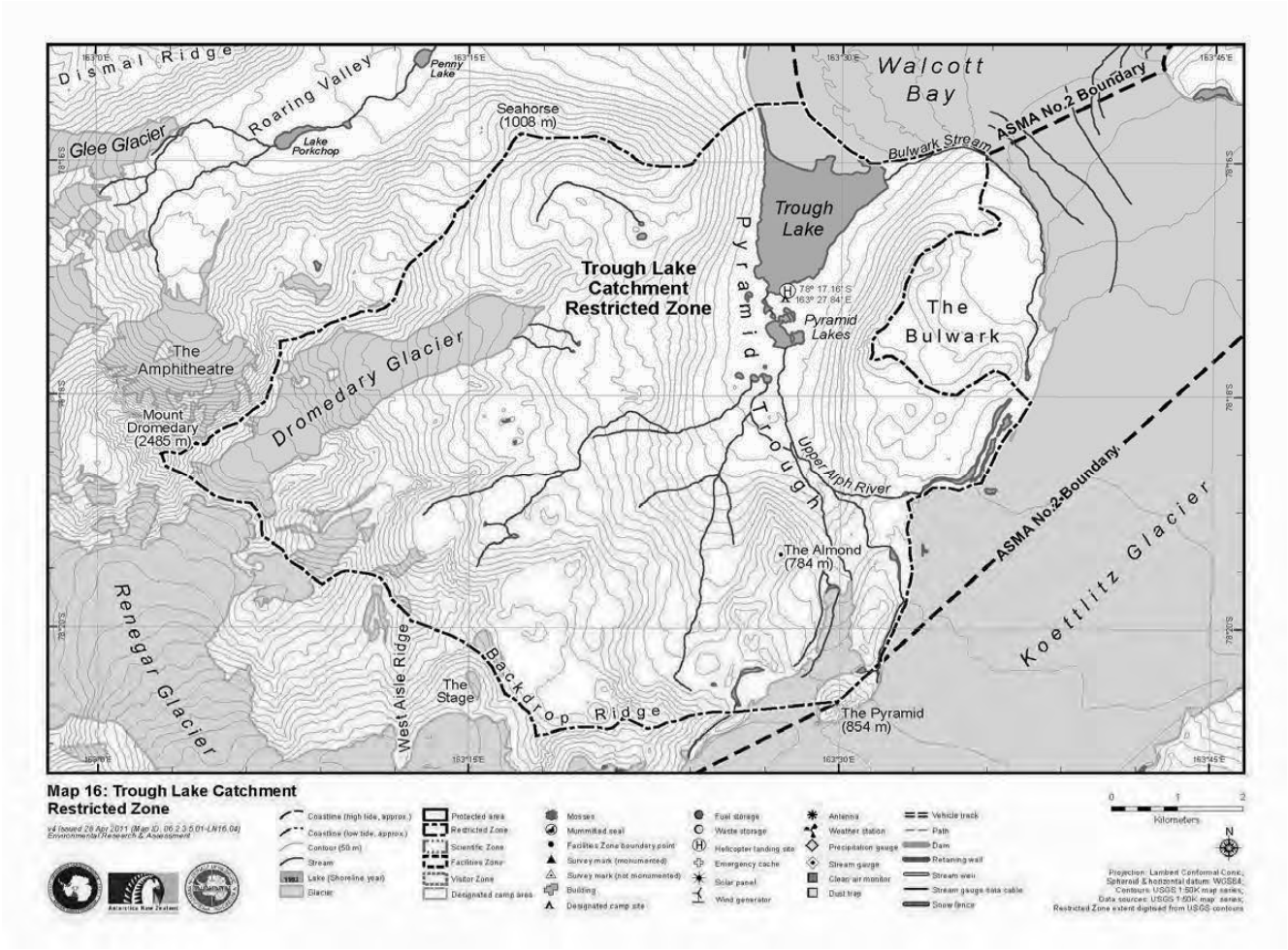
Key references

Chinn, T.J.H. 1993. Physical hydrology of Dry Valleys lakes. *Antarctic Research Series* **59**: 1 –51.

Hendy, C.H. & Hall, B.L. 2006. The radiocarbon reservoir effect in proglacial lakes: examples from Antarctica. *Earth and Planetary Science Letters* **241**: 413-21.

Hawes, I., Webster-Brown, J., Wood, S. & Jungblut, A. 2010. A brief survey of aquatic habitats in the Pyramid Trough region, Antarctica. Unpublished report prepared for USAP on the aquatic ecology of the Trough Lake catchment.

Site Map – Map 16



Restricted Zone

Mount Feather Sirius Deposit

Mount Feather: C. Harris, ERA / USAP (11 Dec 2009)

Location

Northeast flank of Mount Feather (3011 m) between Lashley Glacier and the upper Ferrar Glacier: 77° 56.05' S, 160° 26.30' E

Purpose

To avoid disturbance or damage to an area of Sirius Deposits, which are of high scientific value.

Description **Zone area:** 0.57 km²

The Mount Feather Diamicton is an area of semi-lithified glacigenic deposits that have been included within the Sirius Group at the upper Ferrar Glacier, ~3 km NE of Mount Feather (3011 m) (Map 17). The deposits lie at an elevation of between ~2400-2650 m, extending over ground of relatively gentle slope near the ridge crest and also outcropping on the steep eastern cliffs of the Mount Feather massif above Friedmann Valley and the Ferrar Glacier. The diamicton surface has distinct melt-water runnels near its perimeter and on steeper slopes. The deposits, which extend over an area of ~1.5 km x 1 km, contain microfossils and other evidence of high scientific importance for interpretation of the Neogene glacial history of the Dry Valleys and of the East Antarctic ice sheet as a whole.

Boundaries

The boundary of the Restricted Zone (Map 17) is defined based on the extent of the Mount Feather Diamicton as mapped by Wilson *et al.* (2002: Fig.1). Owing to limitations in the accuracy of available mapping in the region, the boundary is considered approximate, with an estimated accuracy of at least +/- 100 m.

Impacts

KNOWN IMPACTS Rock samples have been collected. At least four shallow drill cores (of 3.2 m in depth or less) have been recovered from the site, although drilling fluids were not employed.

POTENTIAL IMPACTS Drilling operations, especially those employing drilling fluids. Sampling and disturbance to sedimentary sequences.

Access requirements

HELICOPTER ACCESS Helicopter operations in this location can be difficult owing to altitude and winds, and no specific landing site has yet been designated.

SURFACE ACCESS Movement within the Restricted Zone should be on foot.

Special site guidance

- Do not move sediments, rocks and boulders, unless necessary for scientific purposes, and avoid disturbance to or alteration

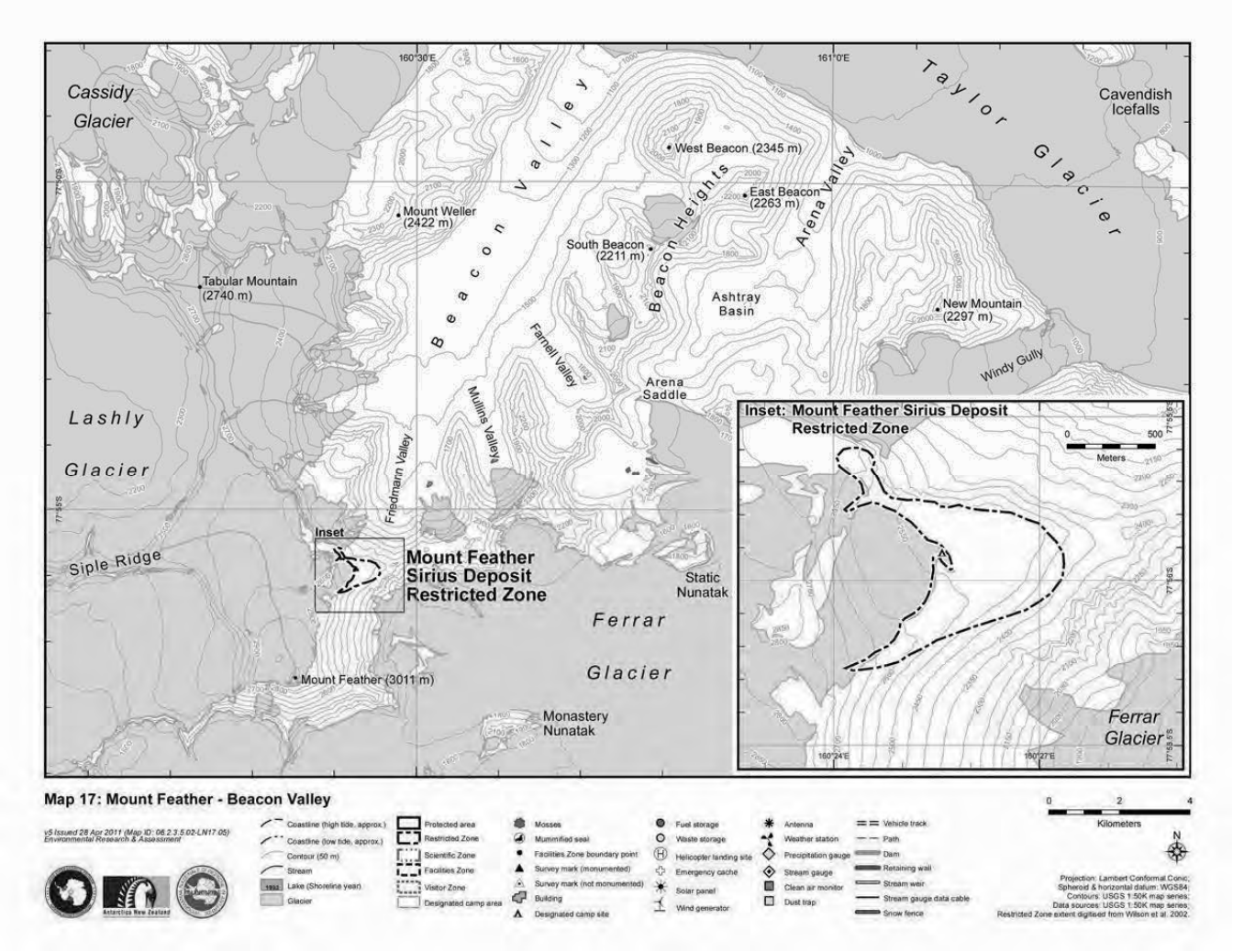
of the sedimentary sequences and melt-water runnels.

- Camping should be at the site previously used on adjacent snow surfaces at: 77° 55.93' S, 160° 25.66' E.

Key references

Wilson, G.S., Barron, J.A., Ashworth, A.C., Askin, R.A., Carter, J.A., Curren, M.G., Dalhuisen, D.H., Friedmann, E.I., Fyodorov-Davidov, D.G., Gilichinsky, D.A., Harper, M.A., Harwood, D.M., Hiemstra, J.F., Janecek, T.R, Licht, K.J., Ostroumov, V.E., Powell, R.D., Rivkina, E.M., Rose, S.A., Stroeven, A.P., Stroeven, P., van der Meer, J.J.M., and Wizevich M.C. 2002. The Mount Feather Diamicton of the Sirius Group: an accumulation of indicators of Neogene Antarctic glacial and climatic history. *Palaeogeography, Palaeoclimatology, Palaeoecology* **182**: 117-31.

Site Map – Map 17



Restricted Zone

Don Juan Pond

Don Juan Pond: C. Harris, ERA / USAP (14 Dec 2009)

Location

At the foot of a rock glacier in South Fork, Wright Valley, in a closed basin at 118 m elevation below the Dais, ~ 7.5 km from Lake Vanda: 77° 33.77' S, 161° 11.32' E

Purpose

To protect a rare and sensitive hypersaline ecosystem of high scientific value from disturbance and damage.

Description **Zone area:** 20 ha

Don Juan Pond is a small hypersaline lake currently of ~400 x 150 m containing a calcium-chloride-rich brine with a salinity level of ~40%, making it the most saline natural water body known on Earth. Water levels have fluctuated over time, although recently the pond has been ~10 cm in depth. While water levels vary, the Restricted Zone extends to the perimeter of the pond floor salt deposits (Map 18). Microbial life, including numerous heterotrophic bacteria and a yeast, are found in the pond. A mat of mineral material and detritus cemented together by organic matter, referred to as the Don Juan Pond Salt Deposits, is found at the edge of the pond where the calcium chloride concentrations are reduced. Don Juan Pond is also the site where Antarcticite ($CaCl_2$ 6H20), a hygroscopic colorless mineral, was first identified forming naturally.

Boundaries

The Restricted Zone boundary is defined by the outer extent of the Don Juan Pond Salt Deposits, which extend to the edge of the basin pond floor, occupying an area of ~720 x 300 m (Map 18).

Impacts

KNOWN IMPACTS The Dry Valleys Drilling Project drilled two boreholes at Don Juan Pond: DVDP 5 (3.5 depth) and DVDP 13 (75 m depth), situated within the salt deposit area ~60 m and ~110 m respectively east of the rock glacier. DVDP 13 remains in evidence as an iron tube (capped) protruding ~ 1 m above the dry pond floor (Map 18). Small quantities of waste (e.g. rusted cans) were observed in soils ~50-100 m south and east of the Restricted Zone in Dec 2009, most likely originating from early camps established near the site.

POTENTIAL IMPACTS Disturbance to water body, salt deposits and sensitive soils by sampling or trampling.

Access requirements

HELICOPTER ACCESS Helicopters should avoid landing in the Restricted Zone and avoid overflight below 50 m above ground level. Helicopters should land at the designated site ~250 m east of Don Juan Pond at: 77° 33.784' S, 161° 12.948' E.

SURFACE ACCESS Access to and movement within the Restricted Zone should be on foot.

Special site guidance

- Avoid walking through the pond and adjacent salt deposits unless necessary for scientific or management purposes.
- Walk carefully to minimize disturbance to the salt deposits and surrounding soft soils and sensitive slopes.
- Do not move any boulders.
- Camping is not permitted within the Restricted Zone.

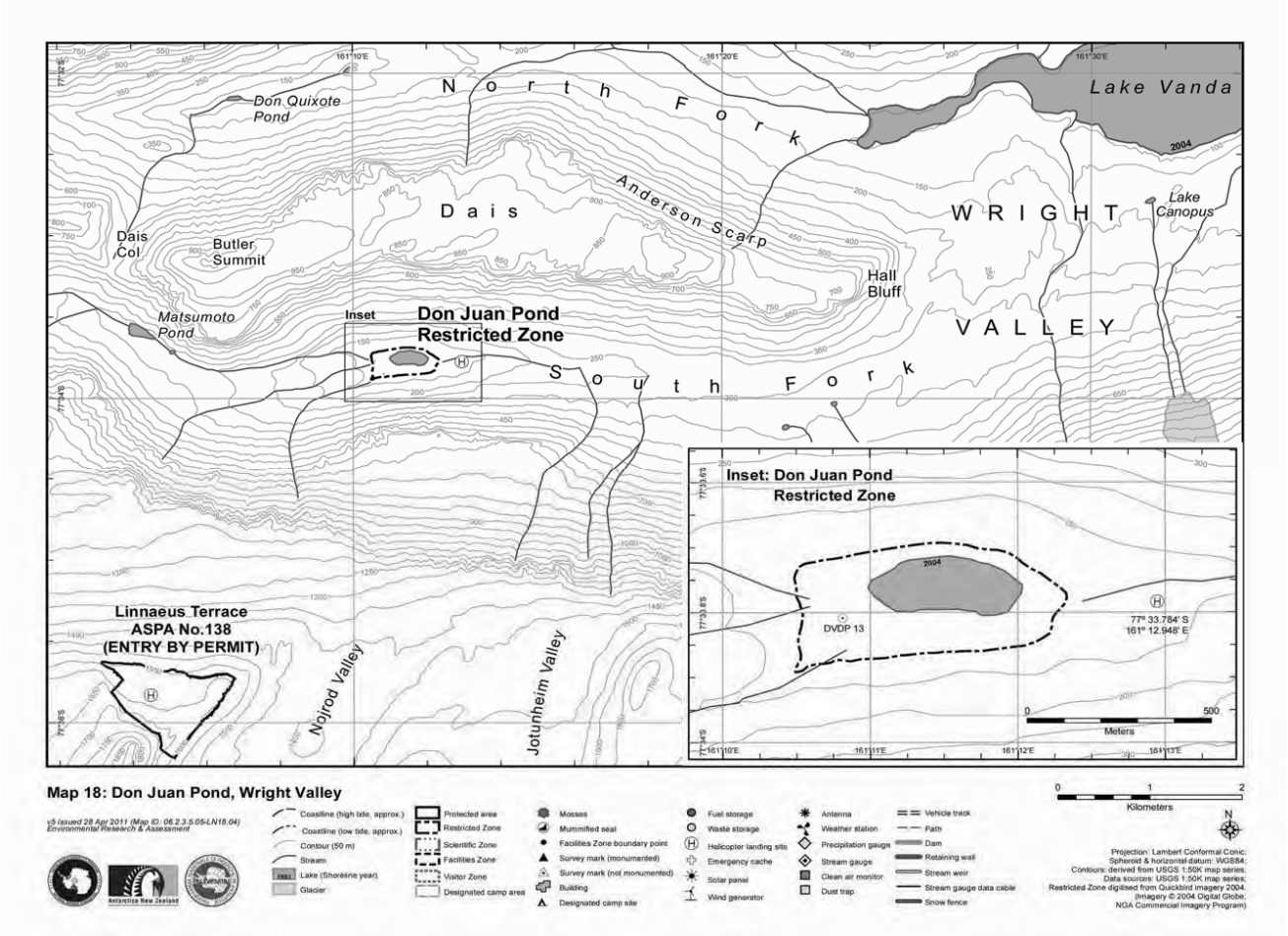
Key references

Harris, H.J.H. & Cartwright, K. 1981. Hydrology of the Don Juan Basin, Wright Valley, Antarctica. *Antarctic Research Series* **33:** 161-84.

Chinn, T.J. 1993. Physical hydrology of the Dry Valley lakes. *Antarctic Research Series* **59:** 1-51.

Samarkin, V.A., Madigan, M.T., Bowles, M.W., Casciotti, K.L., Priscu, J.C., McKay, C.P. & Joye, S.B. 2010. Abiotic nitrous oxide emission from the hypersaline Don Juan Pond in Antarctica. *Nature Geoscience* Online: 25 April 2010. DOI: 10.1038/NGEO847.

Site Map – Map 18



Restricted Zone

Argo Gully

Location

Northeastern shore of Lake Vanda, Wright Valley, below Mount Jason, at an elevation between 104 m and 235 m:
77° 31.09' S, 161° 38.77' E

Purpose

To avoid damage to exposed stratified marine fossiliferous deposits within the gully, which are of high scientific value.

Argo Gully: K. Pettway, USAP (31 Jan 2011)

Description **Zone area:** 4800 m^2 Part of the lower reach of a prominent stream channel in Argo Gully, below Mount Jason (1920 m), Olympus Range (Map 19), contains exposed beds (up to 2.8 meters thick) of massive glacial silts containing abundant marine diatom and silicoflagellate material overlying sediment. Pecten shell fragments have reportedly been found in the upper few centimeters of the deposit. The beds are horizontally stratified, which is in contrast to the underlying sediments. The deposits are overlain by deltaic sands, silts and gravels, deposited by the stream in Argo Gully. The deposits are indicative that the Wright Valley was formerly a shallow marine fjord, and have been dated as Middle Miocene. The full extent of the deposits below the overlying sediment is unknown, and the intermittent exposures along the channel change over time as a result of natural erosion.

Boundaries

The Restricted Zone extends from the first prominent raised beach (elevation 104 m) above, and ~140 meters from, the shore of Lake Vanda, for 175 meters up the stream channel to an elevation of ~135 m. The zone extends 25 meters either side of the stream channel (Map 19).

Impacts

KNOWN IMPACTS	None.
POTENTIAL IMPACTS	The deposit is within the permafrost but the surface continually slumps when the permafrost melts. The surface of the deposit if friable when touched.

Access requirements

HELICOPTER ACCESS	Helicopters should land at the designated site at Lake Vanda Hut Facilities Zone ~1.2 km to the east at: 77° 31.361' S, 161° 41.442' E.
SURFACE ACCESS	Access to and movement within the Restricted Zone should be on foot.

Special site guidance

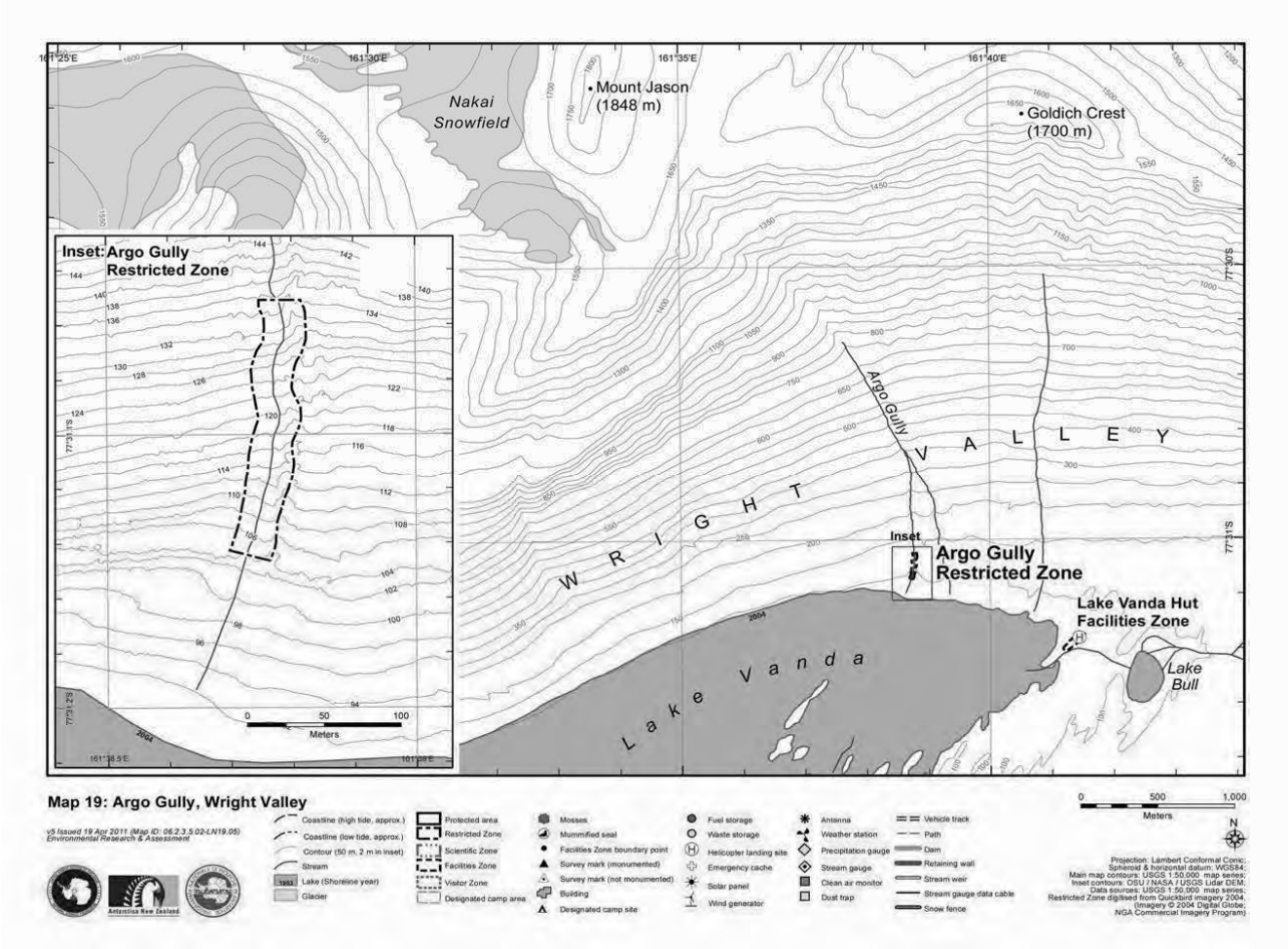
- Avoid walking on the edges of the gully or above the exposed outcrops.
- Minimize disturbance to the sediments surrounding the deposits.
- Avoid touching the exposed outcrops unless conducting scientific research.

Key references

Brady, H.T. 1980. Palaeoenvironmental and biostratigraphic studies in the McMurdo and Ross Sea regions, Antarctica. Unpublished PhD thesis, Macquarie University, Australia.

Brady, H.T. 1979. A diatom report on DVDP cores 3, 4a, 12, 14, 15 and other related surface sections. In: Nagatta, T. (Ed) *Proceedings of the Seminar III on Dry Valley Drilling Project, 1978.* Memoirs of National Institute of Polar Research, Special Issue 13: 165-75.

Site Map – Map 19.



Restricted Zone

Prospect Mesa

Prospect Mesa: C. Harris, ERA / USAP (15 Dec 2009)

Location

Below Bull Pass ~250 m north of the Onyx River, Wright Valley:
77° 31.33' S; 161° 54.58' E

Purpose

To avoid damage to a fragile deposit of fossilized extinct marine pecten (scallop) shells of a single species.

Description **Zone area:** 4.76 ha

Prospect Mesa is a deposit of fossiliferous gravels overlying till containing a high density of well-preserved extinct marine pecten (scallop) shells of a single species, *Chlamys (Zygochlamys) tuftsensi*, of the Family Pectinidae. This is the only known site where this species is found. A stratified layer of sand and gravel overlying till is exposed in a gully cut by a stream flowing from Bull Pass a few hundred meters from its junction with the Onyx River (Map 20). The precise age of the deposit is unknown, although the presence of articulated shells, the abundance of complete shells, the lack of abrasion, the similarity of internal and external matrix, the lack of good size segregation and a generally very poor sorting of the clasts suggest that the fossils were deposited *in situ* in a marine fjord. Sponge spicules, radiolarian and a few ostracod fragments are also present but foraminifera are the most abundant and diverse microfossil group present.

Boundaries

The Restricted Zone boundary is defined around two adjacent mesa features, the smaller of the two being ~100 m north of the main feature. The boundary follows the well-defined NE bank of the stream descending from Bull Pass in the SW of the zone, and then follows around the base of the slopes that define the two features (Map 20).

Impacts

KNOWN IMPACTS An excavation from early research exists on the southwest slope of the mesa (see photo), which is marked by a pole at the base.

POTENTIAL IMPACTS Isolation of unbroken pecten fragments is extremely difficult. Disturbance or damage to the sediments may cause damage to the fossils.

Access requirements

HELICOPTER ACCESS Helicopters should not land within the Restricted Zone. Use the designated helicopter landing site at Bull Pass Hut Facility Zone: 77° 31.056' S, 161° 51.048' E

SURFACE ACCESS Access to and movement within the Restricted Zone should be on foot.

Special site guidance

- Avoid walking on top of the mesa.
- Pedestrians should walk carefully to minimize disturbance to fragile sedimentary structures, deposits and slopes.
- Camping is not permitted within the Restricted Zone.

Key references

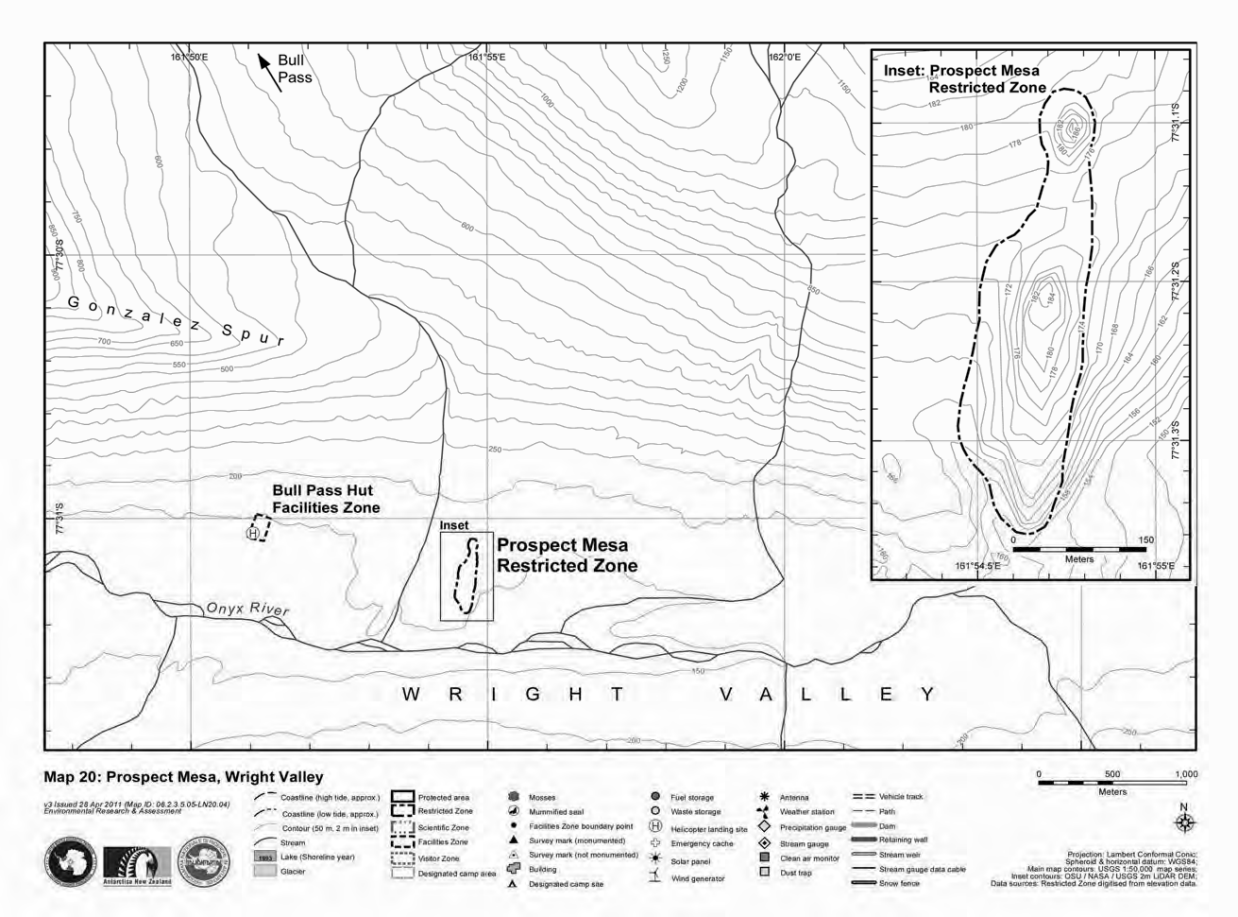
Turner, R.D. 1967. A new species of fossil Chlamys from Wright Valley, McMurdo Sound, Antarctica. *New Zealand Journal of Geology and Geophysics* **10**: 446-55.

Vucetich, C.G. & Topping, W.W. 1972. A fjord origin for the pecten deposits, Wright Valley, Antarctica. *New Zealand Journal of Geology and Geophysics* **15**(4): 660-73.

Webb, P.N. 1972. Wright fjord, Pliocene marine invasion of an Antarctic Dry Valley. *Antarctic Journal of the United States* **7**: 227-34.

Prentice, M.L., Bockheim, J.G., Wilson, S.C., Burckle, L.H., Jodell, D.A., Schluchter, C. & Kellogg, D.E. 1993. Late Neogene Antarctic glacial history: evidence from central Wright Valley. *Antarctic Research Series* **60**: 207-50.

Site Map – Map 20.



Restricted Zone Hart Ash Deposit Location

On a relatively featureless slope between the Goodspeed and Hart Glaciers, Wright Valley, at an elevation of ~400 m:
77° 29.76' S, 162° 22.35' E

Hart Ash deposit: J. Aislabie Antarctica NZ Pictorial Collection (2005)

Purpose

To avoid damage to an *in situ* deposit of volcanic ash airfall tephra that is of high scientific value.

Description **Zone area:** 1.8 ha

The Hart Ash deposit is an *in situ* preserved deposit of volcanic ash airfall tephra protected by a surface layer of gravel. The surface gravel protecting the ash layer has a wide spatial extent and the Hart Ash is not immediately visible unless the surface gravel is removed, making field identification difficult. The full extent of the Hart Ash deposit is thus unknown, although its maximum extent has been estimated as ~100 x 100 m (Map 21). The Hart Ash deposit, dated 3.9 ± 0.3 million years old, is of high scientific importance for interpreting the paleoclimate of the McMurdo Dry Valleys.

Boundaries

Owing to a lack of prominent surface landmarks, the boundary of the Restricted Zone is defined as an area of 150 m x 120 m following lines of latitude and longitude (Map 21) extending from the coordinates: Upper Left: 77°29.72' S, 162°22.2' E
Lower Right: 77 29.8' S, 162 22.5' E

Impacts

KNOWN IMPACTS None.
POTENTIAL IMPACTS The deposit is covered by a thin gravel desert pavement which is easily disturbed by walking. Wind erosion of the ash deposits would be rapid if the desert pavement is disturbed.

Access requirements

HELICOPTER ACCESS Helicopters should avoid landings and overflight below 50 m above ground level within the Restricted Zone. Helicopter landings should be made at least 100 m from the boundary.
SURFACE ACCESS Access to and movement within the Restricted Zone should be on foot.

Special site guidance

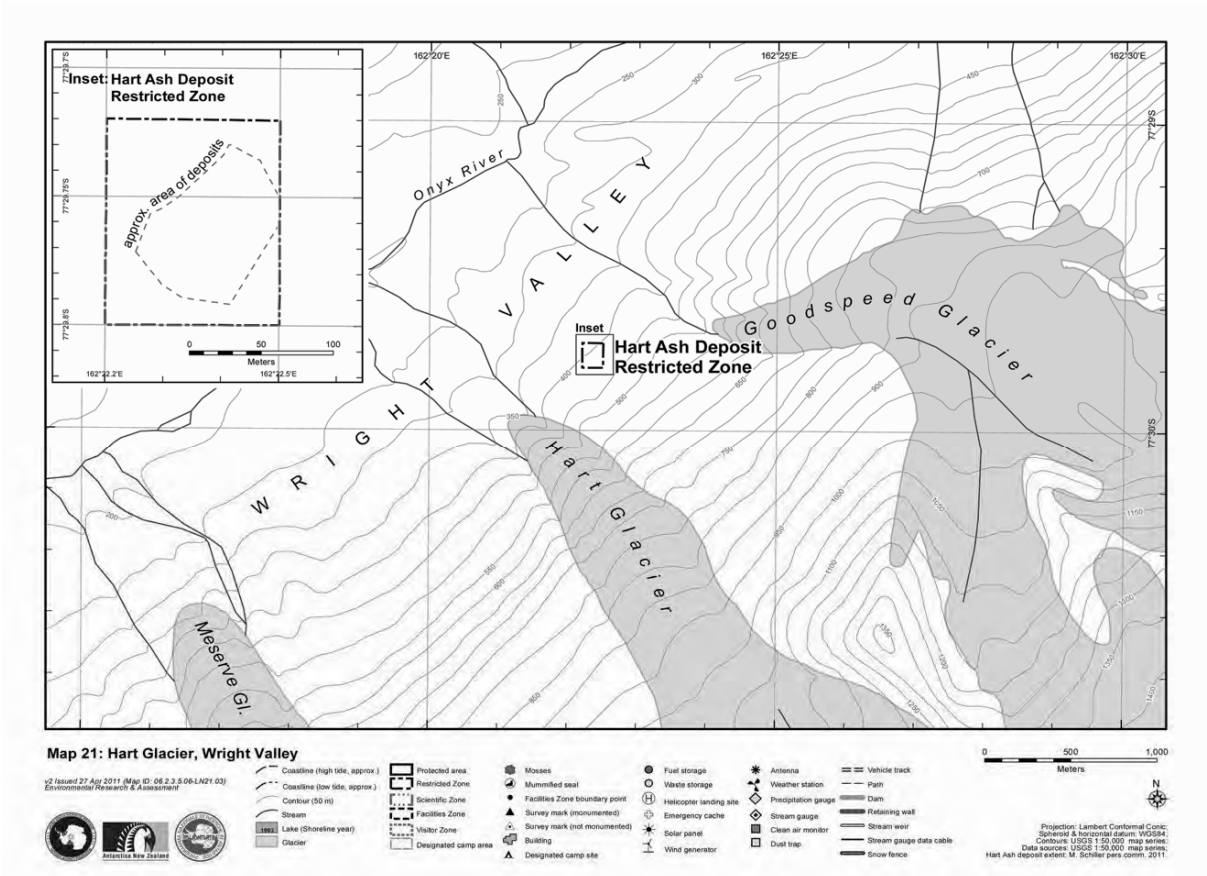
- Avoid walking on the desert pavement overlying the ash deposits unless necessary for essential scientific or management purposes, and then walk carefully to minimize disturbance.
- Should the desert pavement be removed for essential scientific purposes, ensure the material is replaced to protect the feature.
- Camping is not permitted within the Restricted Zone.

Key references

Hall, B.L., Denton, G.H., Lux, D.R. & Bockheim, J. 1993. Late tertiary Antarctic paleoclimate and ice-sheet dynamics inferred from surficial deposits in Wright Valley. *Geografiska Annaler* **75A**(4): 239-67.
Morgan, D.J., Putkonen, J., Balco, G. & Stone, J. 2008. Colluvium erosion rates in the McMurdo Dry

Valleys, Antarctica. Proceedings of the American Geophysical Union, Fall Meeting, 2008.
Schiller, M., Dickinson, W., Ditchburn, R.G., Graham, I.J. & Zondervan, A. 2009. Atmospheric 10Be in an Antarctic soil: implications for climate change. *Journal of Geophysical Research* **114**, FO1033.

Site Map – Map 21.



Restricted Zone

Victoria Valley Sand Dunes

Victoria Valley sand dunes (eastern group below Packard Glacier) H. McGowan, Antarctica NZ Pictorial Collection (Dec 2004).

Location

In two main groups between Lake Vida and Victoria Lower Glacier, ~ 1 km south from the Packard Glacier terminus, Victoria Valley:
77° 22.19' S, 62° 12.45'

Purpose

To avoid damage to the sand dune system, which is fragile and of high scientific value.

Description **Zone area:** 3.16 km²

The extensive Victoria Valley sand dune system is comprised of two distinctive areas made up of crescent-, transverse- and whaleback-shaped dunes and numerous sand mounds (Map 22). The largest group of dunes in the west extends over ~6 km and ranges between 200 to 800 m wide, with a total area of ~1.9 km^2. The smaller group of dunes in the east, which is bisected by Packard Stream and bounded to the south by Kite Stream, extends over ~3 km and ranges between 300 to 600 m wide with a total area of ~1.3 km^2. The source of sediment is from the surface and margins of the Victoria Lower Glacier and from ground moraine, which are transported west toward Lake Vida by the dominant easterly wind and meltwater streams. It is the only area where major eolian sand depositional forms occur in Antarctica. The dunes differ from the usual desert and coastal formations because the sand in the dunes is interbedded with compacted snow and contains permafrost.

Boundaries

The Restricted Zone boundary is defined by the outer extent of the main sand dune system in Victoria Valley, which extends in two groups for a distance of ~9 km with a width from varying from 200 to 800 m (Map 22).

Impacts

KNOWN IMPACTS	None
POTENTIAL IMPACTS	A thin surface layer of the sand dunes is mobile and dynamic. Damage or disruption to the internal permafrost of the dunes, can affect the integrity of the sand dune structure.

Access requirements

HELICOPTER ACCESS	Helicopters should avoid landing within the Restricted Zone and avoid overflight below 50 m above ground level.
SURFACE ACCESS	Access to and movement within the Restricted Zone should be on foot.

Special site guidance

- Avoid walking through the dunes unless necessary for scientific or management purposes.
- Walk carefully to minimize disturbance to the sensitive dune surfaces and slopes. Avoid disturbing the internal permafrost and structure of the sand dunes.
- Camping is not permitted within the Restricted Zone.

Key references

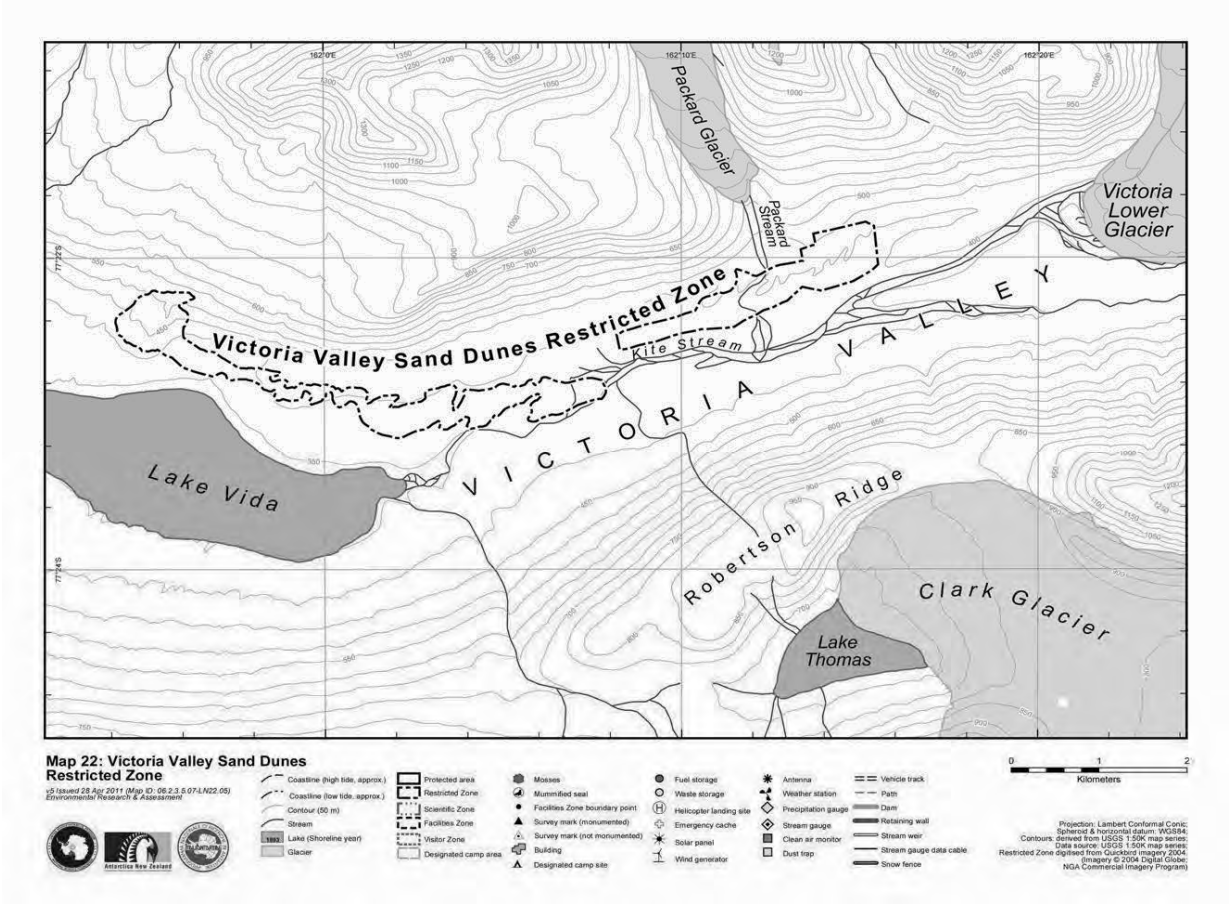
Lindsay, J.F. 1973. Reversing barchans dunes in Lower Victoria Valley, Antarctica. *Geological Society of America Bulletin* **84**: 1799-1806.

Calkin, P.E. & Rutford, R.H. 1974. The sand dunes of Victoria Valley, Antarctica. *The Geographical Review* **64**(2): 189- 216.

Selby, M.J., Rains, R.B. & Palmer, R.W.P. 1974. Eolian deposits of the ice-free Victoria Valley, Southern Victoria Land, Antarctica. *New Zealand Journal of Geology and Geophysics* **17**(3): 543-62.

Speirs, H.C., McGowan, J.A. & Neil, D.T. 2008. Meteorological controls on sand transport and dune morphology in a polar-desert: Victoria Valley, Antarctica. *Earth Surface Processes and Landforms* **33**: 1875-91.

Site Map – Map 22.



Restricted Zone

Battleship Promontory

Location

Southwest Alatna Valley, Convoy Range, ~1 km west of Benson Glacier:
76° 55.17' S, 161° 02.77' E

Purpose

To avoid damage to the fragile sandstone rock formations that host microbial communities, and to ensure aesthetic and wilderness values of the site are maintained.

a) Aerial from Alatna Valley.
b) from Cargo Pond. C. Harris, ERA / USAP (16 Dec 2009)

Description **Zone area:** 4.31 km²

Battleship Promontory is an area of dramatic Beacon Sandstone outcrops rising from the southwestern floor of Alatna Valley, near Cargo Pond (Map 23). The cliff formation is ~5 km in length, and extends over an area of between 0.4 – 1.2 km in width. The promontory stands ~300 m in height at an elevation of between ~900-1200 m in the west and ~1050-1350 m in the east. The russet and white sandstone outcrops are deeply weathered into striking spires, ledges and eroded gully formations, into which dark boulders and sediments have accumulated from the overlying dolerite as it weathers from above. The environment hosts rich microbial communities, including lichens, cyanobacteria, non-photosynthetic bacteria, and fungi, with the highest microbial biodiversity yet recorded in the Dry Valleys. Cryptoendolithic microbial communities live in pore spaces within the sandstone rock, and comprise lichens and cyanobacteria growing to depths of up to 10 mm beneath the surface. These communities are extremely slow-growing, and the rocks in which they live are susceptible to breakage.

Boundaries

The Restricted Zone boundaries encompass the main area of sandstone outcrops at Battleship Promontory, extending from and including several small lakes present the foot of the formation, to its maximum upper extent (Map 23).

Impacts

KNOWN IMPACTS Small instruments have previously been installed in rocks for *in situ* measurements, and a small quantity of rock samples collected. The designated helicopter landing site is marked by cloth flags weighed down by rocks, some of which were selected to ensure they were not used by subsequent scientists because they were modified by an early experiment (E. Friedmann, pers. comm. 1994). Air safety smoke canisters have been released at the site, causing localized contamination, a practice discontinued in the 1990s.

POTENTIAL IMPACTS Breakage of fragile rock formations, over-sampling, introduction of non-native species.

Access requirements

HELICOPTER ACCESS Helicopters should land at the designated site at: 76° 55.35' S, 161° 04.80' E (1296 m). If access is required to the base of the cliffs, or parts of the zone that are impractical to reach on foot, helicopters should avoid landing on sandstone surfaces or on lakes / ponds. SURFACE ACCESS Movement within the Restricted Zone should be on foot.

Special site guidance

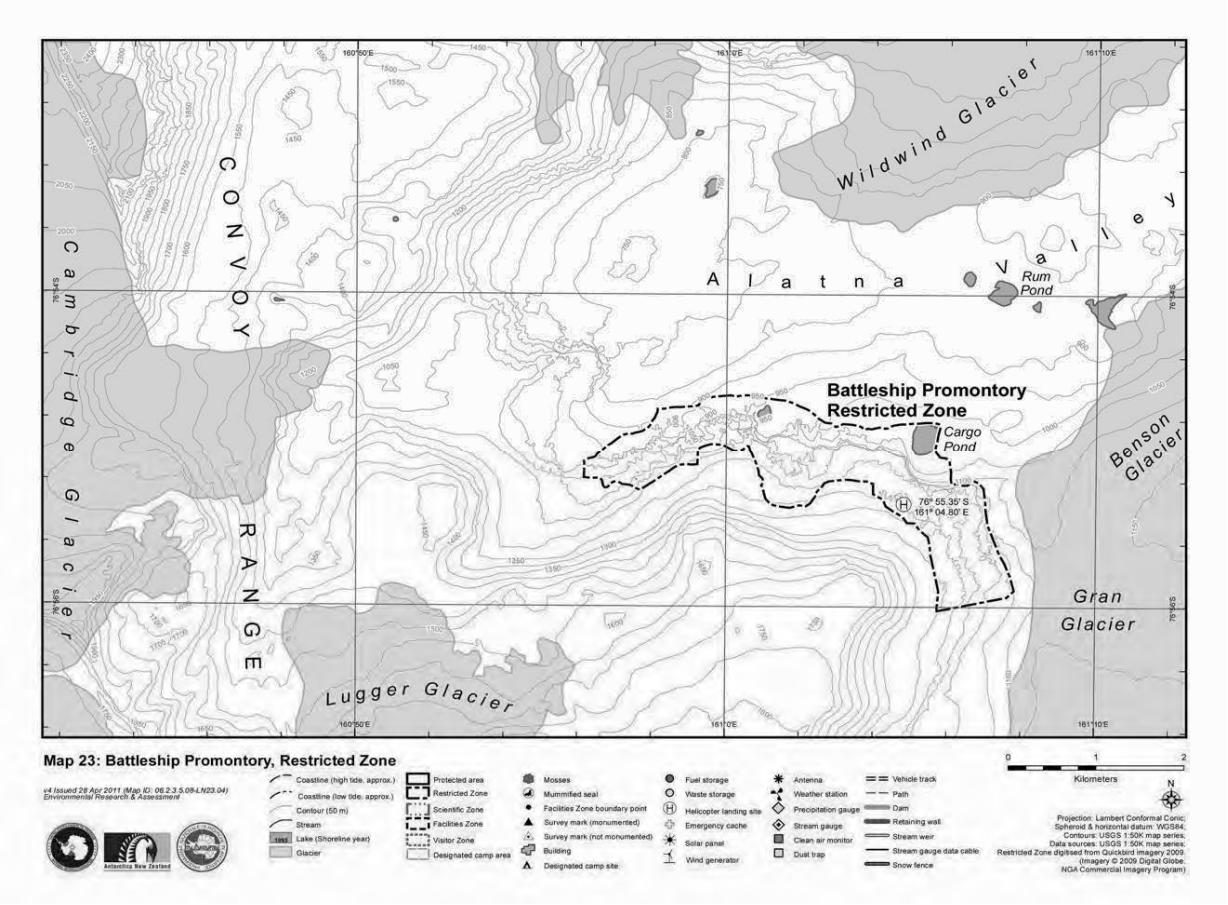
- Walk carefully to minimize disturbance, avoid moving rocks and boulders, and do not break the fragile sandstone rock formations.
- Camping within the Restricted Zone should be at the site previously used, which is adjacent to the designated helicopter landing site at 76° 55.31' S, 161° 04.80' E (1294 m).

Key references

Friedmann, E.I., Hua, M.S., Ocampo-Friedmann, R. 1988. Cryptoendolithic lichen and cyanobacterial communities of the Ross Desert, Antarctica. *Polarforschung* **58**: 251-59.

Johnston, C.G. & Vestal, J.R. 1991. Photosynthetic carbon incorporation and turnover in Antarctic cryptoendolithic microbial communities: are they the slowest-growing communities on Earth? *Applied & Environmental Microbiology* **57**(8): 2308-11.

Site Map – Map 23.



APPENDIX F:

Guidelines for Visitor Zones

The following site within the Area is designated a Visitor Zone:

- Taylor Valley

The Visitor Zone is located in the lower Taylor Valley near Canada Glacier. The location, boundaries, helicopter landing site, and features at the Visitor Zone are shown in Map 24.

The boundary of the Visitor Zone is defined as follows: proceeding in a clockwise direction from the northern limit of the zone on a low hill at 77° 37.523' S, 163° 03.189' E, the boundary extends 225 m southeast, past the designated helicopter landing site, to a point in moraine soils at 77° 37.609' S, 163° 03.585' E, thence extends 175 m southward ascending the summit of a small hill (elevation 60m) at 77° 37.702' S, 163° 03.512' E. From this small hill, the boundary extends northwest 305 m towards and beyond a second small hill (summit elevation 56 m, marked nearby with a rock cairn and old survey marker), following a line ~30 m south of the main ridge joining the two hills, directly to a point on the western ridge of this second small hill at 77° 37.637' S, 163° 02.808' E. From this ridge, the boundary extends northeast 80 m directly to the western face of a prominent boulder located at 77° 37.603' S, 163° 02.933' E, which is ~70 m northwest from the cairn on the hill. The boundary thence extends northeast 130 m, descending parallel with the designated walking track (which follows a low moraine ridge) to a point near Bowles Creek at 77° 37.531' S, 163° 03.031' E. A mummified (dessicated seal) is located here, adjacent to a small area of mosses. The boundary thence extends eastward 65 m to return to the northern limit of the zone at 77° 37.523' S, 163° 03.189' E.

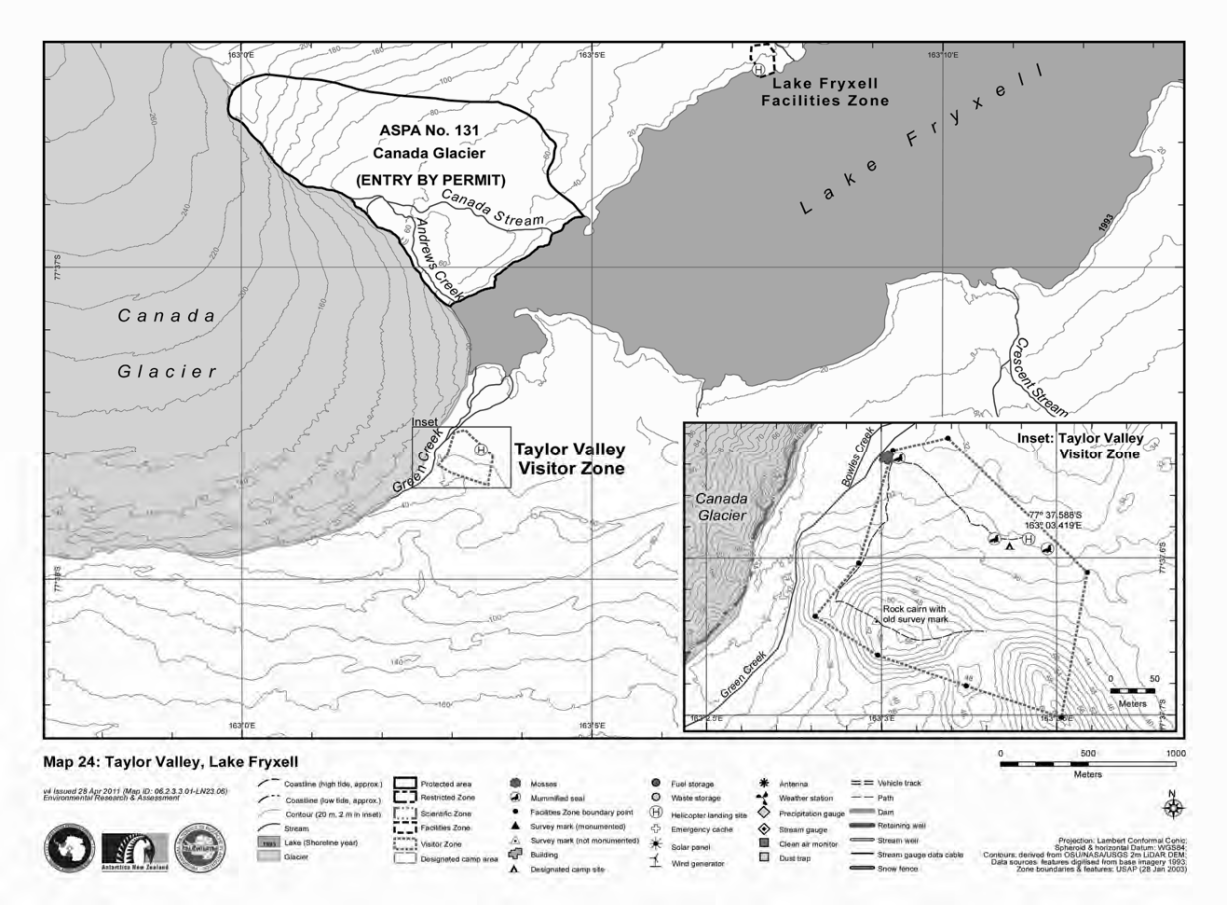
Special guidelines for activities within the Visitor Zone include that:

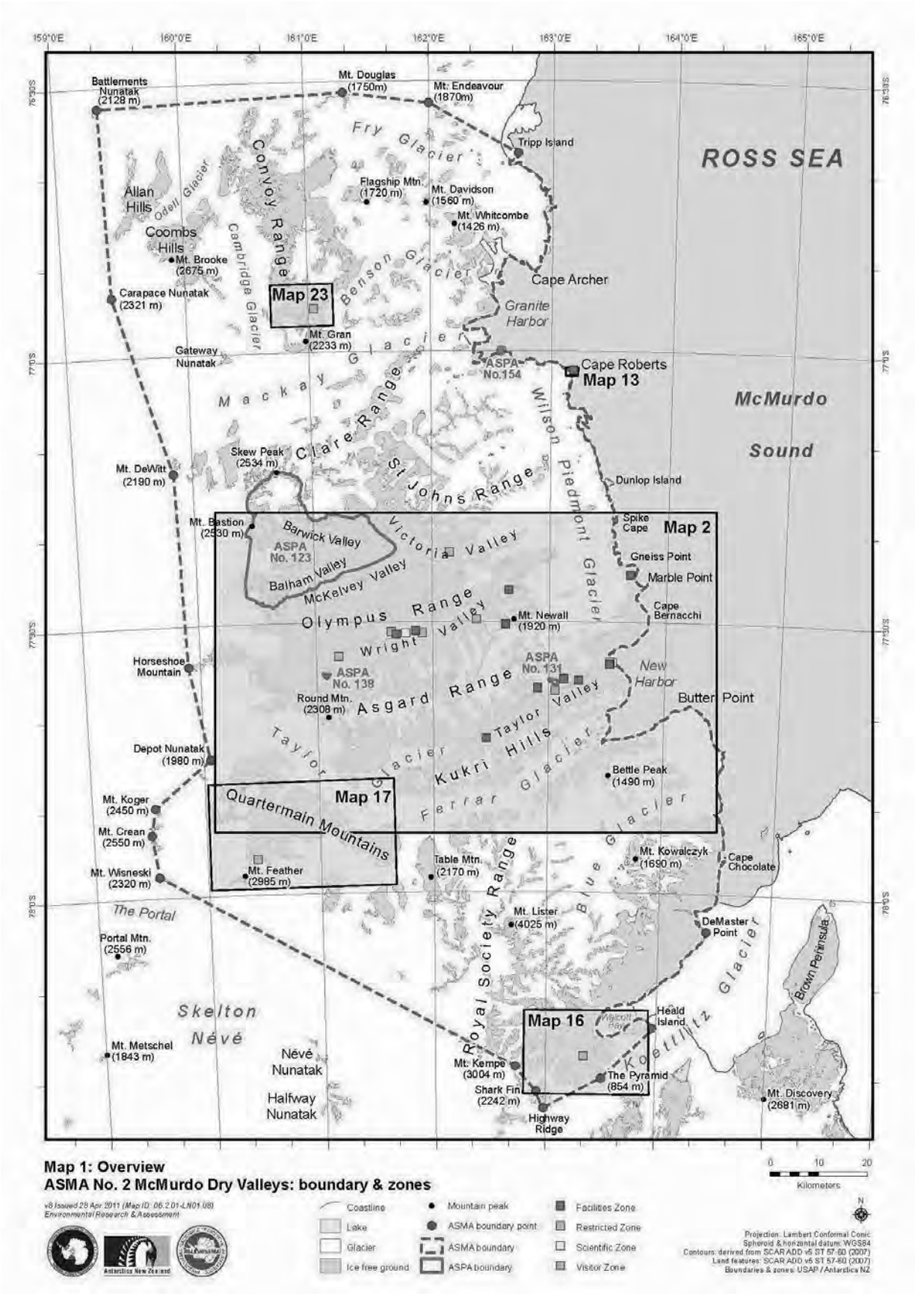
- Tour operators should ensure that all visitors to the Visitor Zone for which they are responsible have clean boots and equipment before visiting the site;
- Tour expedition helicopter landings should be made at the designated landing site at 77° 37.588' S, 163° 03.419' E (elevation 34 m);
- Tour operators should ensure that foot tracks within the Visitor Zone are clearly marked and that visitors stay on those routes. Markers used to mark tourist routes and sites of interest should be installed securely and removed at the end of each visit;
- Tents should only be erected at the designated tent site for health and safety reasons, and tour groups should not camp in the Visitor Zone except for reasons of safety;
- Tourist movement within the Visitor Zone should be conducted in small, guided groups;
- Stream and pond beds should be avoided; and
- Activities planned for and conducted within the Visitor Zone should be in accordance with ATCM Recommendation XVIII-1.

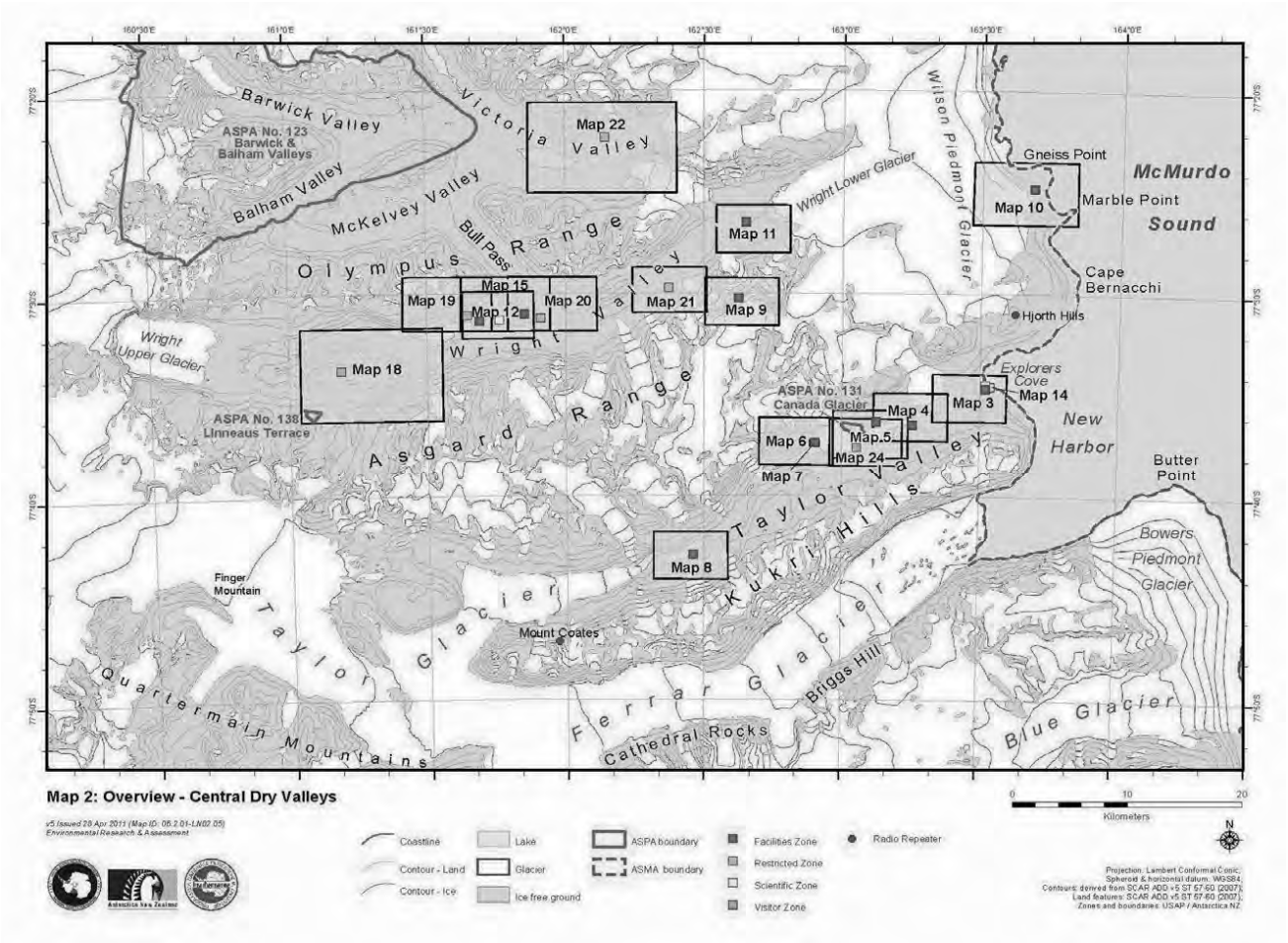
Further site-specific guidelines for the conduct of activities within the Visitor Zone are attached as the Antarctic Treaty Visitor Site Guide: Taylor Valley, Southern Victoria Land,

Ross Sea (submitted as ATCM XXXIV WPXX).

Site Map – Map 24




159°0'E
160°0'E
161°0'E
162°0'E
163°0'E
164°0'E
165°0'E
76°30'S
77°0'S
77°30'S
78°0'S
Battlements Nunatak (2128 m)
Mt. Douglas (1750m)
Mt. Endeavour (1870m)
Tripp Island
ROSS SEA
Fry Glacier
Flagship Mtn. (1720 m)
Mt. Davidson (1560 m)
Mt. Whitcombe (1426 m)
Allan Hills
Odell Glacier
Convoy Range
Coombs Hills
Mt. Brooke (2675 m)
Cambridge Glacier
Benson Glacier
Cape Archer
Granite Harbor
Carapace Nunatak (2321 m)
Map 23
Mt. Gran (2233 m)
Gateway Nunatak
Mackay Glacier
Clare Range
ASPA No.154
Cape Roberts
Map 13
McMurdo Sound
Skew Peak (2534 m)
St Johns Range
Wilson Piedmont Glacier
Mt. DeWitt (2190 m)
Dunlop Island
Mt. Bastion (2530 m)
Barwick Valley
ASPA No. 123
Victoria Valley
Balham Valley
McKelvey Valley
Spike Cape
Map 2
Gneiss Point
Marble Point
Olympus Range
Wright Valley
Mt. Newall (1920 m)
Cape Bernacchi
Horseshoe Mountain
ASPA No. 138
ASPA No. 131
New Harbor
Asgard Range
Round Mtn. (2308 m)
Taylor Valley
Butter Point
Depot Nunatak (1980 m)
Taylor Glacier
Kukri Hills
Bettle Peak (1490 m)
Ferrar Glacier
Map 17
Quartermain Mountains
Mt. Koger (2450 m)
Mt. Crean (2550 m)
Mt. Feather (2985 m)
Table Mtn. (2170 m)
Mt. Kowalczyk (1690 m)
Cape Chocolate
Mt. Wisneski (2320 m)
Blue Glacier
Royal Society Range
The Portal
Mt. Lister (4025 m)
DeMaster Point
Portal Mtn. (2556 m)
Brown Peninsula
Skelton Névé
Heald Island
Map 16
Mt. Metschel (1843 m)
Névé Nunatak
Mt. Kempe (3004 m)
The Pyramid (854 m)
Koettlitz Glacier
Halfway Nunatak
Shark Fin (2242 m)
Mt. Discovery (2681 m)
Highway Ridge
Map 1: Overview
ASMA No. 2 McMurdo Dry Valleys: boundary & zones
v8 Issued 28 Apr 2011 (Map ID: 06.2.01-LN01.08)
Environmental Research & Assessment
Antarctica New Zealand
Coastline
Lake
Glacier
Ice free ground
Mountain peak
ASMA boundary point
ASMA boundary
ASPA boundary
Facilities Zone
Restricted Zone
Scientific Zone
Visitor Zone
0 10 20
Kilometers
N
Projection: Lambert Conformal Conic
Spheroid & horizontal datum: WGS84
Contours: derived from SCAR ADD v5 ST 57-60 (2007)
Land features: SCAR ADD v5 ST 57-60 (2007)
Boundaries & zones: USAP / Antarctica NZ


Barwick Valley
ASPA No. 123
Barwick &
Balham Valleys
Balham Valley
McKelvey Valley
Victoria
Valley
Map 22
Bull Pass
Olympus Range
Map 11
Wright Lower Glacier
Wilson Piedmont Glacier
Gneiss Point
Map 10
McMurdo
Sound
Marble Point
Cape
Bernacchi
Hjorth Hills
Map 15
Map 19
Map 12
Map 20
Map 21
Map 9
Wright
Valley
Wright
Upper Glacier
Map 18
ASPA No. 138
Linneaus Terrace
Asgard Range
ASPA No. 131
Canada Glacier
Explorers
Cove
Map 14
Map 3
Map 4
Map 6
Map 5
Map 24
Map 7
New
Harbor
Butter
Point
Taylor
Valley
Taylor
Glacier
Kukri Hills
Map 8
Bowers
Piedmont
Glacier
Finger
Mountain
Mount Coates
Quartermain Mountains
Ferrar Glacier
Briggs Hill
Cathedral Rocks
Blue Glacier
Map 2: Overview - Central Dry Valleys
v5 (issued 28 Apr 2011 (Map ID: 05.2.01-LN02.05)
Environmental Research & Assessment
Coastline
Contour - Land
Contour - Ice
Lake
Glacier
Ice free ground
ASPA boundary
ASMA boundary
Facilities Zone
Restricted Zone
Scientific Zone
Visitor Zone
Radio Repeater
0
10
20
Kilometers
N
Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Contours: derived from SCAR ADD v5 ST 57-60 (2007);
Land features: SCAR ADD v5 ST 57-60 (2007);
Zones and boundaries: USAP / Antarctica NZ

Measure 11

Antarctic Historic Sites and Monuments: Monument to the Antarctic Treaty and Plaque

The Representatives,

Recalling the requirements of Article 8 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty to maintain a list of current Historic Sites and Monuments, and that such sites shall not be damaged, removed or destroyed;

Recalling

- Measure 3 (2003), which revised and updated the "List of Historic Sites and Monuments";
- Measure 3 (2007), which added Monument to the Antarctic Treaty and Plaque to the List of Historic Monuments and Sites annexed to Measure 3 (2003);

Desiring to modify the description of a Historic Site and Monument;

Recommend to their Governments the following Measure for approval in accordance with Paragraph 2 of Article 8 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That the description of the Historic Monument and Site No 82 (Measure 3 (2007))be modifed in order to read as follows:

"No 82: Monument to the Antarctic Treaty and Plaque"

This Monument is located near the Frei, Bellingshausen and Escudero bases, Fildes Peninsula, King George Island. The plaque at the foot of the monument commemorates the signatories of the Antarctic Treaty. This Monument has 4 plaques in the of cial languages of the Antarctic Treaty. The plaques were installed in February 2011 and read as follows: "This historic monument, dedicated to the memory of the signatories of the Antarctic Treaty, Washington D.C., 1959, is also a reminder of the legacy of the First and Second International Polar Years (1882- 1883 and 1932-1933) and of the International Geophysical Year (1957-1958) that preceded the Antarctic Treaty, and recalls the heritage of International Cooperation that led to the International Polar Year 2007-2008." This monument was designed and built by the American Joseph W. Pearson, who offered it to Chile. It was unveiled in 1999, on the occasion of the 40th anniversary of the signature of the Antarctic Treaty.".

Measure 12

Antarctic Historic Sites and Monuments: No 1 Building at Great Wall Station

The Representatives,

Recalling the requirements of Article 8 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty to maintain a list of current Historic Sites and Monuments, and that such sites shall not be damaged, removed or destroyed;

Recalling Measure 3 (2003), which revised and updated the "List of Historic Sites and Monuments";

Desiring to add a further Historic Monument to the "List of Historic Sites and Monuments";

Recommend to their Governments the following Measure for approval in accordance with Paragraph 2 of Article 8 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty:

That the following Historic Monument be added to the "List of Historic Sites and Monuments" annexed to Measure 3 (2003): "No 86:

No 1 Building at Great Wall"

The No 1 Building, built in 1985 with a total oor space of 175 square metres, is located at the centre of the Chinese Antarctic Great Wall Station which is situated in Fildes Peninsula, King George Island, South Shetlands, West Antarctica. The Building marked the commencement of China devoting to Antarctic research in the 1980s, and thus it is of great signi cance in commemorating China's Antarctic expedition.

Location: 62°13 4 S, 58°57 44 W

Original proposing Party: CHINA

Party undertaking management: CHINA

Published by TSO (The Stationery Office) and available from:

Online
www.tsoshop.co.uk

Mail, Telephone, Fax & E-mail
TSO
PO Box 29, Norwich NR3 1GN
Telephone orders/General enquiries: 0870 600 5522
Order through the Parliamentary Hotline Lo-Call: 0845 7 023474
Fax orders: 0870 600 5533
Email: customer.services@tso.co.uk
Textphone: 0870 240 3701

The Houses of Parliament Shop
12 Bridge Street, Parliament Square
London SW1A 2JX
Telephone orders: 020 7219 3890/General enquiries: 020 7219 3890
Fax orders: 020 7219 3866
Email: shop@parliament.uk
Internet: http://www.shop.parliament.uk

TSO@Blackwell and other accredited agents

ISBN 978-0-10-188092-3