The Antarctic Treaty

Measures adopted at
the Thirty-ninth Consultative Meeting
held at Santiago, Chile 23 May – 1 June 2016

Presented to Parliament
by the Secretary of State for Foreign and Commonwealth Affairs
by Command of Her Majesty
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MEASURES ADOPTED AT THE THIRTY-NINTH ANTARCTIC TREATY CONSULTATIVE MEETING

Santiago, Chile 23 May – 1 June 2016

The Measures[1] adopted at the Thirty-ninth 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 8 (2016).

The approval procedures set out in Article 8 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty applies to Measure 9 (2016).

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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, Thirty-third, Thirty-fourth, Thirty-fifth, Thirty-sixth, Thirty-seventh and Thirty-eighth 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 XXXIX Consultative Meeting held at Santiago, Chile 23 May - 1 June 2016

Measure 1 (2016)

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 Scientific 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;
- 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;
- Measures 1 (2006) and 2 (2011), which adopted revised Management Plans 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 Recommendations XIII-12 (1985) and XVI-7 (1991) were 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 Management Plan for Antarctic Specially Protected Area No 116 annexed to Measure 1 (2011) be revoked.

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

An area at Cape Bird, Ross Island was originally designated as Site of Special Scientific Interest (SSSI) No. 10, Caughley Beach by Recommendations XIII-8 (1985) and Specially Protected Area (SPA) No. 20, New College Valley by Recommendation XIII-12 (1985) after proposals by New Zealand on the grounds that the area contains 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.

SPA No. 20 was originally enclosed within SSSI No. 10 in order to provide more stringent access conditions to this part of the Area. SSSI No. 10 was incorporated into SPA No. 20 by Measure 1 (2000), with the former Area of SPA No. 20 becoming a Restricted Zone within the SPA. 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) and Measure 1 (2011).

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 adjacent operational research/field stations.
- Rock cairns or signs illustrating the location and boundaries, 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 foot 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 west 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.

New College Valley, Caughley Beach is located within Environment S – McMurdo – South Victoria Land geologic based on the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)) and in Region 9 – South Victoria Land based on the Antarctic Conservation Biogeographic Regions (Resolution 6 (2012))

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. 175) 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 77° 13.221'S, 166° 25.812'E (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 77° 13.093S, 166° 26.168' E (Map B).

Between October and February the preferred flight path is an approach from the south above Middle Rookery (Map A). Flights north of the helicopter pad may be necessary under certain wind conditions but should follow the recommended aircraft approach and departure routes, and to maximum extent possible, follow the 'Guidelines for the Operation of Aircraft Near Concentrations of Bird in Antarctica' (Resolution 2, 2004). 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. 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 radionuclides 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 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*. If this is the case 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;
- to erect or maintain signposts, structures or scientific equipment; or
- for management activities.

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

To help maintain the ecological and scientific values of the isolation and relatively low level of human impact at the Area, visitors shall take special precautions against introductions. Of particular concern are microbial or vegetation introductions sourced from soils at other Antarctic sites, including stations, or from regions outside Antarctica. To 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 visit reports should include, as applicable, the information identified in the recommended visit report form [contained in Appendix 4 of the Guide to the Preparation of Management Plans for Antarctic

Specially Protected Areas appended to Resolution 2 (1998)] [available from the website of the Secretariat of the Antarctic Treaty www.ats.aq].

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 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., Convey, P, Redding, G.P. and Stevens, M.I. 2010. Temporal and spatial metabolic rate variation in the Antarctic springtail Gomphiocephalus hodgsoni. Journal of Insect Physiology 56: 57-64.

McGaughran, A., Convey, P. and Hogg, I.D. 2011. Extended ecophysiological analysis of Gomphiocephalus hodgsoni (Collembola): flexibility in life history strategy and population response. Polar Biology 34: 1713-1725.

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.

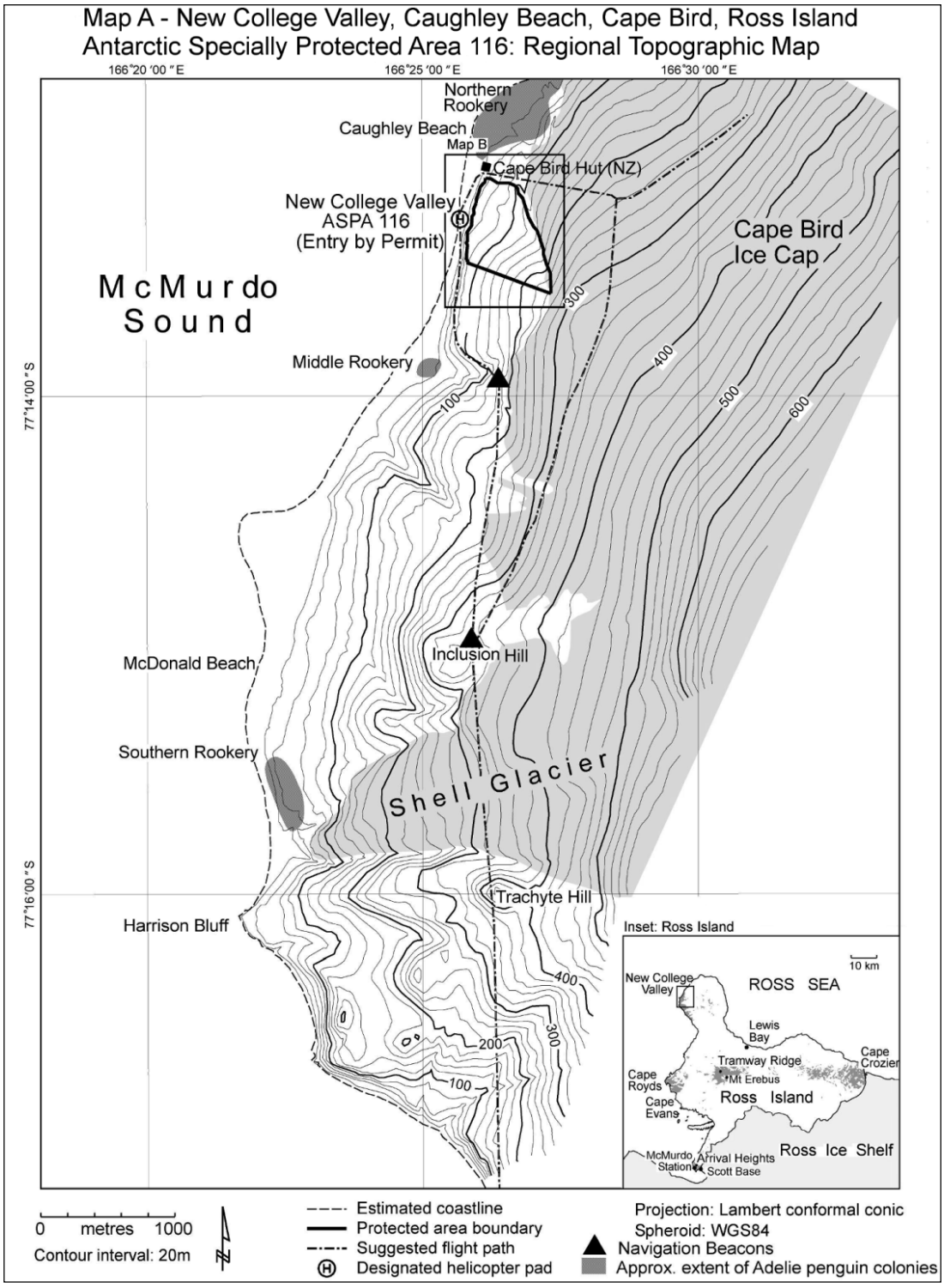
Sinclair, B.J. and Sjursen, H. 2001. Terrestrial invertebrate abundance across a habitat transect in Keble Valley, Ross Island, Antarctica. Pedobiologia 45: 134-145.

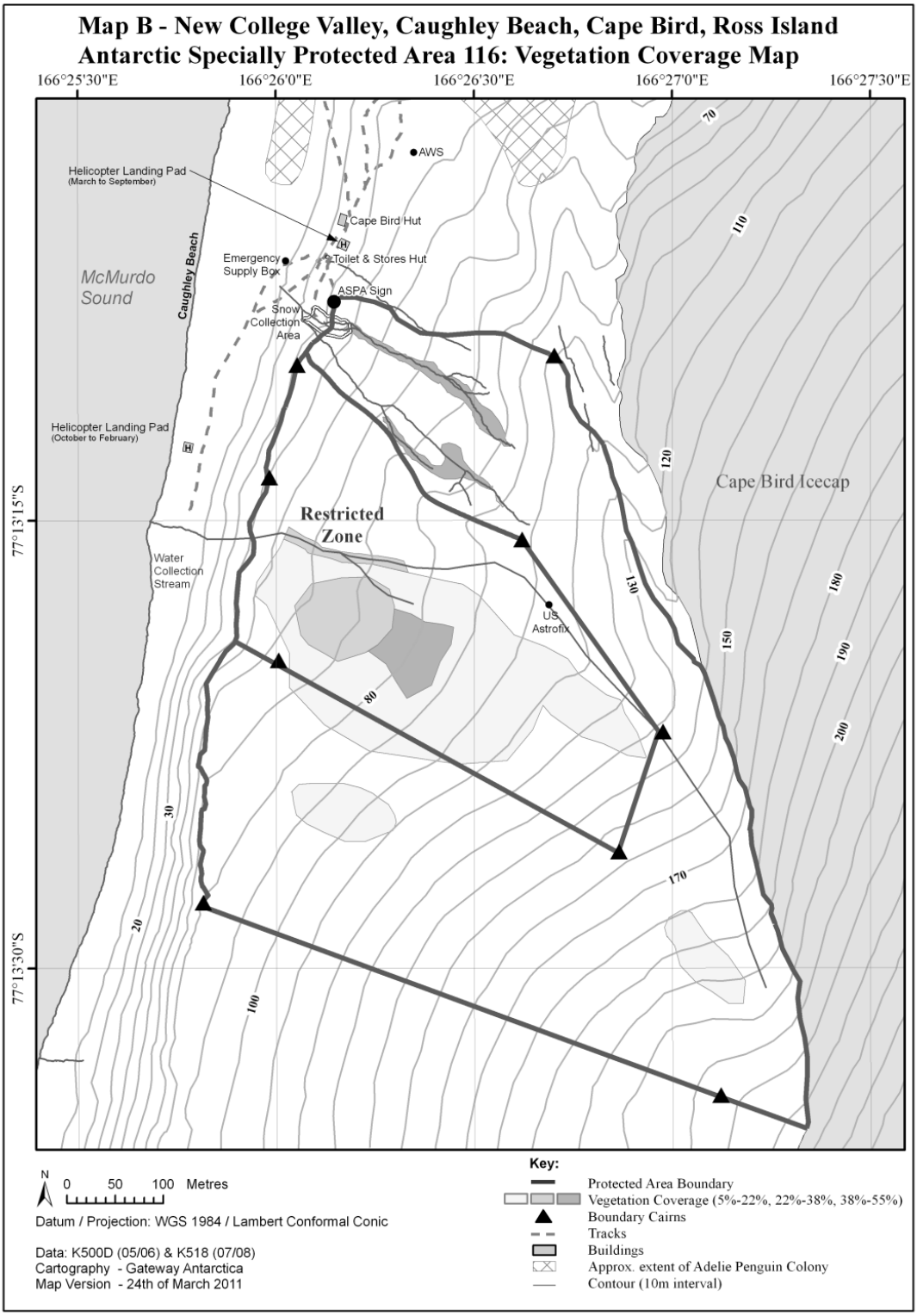
Smith, D.J. 1970. The ecology of *Gomphiocephalus hodgsonii* Carpenter (Collembola, Hypogastuidae) at Cape Bird, Antarctica. Unpublished MSc Thesis, University of Canterbury, Christchurch, New Zealand.

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
200
300
400
500
600
McDonald Beach
Inclusion Hill
Southern Rookery
Shell Glacier
Trachyte Hill
Harrison Bluff
Inset: Ross Island
10 km
New College Valley
ROSS SEA
Lewis Bay
Tramway Ridge
Mt Erebus
Cape Crozier
Cape Royds
Ross Island
Cape Evans
Ross Ice Shelf
McMurdo Station
Arrival Heights
Scott Base
0 metres 1000
Contour interval: 20m
N
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
McMurdo
Sound
Caughley Beach
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)

Measure 2 (2016)

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;
- Measures 2 (2005) and 2 (2011), which adopted revised Management Plans for ASPA 120;

Recalling that Measure 3 (1995) had not become effective and was withdrawn by Measure 2 (2011);

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; and
2. the Management Plan for Antarctic Specially Protected Area No 120 annexed to Measure 2 (2011) be revoked.

Management Plan for Antarctic Specially Protected Area No. 120

CAPE GEOLOGY ARCHIPELAGO, TERRE ADÉLIE

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

Introduction

The Cape Geology Archipelago, in Terre Adélie, comprises 8 principal islands grouped over less than 2.4 km², about 5 km from the Antarctic continent. Petrel Island, the largest of these islands, is the site of the Dumont d'Urville French scientific station (66°39′ 46″ S 140°0′ 07″ E). In the 1980s, important work was undertaken in order to connect the Buffon, Cuvier and Lion Islands with a view to establishing a runway for large aircraft. This project was never completed, essentially because the sea destroyed part of the platform created.

This archipelago is distinctive in that it hosts breeding grounds for eight of the nine species of birds that breed on the coasts of the Antarctic. Among these eight species of birds, four belong to the Procellariidae family, two to the Spheniscidae family, one to the Stercorariidae family and lastly, one belongs to the Hydrobatidae family. Two species which are emblematic of the Antarctic are noticeably present: giant petrels and emperor penguins; the winter colony of the latter being a few hundred metres from the Dumont d'Urville base.

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) because they were a representative example of terrestrial Antarctic ecosystems from a biological, geological and aesthetics perspective.

Resolution 3 (2008) recommended that "Environment Domains Analysis for the Antarctic Continent" should serve as a dynamic model for the identification of Antarctic Specially Protected Areas (see also Morgan *et al*., 2007). According to this model, ASPA No. 120 is part of environmental domain L (Continental coastal-zone ice sheet).

Also, Resolution 6 (2012) recommended that "the Antarctic Conservation Biogeographic Regions be used in conjunction with the Environmental Domains Analysis... [to identify] areas that could be designated as ASPAs" and to thereby respond to the idea of the systematic environmental-geographic framework referred to in Article 3 Paragraph 2 of Annex V of the Protocol on Environmental Protection to the Antarctic Treaty. Consequently, Cape Geology is part of Conservation Biogeographic Region n°13, "Terre Adélie" (see Terauds *et al*. 2012), one of the smallest Conservation Biogeographic Regions (178 km²).

1. Description of Values to be Protected

The area contains exceptional environmental and scientific values due to the diversity of the species of birds and marine mammals that breed there:

- The Weddell seal *(Leptonychotes weddellii)*
- The emperor penguin *(Aptenodytes forsteri)*
- The Antarctic skua *(Catharacta maccormicki)*
- The Adélie penguin *(Pygoscelis adeliae)*
- The Wilson's petrel *(Oceanites oceanicus)*
- The Southern giant petrel *(Macronectes giganteus)*
- The snow petrel (*Pagodroma nivea)*
- The cape petrel *(Daption capense)*.

Long-term research and monitoring programmes 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 *Institut Polaire Français Paul-Emile Victor (IPEV) and the French Centre National de la Recherche scientifique (CNRS)*. This has enabled the implementation of a population database of exceptional value, by time-scale of observation. It is maintained and used by the *Centre d'Etudes Biologiques de Chizé (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 46 emperor penguin breeding sites on record (Fretwell *et al*. 2012), Cape Geology is one of the only ones, along with that near the Mirny station, 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 Geology Specially Protected Area aims at:

- Preventing disturbance in the area due to the proximity of the Dumont d'Urville station;
- Limiting disturbance in the area by preventing any unjustified human intervention;
- Avoiding any major changes to the structure and composition of flora and fauna and in particular the different species of marine vertebrates, birds and mammals harboured in the area, which is one of the most representative for both faunistic and scientific interest on the Adélie Coast;
- Permitting scientific research which can not be undertaken elsewhere, in particular in the life sciences (ethology, ecology, physiology and biochemistry, demographic studies of birds and sea mammals, impact

assessment of surrounding human activities etc) and earth sciences (geology, geomorphology etc);
- Controlling logistical 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 wholly protected.
- Any activity - be it scientific or management in nature - carried out in the area must undergo an environmental impact assessment before being undertaken, in accordance with the requirements stipulated in Annex 1 of the Protocol on Environmental Protection to the Antarctic Treaty.
- In accordance with Annex 3 of the Protocol on Environmental Protection to the Antarctic Treaty, abandoned material(s) will be removed, as far as possible, provided that this removal does not damage the environment or the values of the area.
- 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, more generally of the current management plan. To this end, 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.

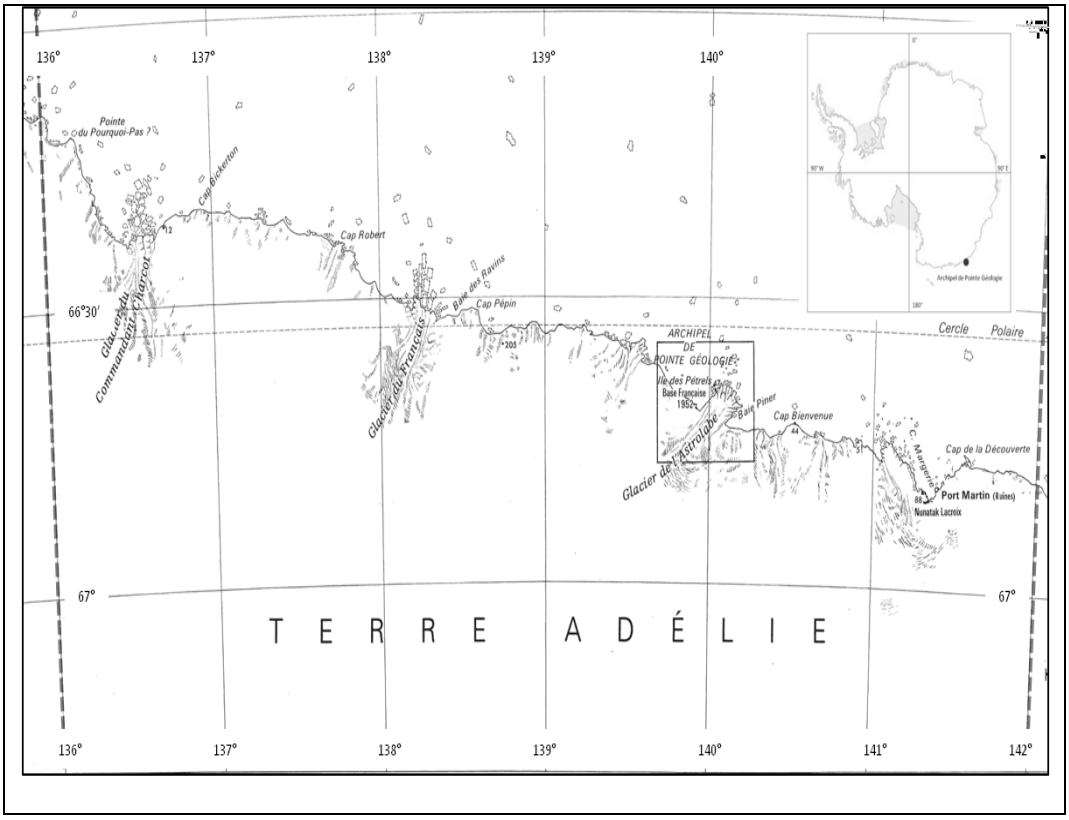
4. Period of Designation

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

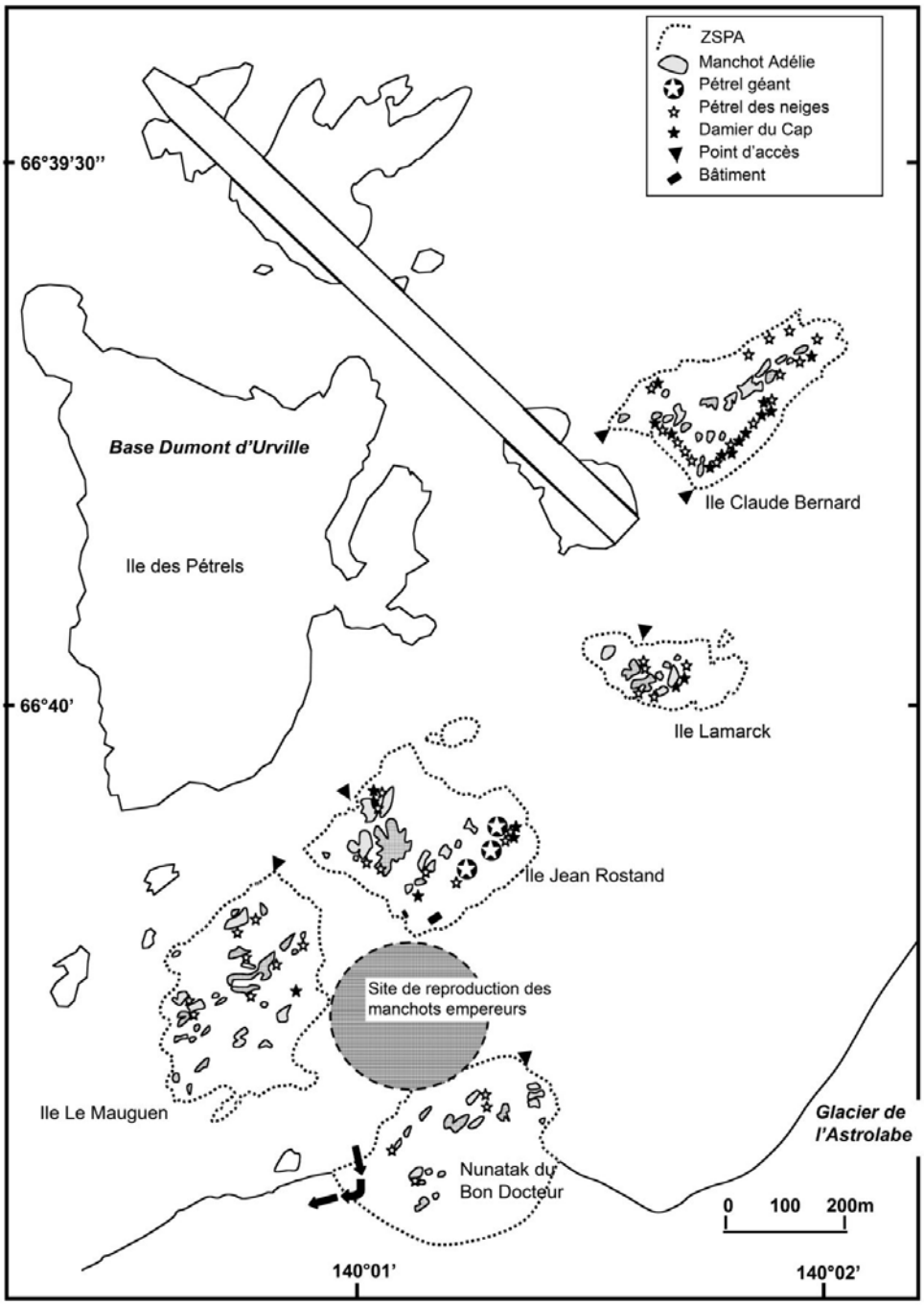
5. Maps

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.

Map 2 of the Cape Geology Archipelago shows the location of the main bird colonies and the dotted line indicates the boundary of ASPA No. 120 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. The emperor penguins, present from March to mid-December, establish their colony on the pack ice between the islands and their location is variable. 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

BOUNDARIES AND COORDINATES

ASPA No. 120 is located along the Terre Adélie coast, in the heart of the Cape Geology Archipelago (140° - 140°02'E; 66°39'30'' - 66°40'30'' S). It comprises the following territories:

- Jean Rostand Island,
- Le Mauguen (formerly Alexis Carrel) Island,
- Lamarck Island,
- Claude Bernard Island,
- the 'Good Doctor' 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; 'Good Doctor' 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 ASPA is then clearly limited by natural markers (island outlines and rocky outcrops).

No tracks or roads exist in the area.

GENERAL DESCRIPTION OF THE AREA

- *Geology*

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 centimetres to more than a metre across).

- *Terrestrial biological communities*

No vascular plants and no macro-arthropods live in the area. Only the *Prasiola crispa* cosmpolitan algae is present and can have significant coverage locally depending on the supply of bird droppings.

- *Vertebrate Fauna*

Seven species of birds and one marine mammal (the Weddell seal) use the Cape Geology Archipelago. They have all been monitored populations since the 1950s-1960s. Table 1 provides information about the number of seabirds observed, Table 2 about periods of presence of the different species and Table 3 about the estimated sensitivity of each species.

The establishment of the Dumont d'Urville station has resulted in a drastic decrease in the populations of southern giant petrels in the Cape Geology Archipelago. The breeding colony on Petrel Island disappeared completely at the end of the 1950s during the early years when the base was being set up in close proximity to this colony (building extensions, increase in helicopter flights, installation and replacement of fuel storage tanks). Currently, 100% of the southern giant petrels population breeds inside the ASPA, in the South-Eastern part of Rostand Island.

The work undertaken between 1984 and 1993 to connect the Buffon, Cuvier and Lion Islands with a view to establishing a runway resulted in the destruction of the breeding sites of approximately 3,000 Adélie penguin pairs, 210 snow petrel pairs, 170 cape petrel pairs, 180 Wilson's petrel pairs and 3 Antarctic skua pairs (Micol & Jouventin 2001). Quite a significant proportion of the Adélie penguin pairs moved to the ASPA, unlike the other species (Micol & Jouventin 2001, CEBC data not published).

The significant decrease in emperor penguins by the end of the 1970s seems to have been due to long weather anomalies between 1976 and 1982 which caused a significant decrease in the surface area of thepack ice (Barbraud & Weimerskirch 2001, Jenouvrier *et al*. 2012). 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 (Table 3).

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

Table 1. Number of sea bird breeding pairs within ASPA No. 120 (count done during the 2014/2015 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 2014/2015 breeding cycle except for Wilson's storm petrels, data from 1986 in Micol & Jouventin 2001)

Site	Emperor penguin	Adélie penguin	South polar skua	Snow petrel	Cape petrel	Wilson's storm petrel*	Southern giant petrel
C. Bernard	--	3,682	4	152	204	178	--
Lamarck	--	1,410	1	31	26	45	--
J. Rostand	--	5,441	8	54	57	35	19
Le Mauguen	--	4,271	18	14	1	72	

Site	Emperor penguin	Adélie penguin	South polar skua	Snow petrel	Cape petrel	Wilson's storm petrel*	Southern giant petrel
(formerly Alexis Carrel)							
Nunatak	---	1793	1	5	--	41	--
Winter pack ice between islands	3,772	--	--	--	--	--	--
ASPA TOTAL	3,772	16,597	32	256	288	371	19
PG TOTAL	3,772	42,757	74	691	492	1,200	19
ASPA/PG %	100	39	43	37	59	31	100

Table 2. Presence of birds on breeding grounds

	Emperor penguin	Adélie 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	December	December	December	October
Last departure	End of 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 CEBC-CNRS data, Thomas 1986, and Micol & Jouventin 2001 for data on Wilson's storm petrels)

	Emperor penguin	Adélie penguin	South polar skua	Snow petrel	Cape petrel	Wilson's storm petrel	Southern giant petrel
Sensitivity	High	Medium	Medium	Medium	High	High	High
Trend 1952-1984	Diminishing	Stable	Stable	?	?	?	Diminishing
Trend 1984-2000	Stable	Increasing	Increasing	Stable	Stable	?	Stable
Trend 2000/15	Slightly increasing	Increasing	Increasing	Increasing	Stable	?	Slightly increasing

6(ii) Identification of restricted or prohibited zones

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). The location of breeding colonies and points of access to the islands are shown on map 2. Birds are mainly present during the austral summer, except for the emperor penguins, which breed in winter.

- *The case of Rostand Island*

The Southern giant petrels are present in an area defined by the NE-SW ridgegoing through the 33.10 m and the 36.39 m marks North West of the colony, marked on the ground 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 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.

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 be 20 m.

6(iii) Structures in the Area

Prévost hut and a shelter are located on Rostand Island. There are no other buildings anywhere else in the Area.

6(iv) Location of other protected Areas nearby

The closest protected area to APSA No. 120 is ASPA No. 166, "Port Martin", located 60 km to the east.

6(v) Special Areas within the ASPA

None.

7. Permit Conditions

- Entry into the Area is subject to obtaining a Permit issued by an appropriate national authority designated under Article 7 of Annex 5 of the Protocol on Environmental Protection to the Antarctic Treaty. The Head of the Dumont d'Urville station is kept informed regarding Permit-holders.
- Permits can be issued for the activities envisaged in Paragraph 7(ii). Permits will authorise 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

- Access to the Area is permitted by foot or by light watercraft (in summer) only.
- No helicopters are authorised within the Area and overflights of the Area by all unauthorised aircraft are prohibited (except in the event of emergency procedures).
- The use of leisure drones within the ASPA is prohibited.
- The use of drones or helicopter overflights for scientific research, population monitoring or logistical purposes, must be specifically requested along with the request to access the ASPA. Access authorisations issued by the appropriate authorities must mention the authorisation, as required, of the use of drones in the area or the helicopter overflight by specifying the flying conditions of these aircraft.
- 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 thesetransits to be made safely, a route along the western edge of the 'Good Doctor' Nunatak' can be permitted exceptionally, as indicated on Map 2.
- In any case, terrestrial vehicles obliged to drive close to colonies of emperor penguins must be remain outside the ASPA, respecting a minimum distance of 40 m.
- 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 and their access are not damaged or endangered.
- Although the base situated on Petrel Island is not included in the ASPA, particular care should also be taken when the emperor penguins move there (an exceptional circumstance which, in the main, involves only adults or thermally emancipated young). In this case, it is recommended that a minimum approach distance of 20 m be maintained, except for ornithologists who can be brought in, taking all necessary precautions, to move the animals in order to allow essential logistical activities to be undertaken around the base.

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.
- Conservation activities pertaining to the species present.
- Essential management and logistical activities.
- Educational and scientific outreach activities (filming, photography, sound recording etc) which cannot be conducted elsewhere.

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 or conservation activities as authorised by an appropriate national authority.
- Permanent structures or facilities are prohibited.
- The possible modification or dismantling of installations currently on Rostand Island can proceed only after authorisation.

7(iv) Location of field camps

Camping in the Area is prohibited. An exception can be made only for security reasons. In such an event, tents should be set up in such a way that they disturb the environment as little as possible.

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 Protocol on Environmental Protection to the Antarctic Treaty, no living animals or plant materials shall be introduced into the Area.
- Special precautions shall be taken against accidentally introducing microbes, invertebrates or plants from other Antarctic sites, including stations, or from regions outside Antarctica. All sampling equipment or markers brought into the Area shall be cleaned or sterilised. To the maximum extent practicable, footwear and other equipment used or brought into the Area (including bags or backpacks) shall be thoroughly cleaned before entering the Area. The CEP's Non-native Species Manual (current edition published on the website of the Secretariat of the Antarctic Treaty) and the COMNAP/SCAR Checklists for Supply Chain Managers of National Antarctic Programmes for the Reduction in the Risk of Transfer of Non-native Species provide additional guidance on this matter.
- No poultry products, including waste associated with these products and products containing egg powder, 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 in 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, SCAR's Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica (ATCM XXXIV-CPE XIV IP53) must be used as a 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 in accordance with Annex II of the Protocol on Environmental Protection to the Antarctic Treaty, which acts as a minimum standard.

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 the activities referred to in paragraph 7 (ii) and duly authorised.
- Scientific activities will be undertaken in accordance with SCAR's Code of Conduct for Terrestrial Scientific Field Research in Antarctica (ATCM XXXII-CPE XII IP004) and SCAR's Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica (ATCM XXXIV-CPE XIV IP53).

7(x) 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 in the Area. Such reports, to be submitted no later than six months after the visit to the Area, should include, as appropriate, the information identified in the visit report form contained in the "Guide to the Preparation ofManagement Plans for Antarctic Specially Protected Areas" (Resolution 2, 2011).

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 Planand when organising the scientific manipulation of the Area.

8. References

Barbraud, C. and Weimerskirch. H. 2001. Emperor penguins and climate change. *Nature*, 411**:** 183-186

Fretwell, P.T., LaRue, M.A., Morin, P., Kooyman, G.L., Wienecke, B., Ratcliffe, N., Adrian, J.F., Fleming, A.H., Porter, C. and Trathan, P.N. 2012. An Emperor Penguin Population Estimate: The First Global, Synoptic Survey of a Species from Space. *PLoS ONE*, 7(4), e33751.

Jenouvier, S., Holland, M., Stroeve, J., Barbraud, C., Weimerskirch, H., Serreze, M. and Caswell, H. 2012. Effects of climate change on an emperor penguin population: analysis of coupled demographic and climate models. *Global Change Biology*, 18, 2756-2770.

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

Morgan, F., Barker, G., Briggs, C., Price, R. and Keys, H. 2007. Environmental Domains of Antarctica Version 2.0 Final Report, Manaaki Whenua Landcare Research New Zealand Ltd. 89 pp.

ATCM XXXIV-CPE XIV IP53 2011. SCAR's Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica

Terauds, A., Chown, S.L., Morgan, F., Peat, H.J., Watts, D.J., Keys, H., Convey, P. and Bergstrom, D. 2012. Conservation biogeography of the Antarctic. *Diversity and Distributions*, 18, 726-741.

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.

Measure 3 (2016)

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 Scientific Interest ("SSSI") No 2 and annexed a Management Plan for the Site;
- Recommendations X-6 (1979), XII-5 (1983), XIII-7 (1985), XIV-4 (1987), Resolution 3 (1996) and Measure 2 (2000), which extended the expiry date of SSSI 2;
- Decision 1 (2002), which renamed and renumbered SSSI 2 as ASPA 122;
- Measures 2 (2004) and 3 (2011), which adopted revised Management Plans for ASPA 122;

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

Recalling that Recommendations VIII-4 (1975), X-6 (1979), XII-5 (1983), XIII-7 (1985), XIV-4 (1987) and Resolution 3 (1996) were 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 Antarctic Specially Protected Area No 122 annexed to Measure 3 (2011) be revoked.

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, unobstructed low viewing horizon, clean air and 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), Resolution 3 (1996) and Measure 2 (2000). The Area was renamed and renumbered through Decision 1 (2002); a revised management plan was adopted through Measure 2 (2004) and Measure 3 (2011). The degradation of electromagnetically 'quiet' conditions within the Area was recognized by SCAR Recommendation XXIII-6 (1994).

The Area lies within 'Environment S – McMurdo – South Victoria Land geologic', as defined in the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)). Under the Antarctic Conservation Biogeographic Regions classification (Resolution 6 (2012)) the Area lies within ACBR9 – South Victoria Land.

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 greenhouse gases, trace gases such as ozone, spectroscopic and air particulate investigations, pollution surveys, and auroral and geomagnetic studies. It is important that these values are protected by maintenance of the broad and unobstructed viewing horizon and that anthropogenic gas emissions (in particular long-term gaseous or aerosol emissions from sources such as internal combustion engines) are minimised and where practicable avoided.

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, and potential changes to the viewing horizon and/or shadowing of instrumentation 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;
- Avoid degradation of the viewing horizon and shadowing effects by Installations on instrumentation reliant on solar and sky viewing geometries;
- Avoid / mitigate as far as practicable anthropogenic gaseous or aerosol Emissions from sources such as internal combustion engines to the atmosphere within 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. The signs should include instructions to make no radio transmissions and to turn vehicle headlights off within the Area, unless required in an emergency.
- 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. The Activity Coordinators shall keep a log of visits to the Area by their programs, recording number of personnel, time and duration of visit, activities, and means of travel into the Area, and shall exchange this information to create a consolidated log of all visits to the Area annually.
- 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

Map 1: ASPA No. 122 Arrival Heights – Regional overview, showing Hut Point Peninsula, 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 (NIWA), New Zealand, http://www.niwa.co.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 NIWA, http://www.niwa.co.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, ozone precursors, ozone destroying substances, biomass burning products and greenhouse gases. 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 $\sim 10^{-52}$ 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 carbon dioxide, ozone, bromine, methane, nitrogen oxides, hydrogen chloride and carbon monoxide, with records commencing as early as 1982 (Zeng *et al*. 2012, Kolhepp *et al*. 2012). Arrival Heights represents a key site in the Network of the Detection of Atmospheric Composition (NDACC) and the Global Atmospheric Watch (GAW), with data being used to monitor changes in the stratosphere and troposphere, including long-term evolution of the ozone layer, Southern Hemisphere greenhouse gas concentrations and changes in overall atmospheric composition. The measurements made at Arrival Heights are vital for Southern Hemisphere and Antarctic satellite comparison (Vigouroux *et al*. 2007) and atmospheric chemistry model validation (Risi *et al*. 2012). Arrival Heights has also been used as one of several Antarctic reference stations for intercomparisons of surface air measurements (Levin *et al*. 2012).

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 (Kremser *et al*. 2015; 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. Interference in the VLF range has been sufficient to render Arrival Heights unsuitable for scientific studies measuring radio pulses from lightning (e.g. the AARDVARK experiment), and for

this reason a second antenna was established at Scott Base where disturbance in the VLF range is much lower.

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, SO_2, Pb, Zn) and PM_{10} (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) Location of structures within and adjacent to the Area

Both New Zealand and United States maintain 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 United States 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 in 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(iv) Location of other protected areas in the vicinity

The nearest protected areas to Arrival Heights are on Ross Island: Discovery Hut, Hut Point (ASPA No.158), is the closest at 1.3 km southwest; Cape Evans (ASPA No. 155) is 22 km north; Backdoor Bay (ASPA No. 157) is 32 km north; Cape Royds (ASPA No. 121) is 35 km NNW; High Altitude Geothermal sites of the Ross Sea region (ASPA No. 175) 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.

6(v) Special zones within the Area

None.

7. Terms and conditions for entry permits

7(i) General 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(ii) Access to, and movement within or over, 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(iii) Activities which may be conducted in the Area

- scientific research that will not jeopardize the scientific values of the Area or interfere with current research activities;
- 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(iv) 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 and the current viewing horizon. 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, obstruct the viewing horizon or emit gases to the atmosphere should take into account their potential to affect the values of the Area.
- Removal of structures, equipment 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(v) Location of field camps

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

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

Anthropogenic gaseous or aerosol emissions to the atmosphere from sources such as internal combustion engines within the Area shall be minimised or where practicable avoided. Long-term or permanent anthropogenic gaseous or aerosol emissions within the Area would jeopardize scientific experiments and are prohibited.

7(vii) Taking of, 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(viii) Collection or removal of materials 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(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

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

8. Supporting documentation

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., Rodger, C.J., Thomson, N.R., Brundell, J.B., Ulich, Th., Lichtenberger, J., Cobbett, N., Collier, A.B., Menk, F.W., Seppl, A., Verronen, P.T., & Turunen, E. 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, F.J. 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.

Kohlhepp, R., Ruhnke, R., Chipperfield, M.P., De Mazière, M., Notholt, J., & 46 others 2012. Observed and simulated time evolution of HCl, ClONO2, and HF total column abundances, *Atmospheric Chemistry & Physics* 12: 3527-56.

Kremser, S., Jones, N.B., Palm, M., Lejeune, B., Wang, Y., Smale, D. & Deutscher, N.M. 2015. Positive trends in Southern Hemisphere carbonyl sulfide, *Geophysical Research Letters* 42: 9473–80.

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., Pazmiño 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.

Levin, C., Veidt, C., Vaughn, B.H., Brailsford, G., Bromley, T., Heinz, R., Lowe, D., Miller, J.B., Poß, C.& White, J.W.C. 2012 No inter-hemispheric δ13CH4 trend observed. *Nature* 486: E3–E4.

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.

Risi, C., Noone, D., Worden, J., Frankenberg, C., Stiller, G., & 25 others 2012. Process-evaluation of tropospheric humidity simulated by general circulation models using water vapor isotopologues: 1. Comparison between models and observations. *Journal of Geophysical Research* 117: D05303 .

Rodger, C. J., Brundell, J.B., Holzworth, R.H. & Lay, E.H. 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.

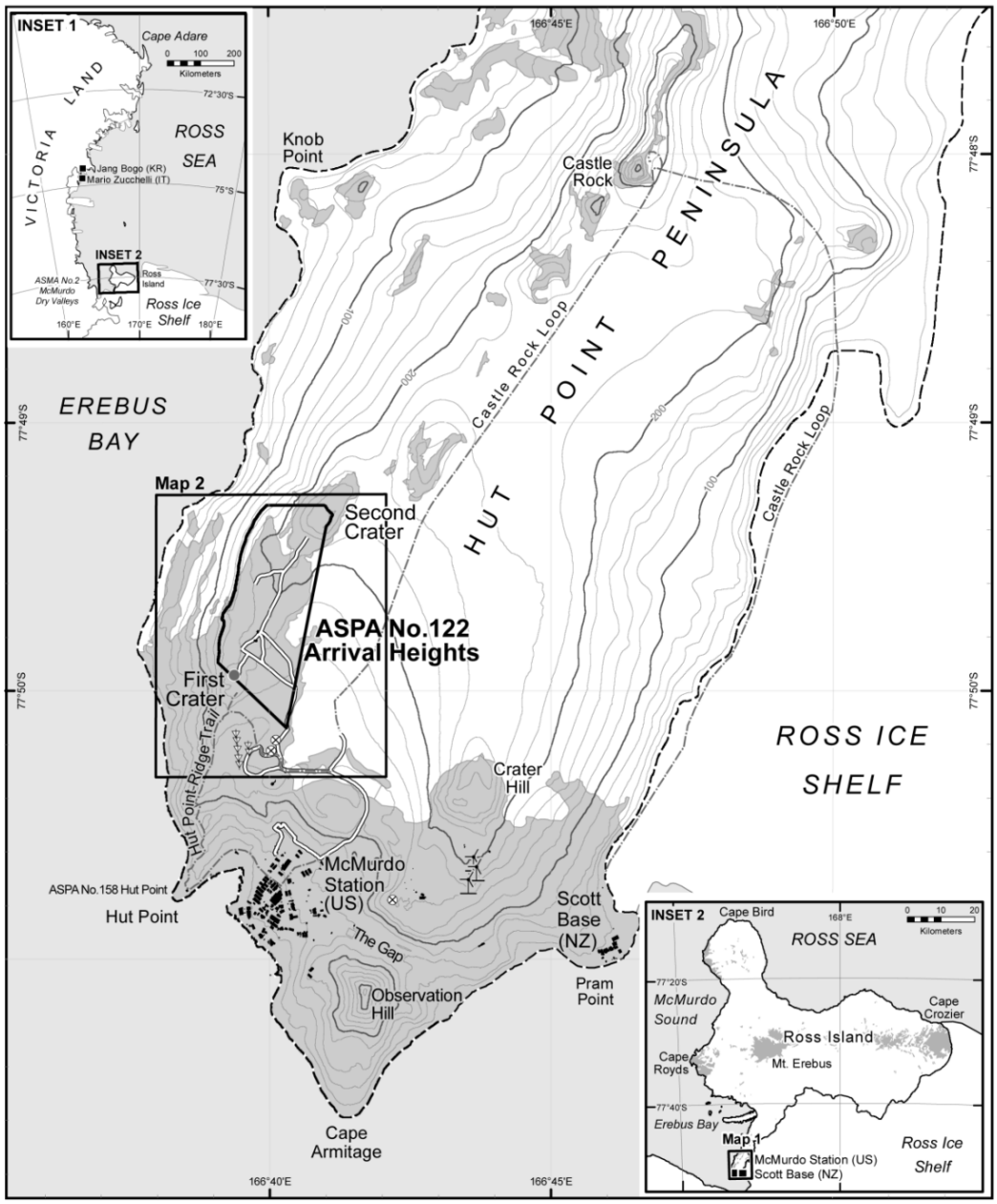
Tauxe, L., Gans, P.B. & Mankinen, E.A. 2004. Paleomagnetic and 40Ar/39Ar ages from Matuyama/Brunhes aged volcanics near McMurdo Sound, Antarctica. *Geochemical Geophysical Geosystems* 5 (10): 1029.

Vigouroux, C., De Mazière, M., Errera, Q., Chabrillat, S., Mahieu, E., Duchatelet, P., Wood, S., Smale, D., Mikuteit, S., Blumenstock, T., Hase, F., & Jones, N. 2007. Comparisons between ground-based FTIR and MIPAS N2O and HNO3 profiles before and after assimilation in BASCOE. *Atmospheric Chemistry & Physics* 7: 377-96.

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.

Zeng, G., Wood, S.W., Morgenstern, O., Jones, N.B., Robinson, J., & Smale, D. 2012. Trends and variations in CO, C2H6, and HCN in the Southern Hemisphere point to the declining anthropogenic emissions of CO and C2H6, *Atmospheric Chemistry & Physics* 12: 7543-55.



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

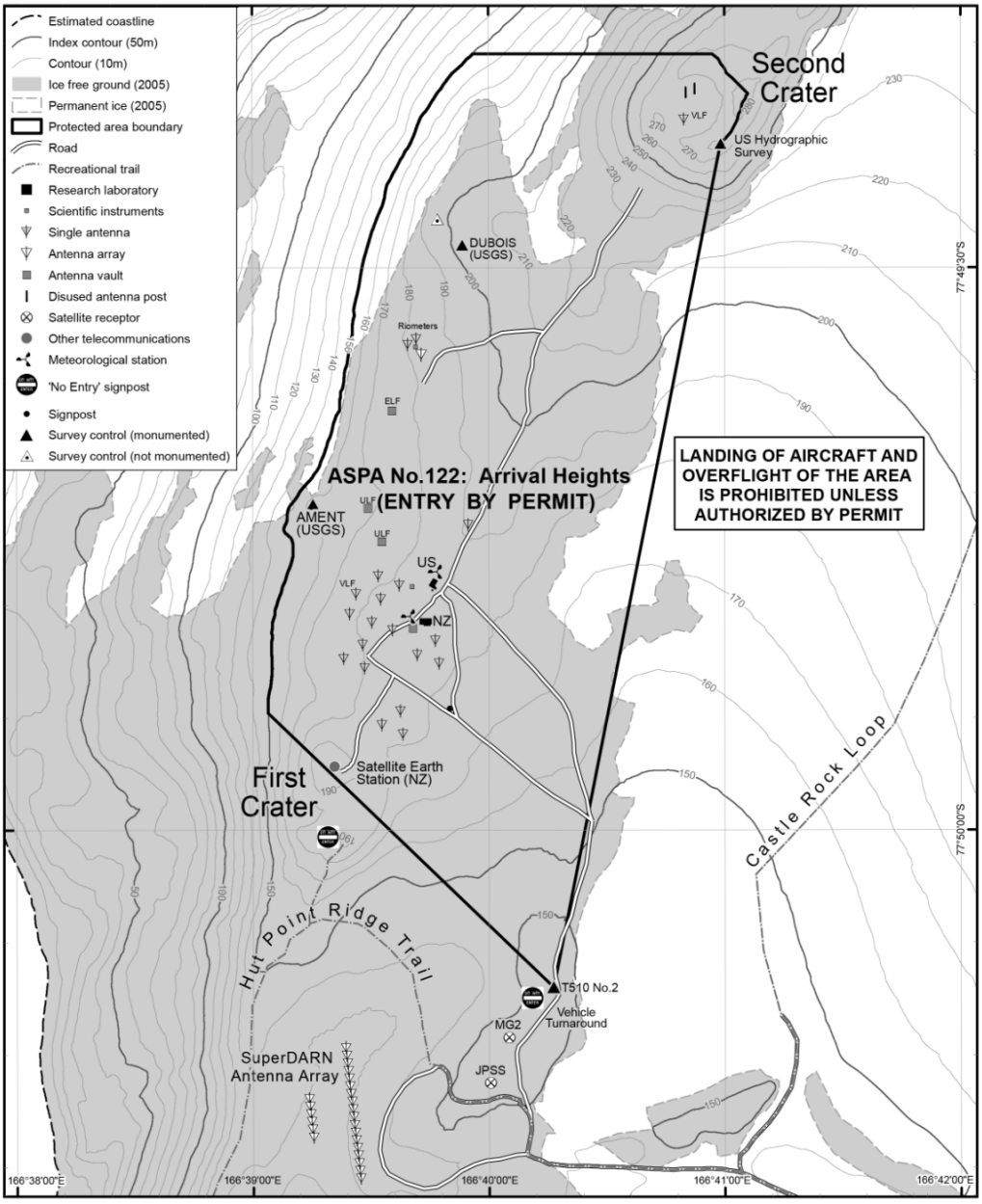
0 0.5 1 Kilometers

N

22 Mar 2016 (Map ID: 10069.001.04)
United States Antarctic Program
Environmental Research & Assessment

Estimated coastline
Index contour (100m)
Contour (20m)
Ice free ground (2005)
Permanent ice (2005)
Ocean
Protected area boundary
Road
Recreational trail
Buildings
SuperDARN antenna array
Satellite receiver
Satellite Earth Station
Wind turbine

Projection: Lambert Conic Conformal
Spheroid and horizontal datum: 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 (2016).



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

11 Mar 2016 (Map ID: 10069.002.03)
United States Antarctic Program
Environmental Research & Assessment

Caution:
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

Projection: Lambert Conic Conformal
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 (2016).

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, Livingstone 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;
- Recommendations X-6 (1979), XII-5 (1983), XIII-7 (1985) and Measure 3 (2001), which extended the expiry date of SSSI 6;
- Recommendation XVI-5 (1991), which adopted a revised Management Plan for SSSI 6;
- Decision 1 (2002), which renamed and renumbered SSSI 6 as ASPA 126;
- Measures 1 (2002) and 4 (2011), which adopted revised Management Plans for ASPA 126;

Recalling that Recommendation XVI-5 (1991) and Measure 3 (2001) had not become effective and were withdrawn by Measure 4 (2011);

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

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 126;

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; and
2. The Management Plan for Antarctic Specially Protected Area No 126 annexed to Measure 4 (2011) be revoked.

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 (Benayas et al. (2013) provide a review of all science conducted in the area that was published between 1957 and 2012). 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, 2013).

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 (López-Bueno et al., 2009; Moura et al., 2012; Barbosa et al., 2013; De Pablos et al., 2013; Emslie et al., 2013; Gil-Delgado et al., 2013; Kopalova and van de Vijvier, 2013; Lyons et al., 2013; Nakai et al., 2013; Pla-Rabes et al., 2013; Rico et al., 2013; Rochera et al., 2013a; Rochera et al., 2013b; Toro et al., 2013; Velazquez et al., 2013; Velazquez et al 2016; Vera et al., 2013; Villaescusa et al., 2013). 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 and diverse 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.

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). 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. 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. Resolution 6 (2012) recommended that the Antarctic Conservation Biogeographic Regions (ACBRs) be used for the 'identification of areas that could be designated as Antarctic Specially Protected Areas within the systematic environmental-geographic framework referred to in Article 3(2) of Annex V to the Environmental Protocol. ASPA 126 sits within Antarctic Conservation Biogeographic Region (ACBR) 3 Northwest Antarctic Peninsula. In Resolution 5 (2015) the ATCM recognised the significance of the Important Bird Areas (IBAs) of Antarctica. The boundary of ASPA 126 also marks the extent of Important Bird Area ANT054 Byers Peninsula, Livingston Island. The IBA qualifies on the basis of the Antarctic tern (*Sterna vittata*) and kelp gull (*Larus dominicanus*) colonies although may other bird species, including southern giant petrels (*Macronectes giganteus*) are present.

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:

- 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.
- 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. The abundance of vegetation is also exceptional with c. 8.1 km^2 of green vegetation contained within the Area, representing over half of the green vegetation protected with all terrestrial ASPAs.
- *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 widespread but sporadic distribution on the Antarctic Peninsula. Both species are abundant at several of the lakes, streams and pools on Byers Peninsula.
- Unusually extensive cyanobacterial mats dominated by *Leptolyngbya* spp. and *Phormidium* spp. 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 and other heavy isotope 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.
- The area has remained largely unaffected by human disturbance, compared to other extensive ice-free areas in the local vicinity, and is thought to be free of non-native plants.

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 trampling impact (Tejedo et al., 2009; Pertierra et al., 2013a). 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. Pertierra et al. (2013b) provides information concerning the challenges and environmental impacts resulting from the running of the camp.

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 60º53'45'' 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 60º53'45'' 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 60º53'45''" 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.

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). Personnel operating vessels to deliver cargo and/or personnel to the ASPA must not leave the landing area unless in accordance with a permit issued by an appropriate national authority.
- 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 Spain and is available for use by all Parties. Parties aiming to use the melon huts should communicate their intentions to the Spanish Polar Committee well in advance. 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:

- 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 60º58'48" W, to the south by latitude 62º38'30"S, and the northern boundary follows the coastline (see Map 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;
- cumulative impacts of geological sampling are taken into consideration in any EIA, as substantial collections have been made at some palaeontological sites with significant negative impacts upon the Area's scientific values.
- 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*)
- Overflight of bird colonies within the Area by Unmanned Autonomous Vehicles (UAVs) at an altitude likely to result in harmful interference shall not be permitted unless in accordance with a permit issued by an appropriate national authority.
- 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. Due to the high winds often experienced in the area, great care should be taken to ensure all camping and scientific equipment is adequately secured.

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). Visitors should also consult and follow, as appropriate, recommendations contained in the *CEP non-native species manual* (CEP, 2011), and in the *Environmental code of conduct for terrestrial scientific field research in Antarctica* (SCAR, 2009). 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. Visitors accessing the ASPA by helicopter should ensure it is free of seeds, soil and propagules before entering the area. The transfer of species between lakes from outside and within the ASPA presents a substantial threat to these chemically and biologically unique waterbodies. Therefore, every precaution shall be taken to prevent cross-contamination of lakes including the cleaning of sampling equipment between use in different waterbodies.

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 visit reports should include, as applicable, the information identified in the recommended visit report form [contained as an Appendix in the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas available from the website of the Secretariat of the Antarctic Treaty (www.ats.aq)]. 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

For a recent list of publication resulting from scientific investigations on Byers Peninsula, see Benayas et al. (2013).

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.

Bañón, M., Justel, M. A., Velazquez, D., Quesada, A. 2013. Regional weather survey on Byers Peninsula, Livingston Island, South Shetland Islands, Antarctica. *Antarctic Science* **25**: 146-156.

Barbosa, A., de Mas, E., Benzal, J., Diaz, J. I., Motas, M., Jerez, S., Pertierra, L., Benayas, J., Justel, A., Lauzurica, P., Garcia-Peña, F. J., and Serrano, T. 2013. Pollution and physiological variability in gentoo penguins at two rookeries with different levels of human visitation. *Antarctic Science* **25**: 329-338.

Benayas, J., Pertierra, L., Tejedo, P., Lara, F., Bermudez, O., Hughes, K.A., and Quesada, A. 2013. A review of scientific research trends within ASPA 126 Byers Peninsula, South Shetland Islands, Antarctica. *Antarctic Science* **25**: 128-145.

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.

Committee for Environmental Protection. 2011. CEP non-native species manual. Antarctic Treaty Secretariat, Buenos Aires. (see: http://www.ats.aq/e/ep_faflo_nns.htm)

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.

De Pablo, M.A., Blanco, J.J., Molina, A., Ramos, M. Quesada, A., and Vieira G. 2013. Interannual active layer variability at the Limnopolar Lake CALM site on Byers Peninsula, Livingston Island, Antarctica. *Antarctic Science* 25: 167-180.

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.

Emslie, S. D., Polito, M. J., and Patterson W. P. 2013. Stable isotope analysis of ancient and modern gentoo penguin egg membrane and the krill surplus hypothesis in Antarctica. *Antarctic Science* **25**: 213-218.

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. 2013. Minimum population size estimates demonstrate an increase in southern elephant seals (Mirounga leonina) on Livingston Island, maritime Antarctica *Polar Biology* **36**: 607-610

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.

Hughes, K. A., Ireland, L. C, Convey, P., Fleming, A. 2015. Assessing the effectiveness of specially protected areas for conservation of Antarctica's botanical diversity. *Conservation Biology* **30**: 113-120.

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.

Kopalova, K., van de Vijver, B. 2013. Structure and ecology of freshwater benthic diatom communities from Byers Peninsula, Livingston Island, South Shetland Islands. *Antarctic Science* **25**: 239-253.

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.

Lyons, W. B., Welch, K. A., Welch, S. A., Camacho, A. Rochera, C., Michaud, L., deWit, R., Carey, A.E. 2013. Geochemistry of streams from Byers Peninsula, Livingston Island. *Antarctic Science* 25: 181-190.

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.

Morgan, F., Barker, G., Briggs, C., Price, R. and Keys, H. 2007. Environmental Domains of Antarctica Version 2.0 Final Report, Manaaki Whenua Landcare Research New Zealand Ltd. 89 pp.

Moura, P.A., Francelino, M.R., Schaefer, C.E.G.R., Simas, F.N.B., de Mendonca, B.A.F. 2012. Distribution and characterization of soils and landform relationships in Byers Peninsula, Livingston Island, Maritime Antarctica. *Geomorphology* **155**: 45-54.

Nakai, R., Shibuya, E., Justel, A., Rico, E., Quesada, A., Kobayashi, F., Iwasaka, Y., Shi, G.-Y., Amano, Y., Iwatsuki, T., Naganuma, T. 2013. Phylogeographic analysis of filterable bacteria with special reference to *Rhizobiales* strains that occur in cryospheric habitats. *Antarctic Science* **25**: 219-228.

Nielsen, U. N., Wall, D. H. W., Li, G., Toro, M., Adams, B. J., Virginia, R. A. 2011. Nematode communities of Byers Peninsula, Livingston Island, maritime Antarctica. *Antarctic Science* 23: 349-357**.**

Otero, X.L., Fernández, S., De Pablo-Hernández, M.A., Nizoli, E.C., Quesada, A. 2013. Plant communities as a key factor in biogeochemical processes involving micronutrients (Fe, Mn, Co, and Cu) in Antarctic soils (Byers Peninsula, maritime Antarctica). *Geoderma* 195-196: 145-154.

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.

Pertierra, L.R., Lara, F., Tejedo, P., Quesada, A., Benayas, J. 2013a. Rapid denudation processes in cryptogamic communities from Maritime Antarctica subjected to human trampling. *Antarctic Science* 25: 318-328.

Pertierra, L.R., Hughes, K.A., Benayas, J., Justel, A., and Quesada, A. 2013b. Environmental management of a scientific field camp in Maritime Antarctica: reconciling research impacts with conservation goals in remote ice-free areas. *Antarctic Science* **25**: 307-317.

Pla-Rabes, S., Toro, M., Van De Vijver, B., Rochera, C., Villaescusa, J. A., Camacho, A., and Quesada, A. 2013. Stability and endemicity of benthic diatom assemblages from different substrates in a maritime stream on Byers Peninsula, Livingston Island, Antarctica: the role of climate variability. *Antarctic Science* **25**: 254-269.

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.

Quesada, A., Camacho, A., Lyons, W.B. 2013. Multidisciplinary research on Byers Peninsula, Livingston Island: a future benchmark for change in Maritime Antarctica. *Antarctic Science* **25**: 123-127.

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.

Rico, E., Quesada, A. 2013. Distribution and ecology of chironomids (Diptera, Chironomidae) on Byers Peninsula, Maritime Antarctica. *Antarctic Science* **25**: 288-291.

Rochera, C., Justel, A., Fernandez-Valiente, E., Bañón, M., Rico, E., Toro, M., Camacho, A., Quesada, A. 2010. Interannual meteorological variability and its effects on a lake from maritime Antarctica. *Polar Biology* **33**: 1615-1628.

Rochera, C., Villaescusa, J. A., Velázquez, D., Fernández-Valiente, E., Quesada, A., Camacho, A. 2013a. Vertical structure of bi-layered microbial mats from Byers Peninsula, Maritime Antarctica. *Antarctic Science* **25**: 270-276.

Rochera, C., Toro, M., Rico, E., Fernández-Valiente, E., Villaescusa, J. A., Picazo, A., Quesada, A., Camacho, A. 2013b. Structure of planktonic microbial communities along a trophic gradient in lakes of Byers Peninsula, South Shetland Islands. *Antarctic Science* **25**: 277-287.

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

SCAR (Scientific Committee on Antarctic Research). 2009. Environmental code of conduct for terrestrial scientific field research in Antarctica. ATCM XXXII IP4.

SCAR (Scientific Committee on Antarctic Research). 2011. SCAR code of conduct for the use of animals for scientific purposes in Antarctica. ATCM XXXIV IP53.

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.

Tejedo, P., Pertierra, L.R., Benayas, J., Convey, P., Justel, A., Quesada, A. 2012. Trampling on maritime Antarctica: can soil ecosystems be effectively protected through existing codes of conduct? *Polar Research* 31: Art. No. UNSP 100888

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.

Toro, M., Granados, I., Pla, S., Giralt, S., Antoniades, D., Galán, L., Cortizas, A. M., Lim, H. S., Appleby, P. G. 2013. Chronostratigraphy of the sedimentary record of Limnopolar Lake, Byers Peninsula, Livingston Island, Antarctica. *Antarctic Science* **25**: 198-212.

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.

Velazquez, D., Lezcano, M.A., Frias, A., Quesada, A. 2013. Ecological relationships and stoichiometry within a Maritime Antarctic watershed. *Antarctic Science* **25**: 191-197.

Vera, M. L., Fernández-Teruel, T., Quesada, A. 2013. Distribution and reproductive capacity of *Deschampsia antarctica* and *Colobanthus quitensis* on Byers Peninsula, Livingston Island, South Shetland Islands, Antarctica. *Antarctic Science* **25**: 292-302.

Villaescusa, J.A., Jorgensen, S.E., Rochera, C., Velazquez, D., Quesada, A., Camacho, A. 2013. Carbon dynamics modelization and biological community sensitivity to temperature in an oligotrophic freshwater Antarctic lake. *Ecological Modelling* **319**: 21-30.

Villaescusa, J.A., Casamayor, E.O., Rochera, C., Velazquez, D., Chicote, A., Quesada, A., Camacho, A. 2010. A close link between bacterial community composition and environmental heterogeneity in maritime Antarctic lakes. *International Microbiology* **13**: 67-77.

Villaescusa, J. A., Casamayor, E. O., Rochera, C., Quesada, A., Michaud L., Camacho, A. 2013. Heterogeneous vertical structure of the bacterioplankton community in a non-stratified Antarctic lake. *Antarctic Science* **25**: 229-238.

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 **143**: 318-333

Annex 1

Supporting information

Byers Peninsula has supported scientific investigations for many years and many of the resulting publications up until 2013 are listed in Banayas et al. (2013); however, but numerous new articles have been published since then.

- 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 -2.8 ºC, with temperatures less than 0 ºC for at least several months each winter and a relatively high precipitation rate estimated at about 800 mm yr^{-1}, much of which falls as rain in summer (Ellis-Evans 1996; Bañón et al. 2013). The peninsula is snow-covered for much of the year, but is usually mostly 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 ° C, but occasionally can be higher than 5 ºC. Exceptionally summer temperature has reached 9 ºC. Minimum average temperature in summer 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; Moura et al., 2012; Otero et al., 2013). 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, are contradictory; some suggest a recent general deglaciation of central Byers Peninsula of around 4000-5000 yr B.P. (Björck *et al* 1991a, b), but others provide a deglaciation age about 8000-9000 yr B.P. (Toro et al, 2013). 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 than 0.5 km^2) remain on Ray Promontory. The pre-existing glacially modified landforms, have been subsequently overprinted by fluvial and periglacial processes (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, rain 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 (Rochera et al., 2010), 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. and *Leptolyngbya* spp. 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 (Rochera et al., 2010). 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 (Kopalova and van de Vijver 2013). 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 et al., 2009), 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 use of satellite technology shows the areas does contain 8.1 km^2 of green vegetation (e.g. vascular plants, algae and some moss species), which represents over 50% of the green vegetation protected within all the terrestrial ASPAs (Hughes et al., 2015) (see http://www.add.scar.org/aspa_vegetation_pilot.jsp). The often 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 (Vera et al., 2013). 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 unusual 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 invertebrate fauna on Byers Peninsula thus far described comprises (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*); ten 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.*), one copepod (*Boeckella poppei*), one crustacean (*Branchinecta gainii*) and one cladoceran (*Macrothrix ciliate*).

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, Rico et al 2013). 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). Thirty seven nematode taxa have been recorded, with samples showing great variation in richness and abundance making Byers Peninsula a nematode biodiversity hotspot (Nielsen et al., 2011).

Some of the water bodies have high microbial biodiversity (Velazquez et al., 2010; Villaescusa et al., 2010) 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 (Barbosa et al., 2013). 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. 2013). 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

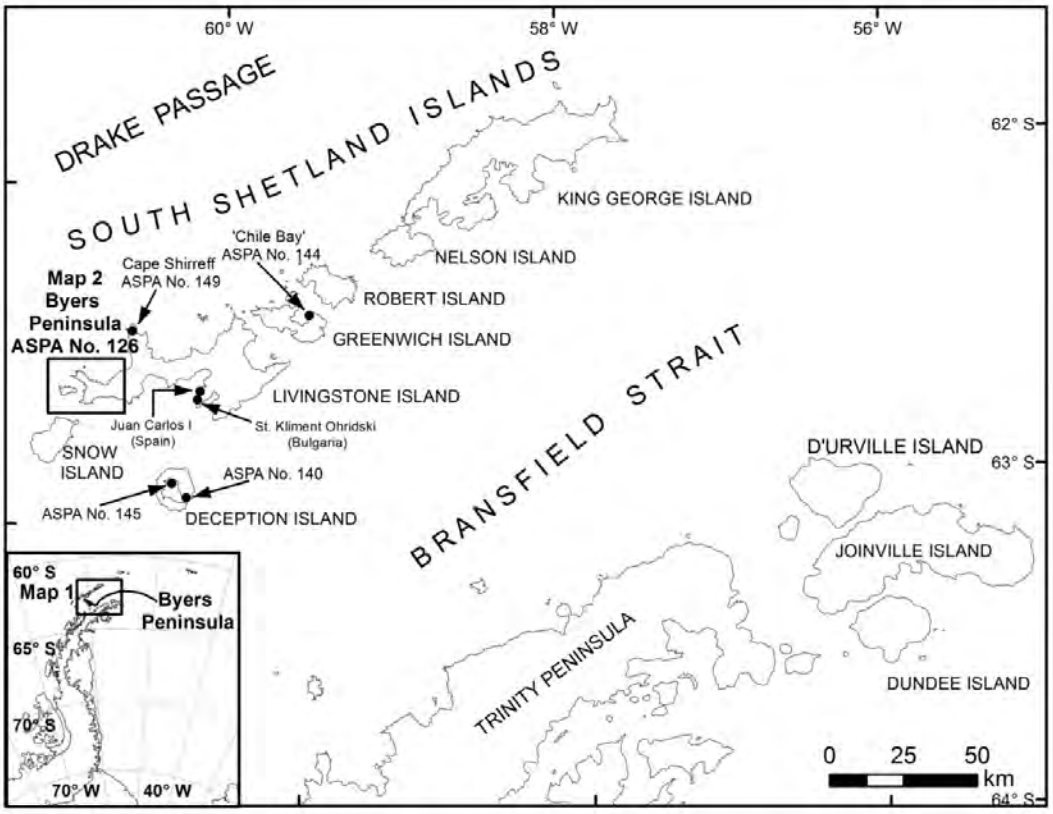
found along the shores. Byers Peninsula has the greatest concentration of early 19th Century sealers' refuges and associated relics in the Antarctic and these are vulnerable to disturbance and/or removal.

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.

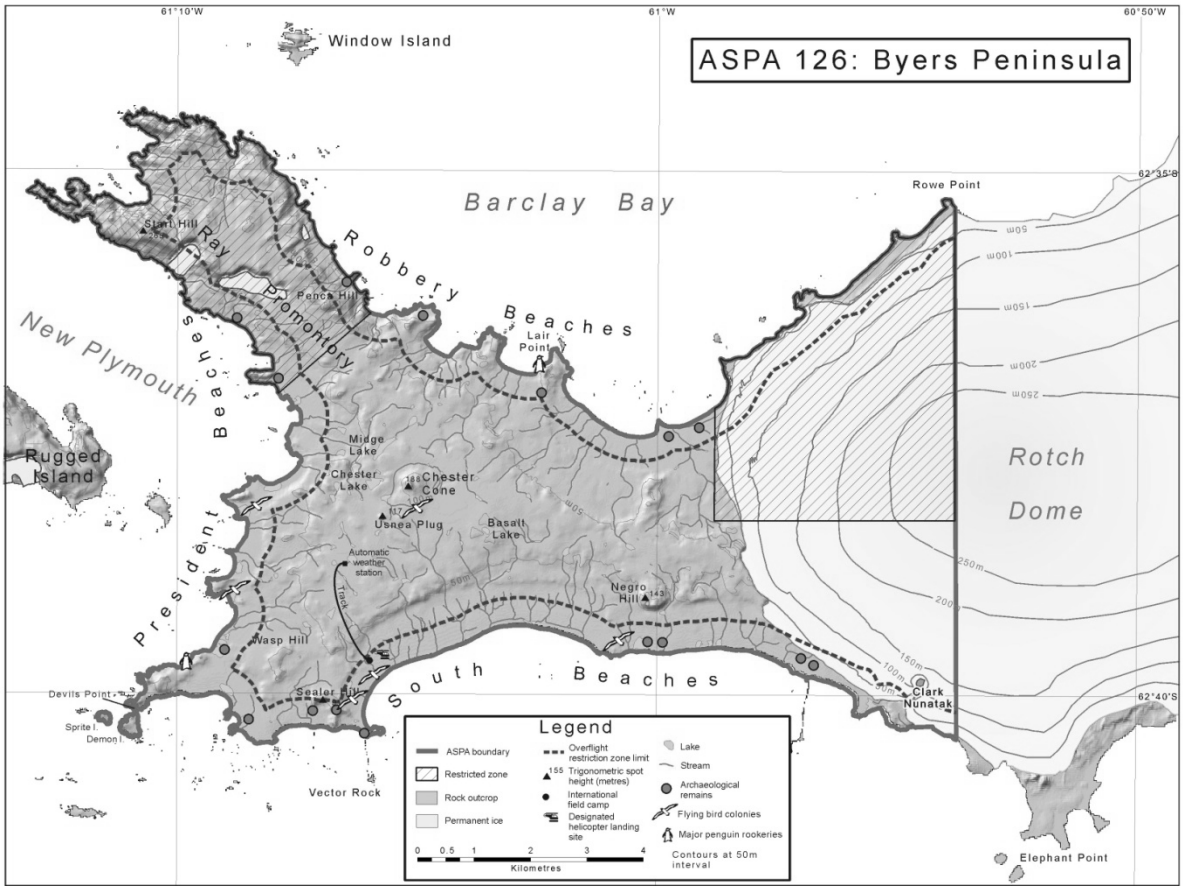
- Human Activities/Impacts

The modern era of human activity at Byers Peninsula has been largely confined to science. The impacts of these activities have not been fully described, but are believed to be minor and limited to items such as campsites, trampling (Tejedo et al., 2012; Pertierra et al., 2013a), markers of various kinds, sea-borne litter washed onto beaches (e.g. from fishing vessels) and from human wastes and scientific sampling. More recently the impacts of the field activities originating from the International Field Camp (62º39'49.7" S, 61º05'59.8" W) between 2001-2010 were quantified (Pertierra et al, 2013b). 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 (L. R. Pertierra pers. comm. 2011). 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. Insert: location of Byers Peninsula on the Antarctic Peninsula.



Map 2. ASPA 126: Byers Peninsula topographic map.



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;
- Recommendations X-6 (1979), XII-5 (1983), XIII-7 (1985), XVI-7 (1987) and Measure 3 (2001), which extended the expiry date of SSSI 7;
- Decision 1 (2002), which renamed and renumbered SSSI 7 as ASPA 127;
- Measure 4 (2005), which extended the expiry date of the Management Plan for ASPA 127;
- Measures 1 (2006) and 5 (2011), which adopted revised Management Plans for ASPA 127;

Recalling that Recommendations VIII-4 (1975), X-6 (1979), XII-5 (1983), XIII-7 (1985) and XVI-7 (1987) were 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 Management Plan for Antarctic Specially Protected Area No 127 annexed to Measure 5 (2011) be revoked.

Management Plan for Antarctic Specially Protected Area No. 127

Haswell Island (Haswell Island and Adjacent Emperor Penguin Rookery on Fast Ice)

1. Description of values to be protected

The area includes Haswell Island with its littoral zone and adjacent fast ice when present.

Haswell Island was discovered in 1912 by the Australian Antarctic Expedition led by D. Mawson. It was named after William Haswell, professor of biology who rendered assistance to the expedition. Haswell is the biggest island of the same-name archipelago, with a height of 93 meters and 0,82 sq.meters in area. The island is at 2,5 km distance from the Russian Mirny Station operational from 1956.

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

The 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*), Lonnberg skua *Catharacta antarctica lonnbergi* and Adelie penguin (*Pygoscelis adeliae*).

The Area supports five species of pinnipeds, including the Ross seal (*Ommatophoca rossii*) which falls in the protected species category.

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 Decision 1 (2002).

The boundaries of the ASPA No 127 embrace Haswell Island (66º31'S, 93º00'E), of 0,82 km² in area and the adjacent section of Davis Sea fast ice (when present) of approximately 5 km², 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 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 presently there is not any station activity. 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 (now station) 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 Station 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. 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 the records, there are 14 bird species in the vicinity of Mirny Station(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 Station.

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*)	B
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 ten 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.

Updates of vagrants to the species list are explained by more extensive ornithological observations. 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, and the traced quartering of Lonnberg skua and their recorded breeding at the archipelago suggest the natural expansion of the breeding areas.

Starting from 2012 the cases of hybrid pair nesting by South-polar skua (*Catharacta maccormicki*) and Lonnberg skua (*Catharacta Antarctica*) came to be observed.

- *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 Mirny Station 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 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 in the area were resumed in 1999-2011 (Gavrilo, Mizin, 2007, Gavrilo, Mizin, 2011, Neelov 2007 et al).

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

According to the census data obtained during 1956 to 1966 the total population of the emperor penguin colony varied between 14 to 20 thousand (Korotkevich, 1958, Makushok, 1959, Prior, 1964, Kamenev, 1977). After that, during the 1970s and 1980s a population declined by one third, but in the 2000s it has been gradually recovered. At present the colony population is stable with tendency for decrease. The observations of 2010/2011 summer season during egg laying period with maximum concentration of adult birds revealed that the colony population reached 13 thousand and according to chick census in 2015 it could be assumed that the colony population was more than 14 thousand (RAE, unpublished).

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 50 years (Barbraud et al., 2011). Before the 1970s the penguin population at Pointe-Geologie Archipelago, Terre Adelie (ASPA 120) was stable, and at Haswell it was also stable or slightly decreasing. The 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 ice 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 the 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: 1 = positive, 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)	170 (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 the root cause which determined the population dynamics of not only emperor penguins but other sea birds in the Haswell Island area as well, are climate changes. However no data on population dynamics in the last 10 to 15 years is available.
The one exception is represented by the south polar skua which population tripled during the whole observation period.

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 an 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 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 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 suggested by SCAR. Parties should maintain a record of such activities, and, in the Annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, which should be in sufficient detail to allow evaluation of the effectiveness of the management plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the management plan and in organizing the scientific use of the Area.

8. References

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.41-42. (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. V. 23. P. 461–468 doi:10.1017/S0954102011000356

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.

Golubev S.V. 2012. Report on ecological and environmental studies at Mirny station during 57 RAE. St.P.,AARI (in Russian) (unpublished)

Golubev S.V. 2016. Report on ecological and environmental studies at Mirny station during 60 RAE. St.P.,AARI (in Russian) (unpublished)

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 Research.-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)

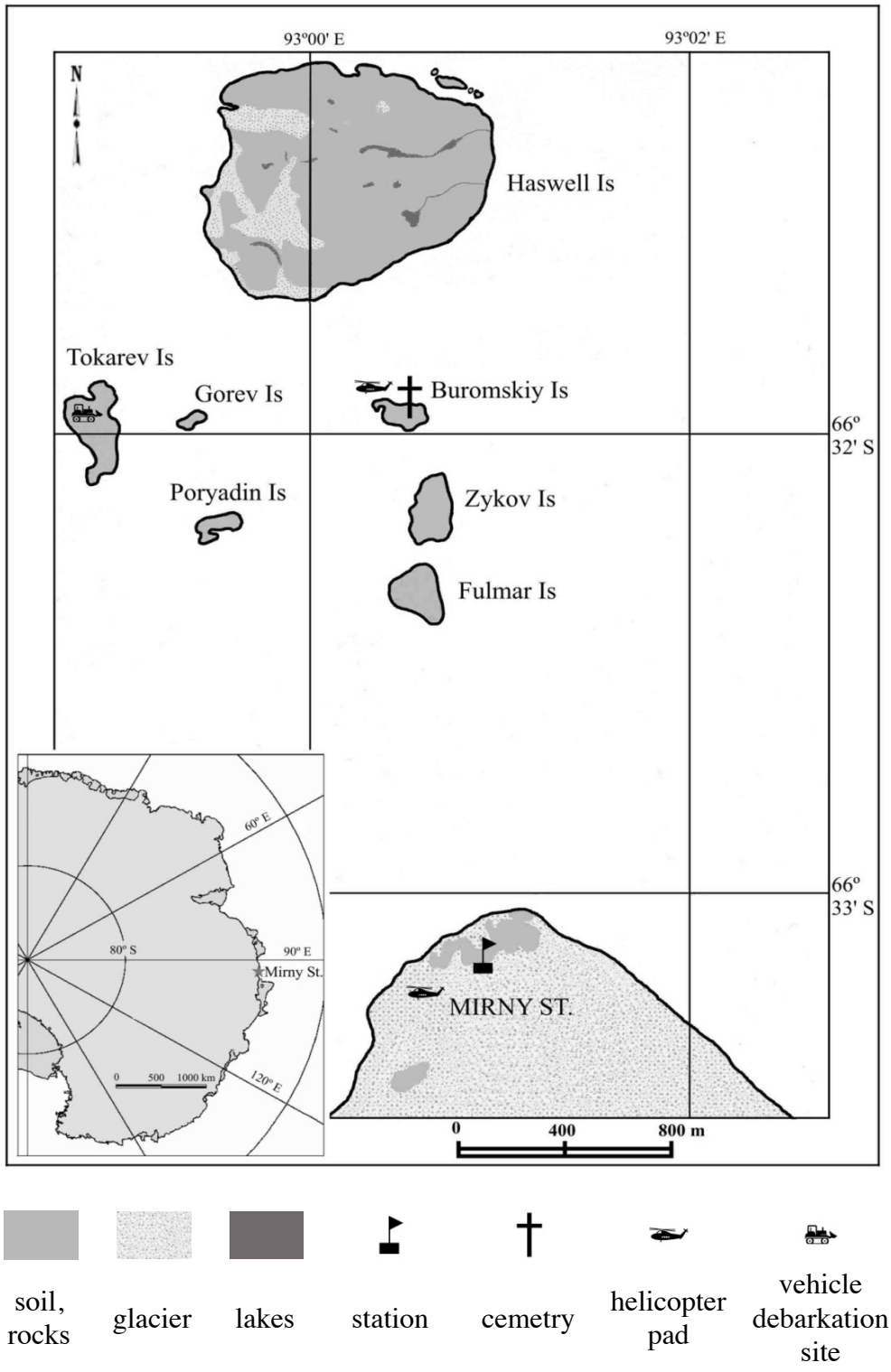
Pushkin, A.F. Some ecological and zoogeographic peculiarities of the Pantopoda fauna in the Davis Sea // Hydrobiology and Biogeography of Cold and Moderate World Ocean Waters in the Off-shore Zone: Report Abstracts.- L.,1974.-P.43-45. (in Russian)

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.

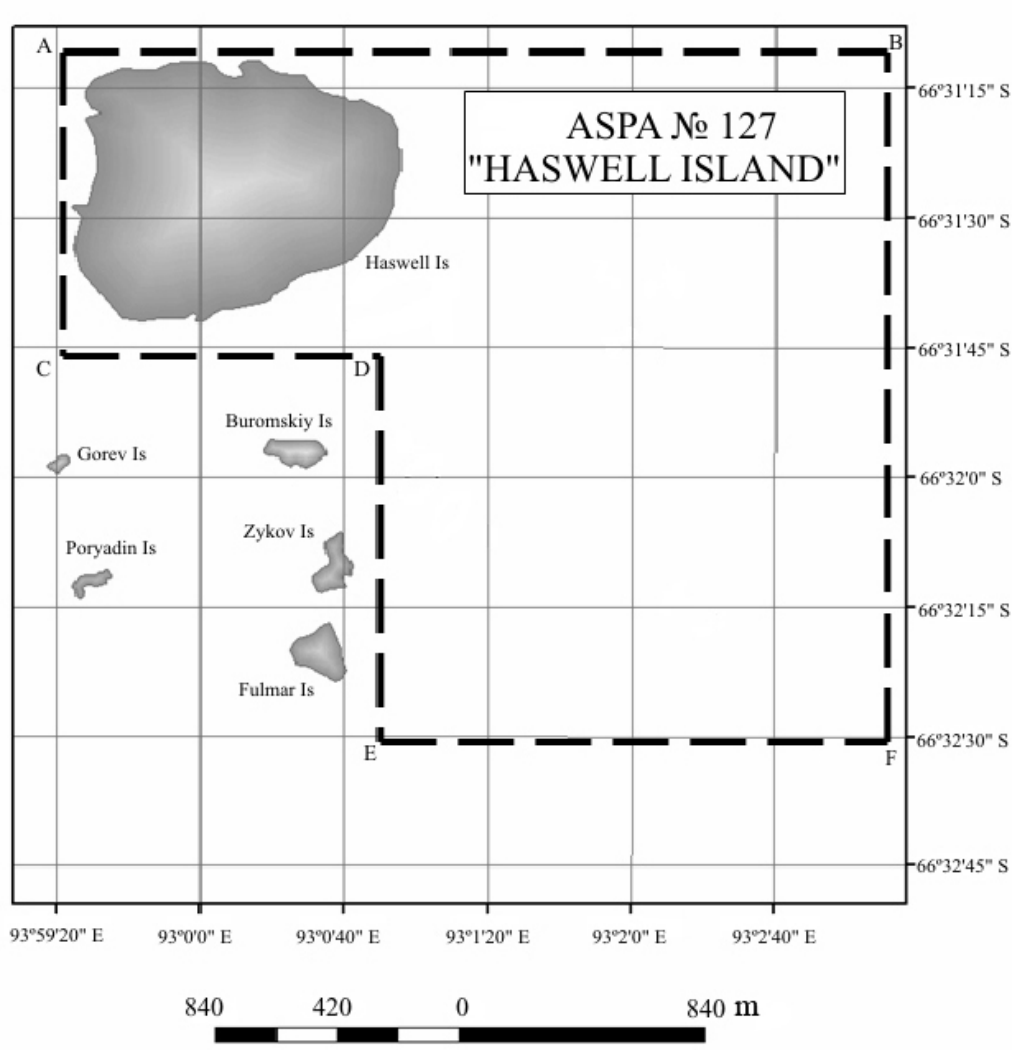
Stepaniants, R.D. Coastal hydrozoans of the Davis Sea (materials of the 11th Soviet Antarctic Expedition, 1965/66) // Marine Fauna Research.- L.,1972.- Vol.11(19).-P.56-79. (in Russian)

The Final Report of the Twenty Second Antarctic Treaty Consultative Meeting (Tromse, Norway, May 25 – June 5, 1998). [Oslo, Royal Ministry of Foreign Affairs], P. – 93 – 130. (in Russian).

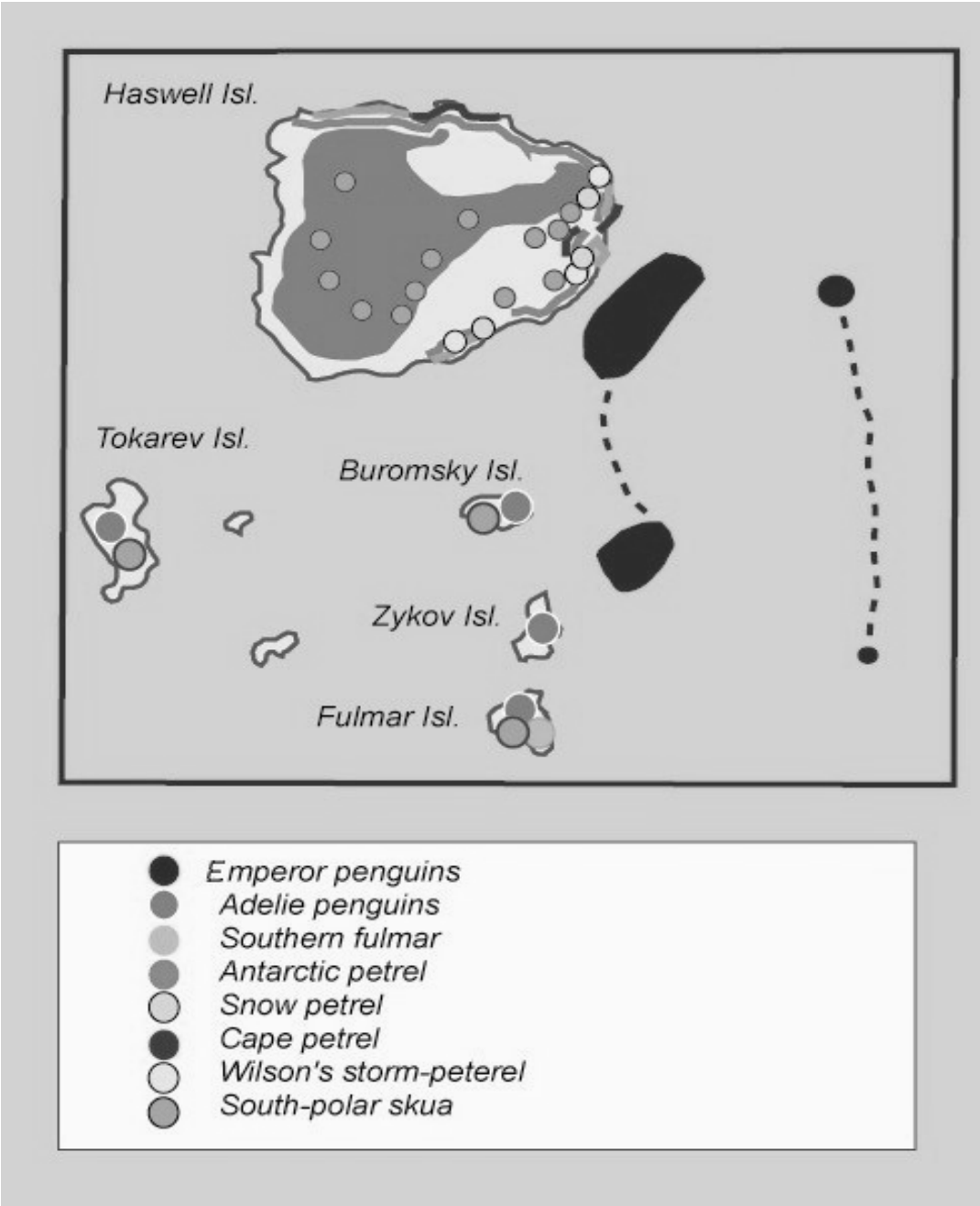
Map 1: Location of the Haswell Islands, Mirny Station, and logistic activity sites.



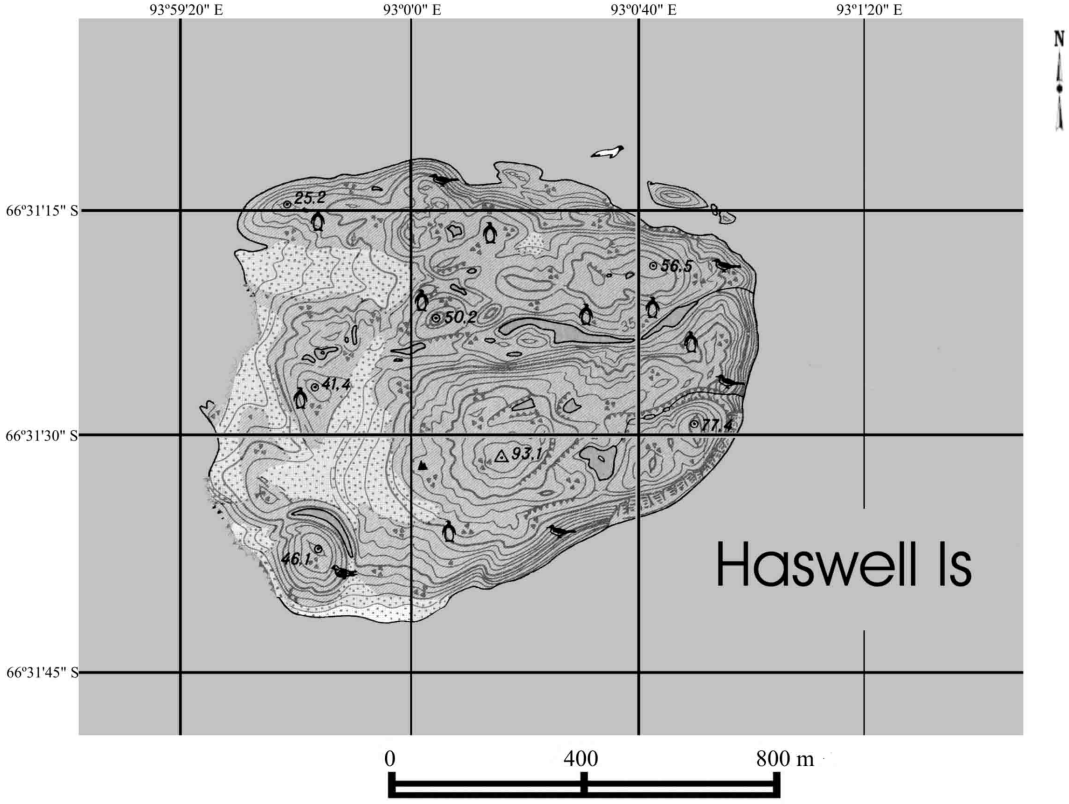
Map 2: Boundaries of Antarctic Specially Protected Area 127, Haswell Island.



Map 3: Location of breeding seabird colonies.



Map 4: Topographic map of Haswell Island.



Measure 6 (2016)

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 Scientific Interest ("SSSI") No 12 and annexed a Management Plan for the Site;
- Recommendation XVI-7 (1987), which extended the expiry date of SSSI 12;
- Measure 3 (1997), which adopted a revised Management Plan for SSSI 12;
- Decision 1 (2002), which renamed and renumbered SSSI 12 as ASPA 131;
- Measures 1 (2006) and 6 (2011), which adopted revised Management Plans for ASPA 131;

Recalling that Measure 3 (1997) had not become effective and was withdrawn by Measure 6 (2011);

Recalling that Recommendation XVI-7 (1987) had not become effective and was 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; and
2. the Management Plan for Antarctic Specially Protected Area No 131 annexed to Measure 6 (2011) be revoked.

Management Plan for Antarctic Specially Protected Area No. 131

CANADA GLACIER, LAKE FRYXELL, TAYLOR VALLEY, VICTORIA LAND

1. Description of values to be protected

An area of approximately 1 km^2 between the east side of Canada Glacier and Lake Fryxell was originally designated in Recommendation XIII-8 (1985) as SSSI No. 12 after a proposal by New Zealand on the grounds that it contains 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) and Measure 6 (2011).

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 continues 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.
- Rock cairns or signs illustrating the location and boundaries, with clear statements of entry restrictions, shall be placed at appropriate locations on the boundary of the Area to help avoid inadvertent entry.
- 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: ASPA No. 131 Canada Glacier: Regional Map.
Map specifications: Projection - Lambert conformal conic. Standard parallels - 1st 77° 35' 00" S; 2nd 77° 38' 00"S. Central Meridian - 163° 00' 00" E. Latitude of Origin - 78° 00' 00" S. Spheroid - WGS84.

Map B: ASPA 131 Canada Glacier: 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. The lake level is currently rising. 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. Prior to 1983, Canada Stream was informally known as Fryxell Stream.

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 one of 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. There are no records of Collembola found in the Area, though there are records where they have been found nearby outside the Area.

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 2014 of close to 35.32 μS 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.

Canada Glacier is located within Environment S – McMurdo - South Victoria Land geologic based on the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)) and in Region 9 – South Victoria Land based on the Antarctic Conservation Biogeographic Regions (Resolution 6 (2012).

Evidence of past human activity is noticeable within the Area. Indications of past human activity are likely to be found in the soils adjacent to the original New Zealand hut and helicopter landing site. These may be in the form of localised areas of petrochemical residues and soil nutrients. 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) and the paths marked by lines of rocks and areas cleared for use as campsites are still present.

A weir is present on Canada Stream (see Section 6(iii)). Hydrological data collected from this stream measured the average discharge rate of Canada Stream when it was flowing as 22.13 L/s [min = 0.0 L/s and max = 395.76 L/s] from November 2014 to February 2015. The average water temperature over this time was 1.99 °C [min = -1.1 °C and max = 11.34 °C] (http://www.mcmlter.org/).

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 the Lake Hoare Camp Facilities Zone and the 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 (USA) 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:

- Lower Taylor Glacier and Blood Falls, Taylor Valley, McMurdo Dry Valley (ASPA No. 172) approximately 23 km west in the Taylor Valley;
- Linnaeus Terrace, Asgard Range (ASPA No. 138) approximately 47 km west in the Wright Valley; and
- Barwick and Balham Valleys, Southern Victoria Land (ASPA No. 123) approximately 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
- Permits shall be issued for a stated period.

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

Access to the Area shall be primarily by foot or for essential scientific reasons, 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 (Lake Hoare and Lake Fryxell) and/or the Taylor Valley Visitor Zone. If requiring access to the Area by helicopter, helicopters should approach the Area from south of the line marked on the accompanying site map (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 is 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.
Activities which cause disturbance to the flush area should take into account the slow recovery rates of the vegetation at this site. In particular, consideration should be given to minimising any required sample sizes and sample numbers and conducting the sampling regime in such a way that full recovery of the vegetation community is likely.

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 7(ix) 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, 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 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.

Material may be collected or removed from the Area only in accordance with a Permit and should be limited to the minimum number of samples necessary to meet scientific or management needs. Sampling is to be carried out using techniques which minimise disturbance to the Area and from which full recovery of the vegetation from sampling can be expected.

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

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 this is the case the appropriate authority should be notified and approval obtained prior to removal of the items.

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 lodgement with 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 visit reports should include, as applicable, the information identified in the recommended visit report form [contained in Appendix 4 of the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas appended to Resolution 2 (1998)] [available from the website of the Secretariat of the Antarctic Treaty www.ats.aq].

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.

Downes, M.T., Howard-Williams, C. and Vincent, W.F. 1986. Sources of organic nitrogen, phosphorus and carbon in Antarctic streams. Hydrobiologia 134: 215-225.

Fortner, S.K., Lyons, W.B. and Munk, L. 2013. Diel stream geochemistry, Taylor Valley, Antarctica. Hydrological Processes 27: 394-404.

Fortner, S.K., Lyons, W.B. and Olesik, J.W. 2011. Eolian deposition of trace elements onto Taylor Valley Antarctic glaciers. Applied Geochemistry 26: 1897-1904.

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.

Howard-Williams, C., Priscu, J.C. and Vincent, W.F. 1989. Nitrogen dynamics in two Antarctic streams. Hydrobiologia 172: 51-61.

Howard-Williams, C. and Vincent, W.F. 1989. Microbial communities in Southern Victoria Land streams I: Photosynthesis. Hydrobiologia: 172: 27-38.

Howard-Williams, C., Vincent, C.L., Broady, P.A. and Vincent, W.F. 1986. Antarctic stream ecosystems: Variability in environmental properties and algal community structure. Internationale Revue der gesamten Hydrobiologie 71: 511-544.

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.

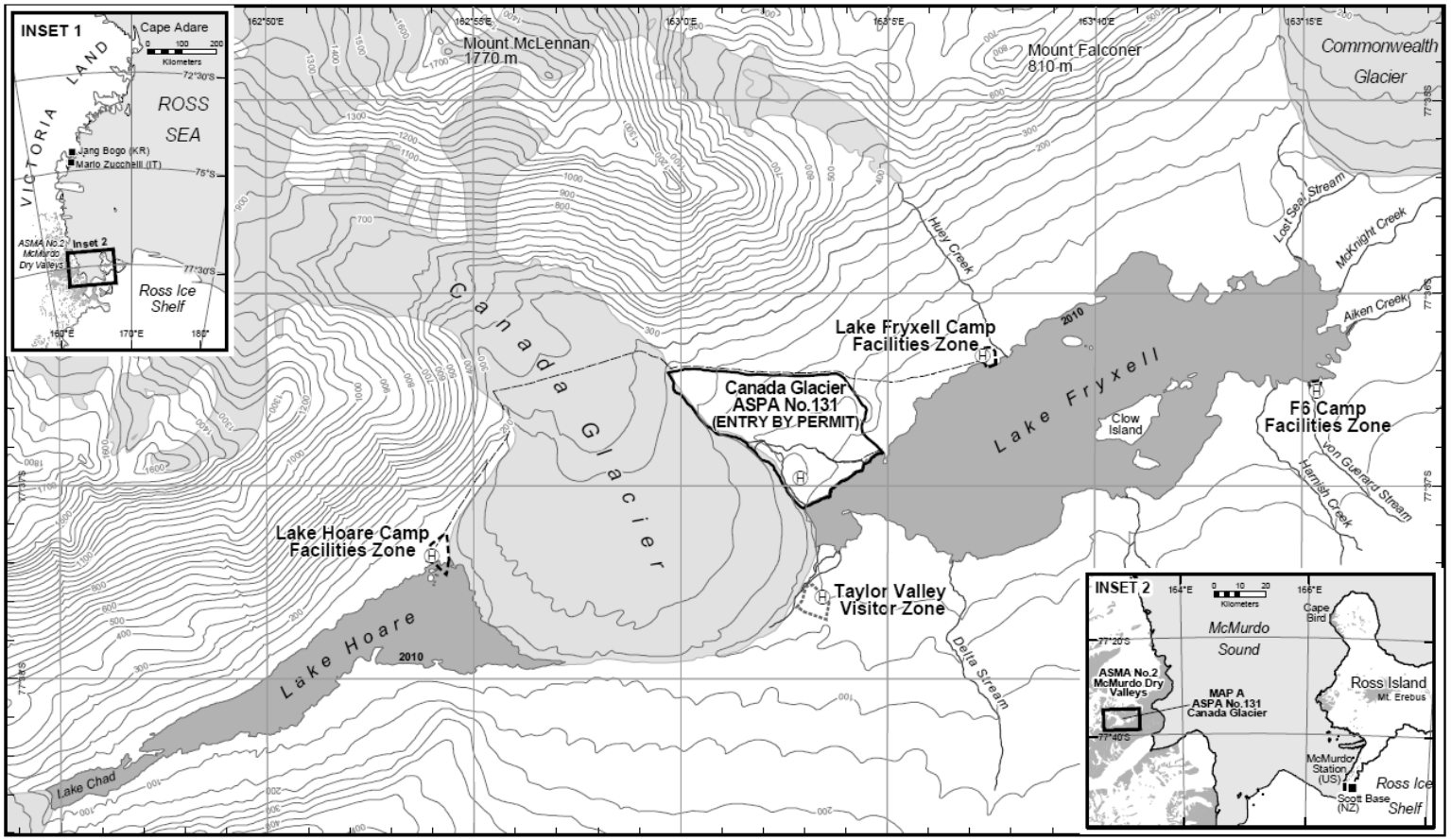
Sjoling, S. and Cowan, D.A. 2000. Detecting human bacterial contamination in Antarctic soils. Polar Biology 23(9): 644-650.

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.

Vincent, W.F. and Howard-Williams, C. 1989. Microbial communities in Southern Victoria Land Streams II: The effects of low temperature. Hydrobiologia 172: 39-49.



Map A: ASPA No. 131 Canada Glacier: Regional map

Environmental Research & Assessment
Issued 24 Mar 2016

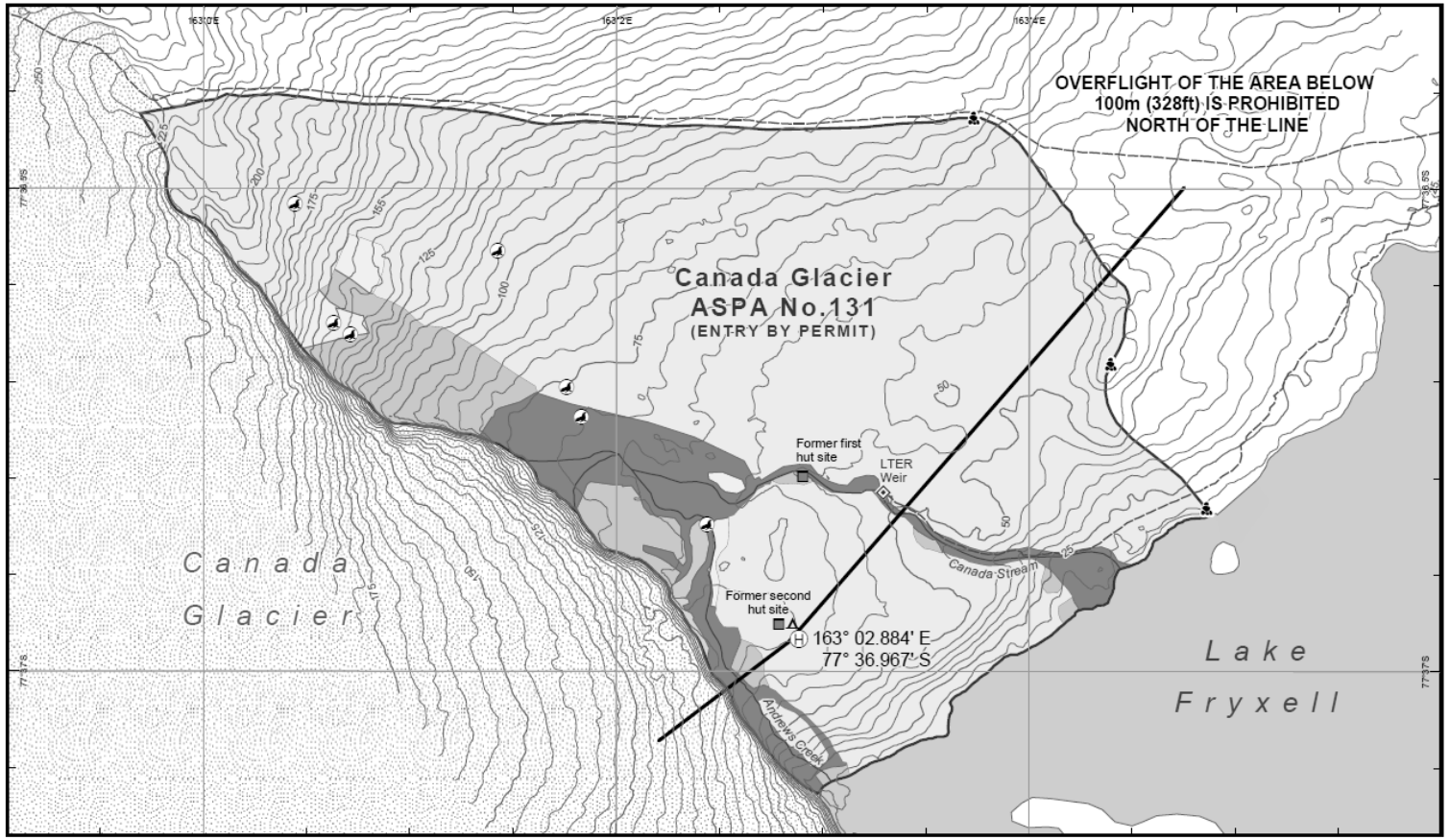
Antarctica New Zealand

Contour (50 m) · Stream · Lake · Glacier · Path · Helicopter landing site · Protected Area boundary · Facilities Zone · Visitor Zone

0 1 2 Kilometres

N

Projection: Lambert Conformal Conic; Spheroid & horizontal datum: WGS84;
Data sources: Streams digitised from aerial imagery (1993); Lakes: PGC shoreline survey (2010); Contours & glaciers: derived from USGS 1:50K map series; Zone boundaries & facilities: USAP (Jun 2015); ASPA boundary based on Management Plan (Mar 2016).



Map B: ASPA No. 131 Canada Glacier: Vegetation density map

Environmental Research & Assessment
Issued 04 Apr 2016

Antarctica New Zealand

- Index Contour (25m)
- Contour (5m)
- Stream
- Lake
- Glacier
- Protected Area boundary
- Path
- Cairn
- Helicopter landing site
- Designated camp site
- Former hut site
- Weir
- Mummified seal

Vegetation density
(within ASPA only)

- Dense >25%
- Medium 1 - 25%
- Scattered 0.01 - 0.99%
- Bare / Very Low <0.01%

0 100 200 300 400 500
Metres

N

Projection: Lambert Conformal Conic;
Spheroid & horizontal datum: WGS84;
Data sources: Streams digitised from aerial imagery (1993);
Contours, cairns, mummified seals, camps,
former huts, weir & lake: Gateway Antarctica;
Vegetation survey: Dept. of Biological Sciences, University of Waikato;
ASPA boundary based on Management Plan (Mar 2016).

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 Shirreff, 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) and Measure 2 (2000), which extended the expiry date of SSSI 32;
- Decision 1 (2002), which renamed and renumbered SSSI 32 as ASPA 149;
- Measures 2 (2005) and 7 (2011), which adopted revised Management Plans 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) were 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 Shirreff and San Telmo Island, Livingston Island, South Shetland Islands), which is annexed to this Measure, be approved; and
2. the Management Plan for Antarctic Specially Protected Area No 149 annexed to Measure 7 (2011) be revoked.

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 60°47'17"W, 62°27'30"S, 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-CAMLR-XXVIII, Annex 4, para 5.29). The Management Plan was revised through Measure 7 (2011).

The Area lies within 'Environment E – Antarctic Peninsula, Alexander and other islands and 'Environment G – Antarctic Peninsula offshore islands, as defined in the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)). Under the Antarctic Conservation Biogeographic Regions classification (Resolution 6 (2012)) the Area lies within ACBR3 – North-west Antarctic Peninsula.

1. Description of values to be protected

Cape Shirreff (60°47'17" W, 62°27'30" S, 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 (U.S.). 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 United States. Designation was on the grounds that the "presence of both Antarctic fur seal and penguin colonies, and of krill fisheries within the foraging ranges 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 United States, 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-CAMLR-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. Historic Site & Monument (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:

  - accommodation facilities at Cape Shirreff;
  - Saint Kliment Ohridski Station (Bulgaria), Hurd Peninsula, Livingston Island;
  - Arturo Prat Station (Chile), Discovery Bay/Chile Bay, Greenwich Island;
  - Base Juan Carlos I (Spain), Hurd Peninsula, Livingston Island;
  - Julio Escudero Station (Chile), Fildes Peninsula, King George Island; and
  - Eduardo Frei Station (Chile), Fildes Peninsula, King George 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

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 200 m; vertical accuracy unknown. Data sources: land features from SCAR Antarctic Digital Database v6 (2012); bathymetry supplied by the U.S. Antarctic Marine Living Resources (U.S. AMLR) Program, NOAA (2002) and IBCSO (v1.0 2013) (http://ibcso.org).

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, 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), except small boat landing site supplied by M. Goebel (Dec 2015).

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. Seal tracking station and HSM: D. Krause (Dec 2015). Walking routes and fauna: INACH, updated by M. Goebel and D. Krause (Dec 2015).

6. Description of the Area

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

- *Boundaries and Coordinates*

Cape Shirreff (60°47'17" W, 62°27'30" S) 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 100m 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 U.S. 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 (U.S. 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.

- *Paleontology*

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, Polito et al. 2015). 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.

Data available on penguin numbers are presented in Table 1. In 2015/16 there were 19 active breeding sub-colonies at Cape Shirreff, with a total of 655 gentoo and 3302 chinstrap penguin nests (U.S. AMLR unpublished data), 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). During the 2010/11 and 2012/13 seasons unmanned aerial systems were tested to aid in estimating penguin abundance (Goebel et al. 2015).

Several other species breed within the Area (Map 3), although data on numbers are patchy. Kelp gulls (Larus domincanus) and brown skuas (Catharacta antarctica) nest in abundance along the entire coastline of the Area. In 2000 there were 25 and 22 breeding pairs of these species respectively (U.S. AMLR, pers. comm. 2000). In 2007/08, 24 pairs of skuas were identified at Cape Shirreff and near Mercury Bluff, of which 23 were brown skuas (Catharacta antarctica) 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, but 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 Shirreff 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

Year	Chinstrap (pairs)	Gentoo (pairs)	Source
1999/00	7744 (N1)	922 (N1)	U.S. AMLR data, Carten *et al*. 2001
2000/01	7212 (N1)	1043 (N1)	U.S. AMLR data, Taft *et al*. 2001
2001/02	6606	907	U.S. AMLR data, Saxer *et al*. 2003
2002/03	5868 (A3)	778 (A3)	U.S. AMLR data, Shill *et al*. 2003
2003/04	5636 (N1)	751 (N1)	U.S. AMLR data, Antolos *et al*. 2004
2004/05	4907 (N1)	818 (N1)	U.S. AMLR data, Miller *et al*. 2005
2005/06	4849 (N1)	807 (N1)	U.S. AMLR data, Leung *et al*. 2006
2006/07	4544 (N1)	781 (N1)	U.S. AMLR data, Orben *et al*. 2007
2007/08	3032 (N1)	610 (N1)	U.S. AMLR data, Chisholm *et al*. 2008
2008/09	4026 (N1)	879 (N1)	U.S. AMLR data, Pietrzak *et al*. 2009
2009/10	4339 (N1)	802 (N1)	U.S. AMLR data, Pietrzak *et al*. 2011
2010/11	4127 (N1)	834 (N1)	U.S. AMLR data, Mudge *et al*. 2014
2011/12	4100 (N1)	829 (N1)	U.S. AMLR unpublished data
2012/13	4200 (N1)	853 (N1)	U.S. AMLR unpublished data
2013/14	3582 (N1)	839 (N1)	U.S. AMLR unpublished data
2014/15	3464 (N1)	721 (N1)	U.S. AMLR unpublished data
2015/16	3302 (N1)	655 (N1)	U.S. AMLR unpublished data

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 8,577 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 remains 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 (Goebel et al. 2014).. Genetic analysis to investigate the recolonization of Antarctic fur seals at Cape Shirreff from the putative source population at South Georgia has been conducted and highly significant genetic differences have been found, which indicates that even relict populations can recover without losing genetic diversity (Bonin *et al*. 2013). The Antarctic fur seal colony at Cape Shirreff has also been used to study the genetic analysis of twin pups, which are rare among pinnipeds (Bonin *et al*. 2012).

During the 2010/11 season, the U.S. AMLR program reported a 14% reduction in pup production from the previous summer season (Goebel *et al*. 2014). Pup production at Cape Shirreff was particularly low during the 2007/08, 2008/09, 2009/10 and 2010/11 seasons, with all of them showing a double-digit decline, most likely as a result of unfavorable winter conditions and a change in demography with an increase in older female seals, leading to lower reproductive rates and higher mortality (Goebel *et al*. 2008, 2009, 2011, 2014). 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, McDonald *et al*. 2012a, 2012b). Studies on population dynamics have also been undertaken, with results showing that without the top-down impact from predation the Antarctic fur seal

colony would most likely increase, despite the bottom-up effects of climate change (Schwarz *et al*. 2013).

A small number of southern elephant seals breed in October on several eastern beaches (U.S. AMLR, pers. comm. 2000; Torres, pers. comm. 2002). On 2 Nov 1999 34 pups were counted on beaches south of Condor Hill (U.S. AMLR, unpublished data). During the 2008/09 season, a total of 40 southern elephant seal pups were born near Cape Shirreff (Goebel *et al*. 2009). During the 2010/11 season a total of 31 pups were born near Cape Shirreff pups (Goebel *et al*. 2014).

Groups of non-breeding southern elephant seals are also present, while isolated animals, mainly juveniles, may be found on various beaches. The maximum number of southern elephant seals during the 2010/11 season at Cape Shirreff was 221 individuals (Goebel *et al*. 2014). 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 4,700 km due west of the Antarctic Peninsula.

Weddell seals, leopard seals and crabeater seals have been observed, although do not breed, 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. 2015). During the 2010/11 season the maximum recorded number of Weddell seals was 48 individuals, 19 individuals of leopard seals and 2 individuals of crabeater seals (Goebel *et al*. 2014). 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 HD video cameras, GPS and time-depth recorders to monitor their foraging range, and hunting strategies (Krause *et al*. 2015). 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). In addition to fur seal pups and penguins, leopard seals were found to take two species of demersal fish (*Gobionotothen gibberifrons and Notothenia coriiceps)*, and scavenge carcasses of fur seals and penguins (Krause et al. *in press*). DNA samples are frequently collected from four seal species at Cape Shirreff and stored in the Southwest Fisheries Science Center DNA archives (Goebel *et al*. 2009). During the 2009/10, 2010/11, 2011/12, and 2014/15 summer seasons, researchers deployed archival tags on Antarctic fur seals, along with Weddell seals and leopard seals, to monitor their behavior over the winter period (Goebel et al. 2014). Unmanned aerial system (UAS) surveys were conducted in 2010/11 and 2012/13 which were successful in estimating the abundance and size of seals (Goebel *et al*. 2015).

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).

In December 2005 an adult male subantarctic fur seal was observed among Antarctic fur seals at Cape Sherriff, which is more than 4000 km from the nearest subantarctic fur seal breeding colony (Torres *et al*. 2012).

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 on 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 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, larval 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. 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 U.S. 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 (U.S. 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, ammunition and a wooden box covered by a pyramid of stones. Several notes in Russian, dating from later visits, were found in this box (Torres 2007).

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 U.S. 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 pinnipeds, 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. 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 33,970 tonnes (t) of Antarctic krill (*Euphausia superba*) were caught in Subarea 48.1 compared with an average of 32993 tonnes 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 t). In 2012/13, 2013/14 and 2014/15 (data provisional) respectively, 153,830, 146,191 and 153,946 t were caught, and the fishery was closed in each of these years in view of the catch limit (CCAMLR 2015; 2015b). Nations recorded as fishing for krill within the Subarea during the recent past included Chile, China, Germany, 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*, *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 is discouraged, and restrictions apply to routes and landing sites for the period 01 November – 31 March inclusive. Details of these restrictions are given in Section 7(ii) below, and of the Helicopter Access Zone in Section 6(v).

Two anchorages have been identified close to the Area (Map 2) and when access to the Area is made from the sea, small boats should land at one of the locations defined in Section 7(ii). 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 on land within the Area is restricted to the coastal zone between Módulo Beach and the Chilean / U.S. camp facilities and to following the access route shown on Map 3 to allow re-supply of the bird blind / emergency hut (see Section 7(ii) for more details).

6(iii) Location of structures within and adjacent to 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°28.249' S, 60°46.283' W) (Map 3). Buildings for the camp remain *in situ* year-round. In 2015, the field camp known as Cape Shirreff Field Station (U.S.), consisted of four small buildings and an outhouse (Krause pers. comm. 2015). The camp 'Dr Guillermo Mann-Fischer' (Chile) is located around 50 m from the U.S. camp and comprised of a main hut, laboratory, store house, a fiberglass igloo, an outhouse and a wind-powered generator (D. Torres, A. Aquayo and J. Acevedo, pers. comm., 2010)). The Chilean fiberglass igloo was originally installed in 1990/91, while the U.S. camp was established in 1996/97. Storage areas are also present, and tents are erected seasonally nearby as required. An All-Terrain Vehicle (ATV) shed, with secondary containment for summer use and winter storage of the ATV, was constructed at the U.S. camp in 2009/10. The site was selected to remain within the existing station footprint and to avoid interference with seal movements. 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 U.S. camp when needed.

Two automatic weather stations are mounted on the exterior of existing buildings at Cape Shirreff. Two remote receiving station used for seal tracking studies are stored within a box (90x60x100cm) located to the east of helicopter landing site A on the northeastern slopes of Condor Hill and northeast of Toqui Hill (see Map 3).

A boundary sign stating that the Area is protected and that access is prohibited is located at Módulo Beach, close to the Chilean and U.S. camps. In the 2015/16 season, the sign was in need of repair, and it is intended that a new sign will be installed during the 2016/17 season (Krause, pers. comm. 2015). The boundaries of the Area are not otherwise marked.

The remains of a camp, believed to be of Russian origin, are present near the Chilean and U.S. 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°27.653' S, 60°47.404' W) was installed by U.S. scientists on the northern slopes of Enrique Hill above Bahamonde Beach, close to the penguin colonies (Map 3).

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

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).

6(v) Special 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 west of 60°48' W and north of 62°29' S.

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.

7. Terms and conditions for entry permits

7(i) General 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(ii) Access to, and movement within or over, the Area
Access to the Area shall be by small boat, by helicopter, on foot or by vehicle. Persons entering the Area may not move beyond the immediate vicinity of their landing site unless authorised by Permit.

- *Boat Access*

Access by small boats should be at one of the following locations (Map 2):
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;
the northern end of Half Moon Beach, on the eastern coast of the peninsula;
the northern end of Yámana Beach, on the western coast (suitable at high tide only);
the north coast at Alcazar Beach near the bird blind / emergency hut;
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; 1,600 m north-east of the main camp facilities and approximately 800 m north of San Telmo Island (Map 2). 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:

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;
Overflight of the Restricted Zone is prohibited below 610 m (2,000 ft) 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;
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) (60°46.438'W, 62°28.257'S), 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 (60°46.814'W, 62°28.269'S).

- 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 1,200 m (~ 0.65 n. mi.) towards Selknam Hill (elevation = 50 m, or ~150 ft). The Helicopter Access Zone then extends east by 300 m (~ 0.15 n. mi) to Ancho Pass, where helicopter landing site B is situated, and a further 400 m (~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.
- 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).
- 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;
- 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 snow-covered land only:

in the coastal zone between Módulo Beach and the Chilean / U.S. camp facilities (Map 3); and

in support of annual re-supply of the bird blind / emergency hut following the designated route (see Map 3), which should be undertaken prior to 15 November in a given season and only if the entire route is snow-covered to a depth of at least 40 cm, to minimise the possibility of damage to underlying soil and vegetation (Felix & Raynolds 1989). A journey after 15 November should be considered carefully, due to potential disturbance to adult female fur seals, which tend to arrive around that time of the year. No more than two re-supply journeys by vehicle to the emergency hut are allowed per season. An inspection of the route should be undertaken when it is snow-free to check for any evidence that vehicle use has caused damage to soils or vegetation. Should any damage be observed, use of vehicles for the purpose of re-supply shall be suspended until such time as a review of this policy has been completed.

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(iii) Activities which may be conducted in the Area

- 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(iv) 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 U.S. 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(v) Location of field camps

Camping is permitted within 200 m of the facilities of the Chilean and U.S. 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 U.S. bird observation hut on the northern slopes of Enrique Hill (60°47'28" W, 62°27'41" S) 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(vi) Restrictions on materials and organisms which may 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(vii) Taking of, 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(viii) Collection or removal of materials 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(ix) 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(x) Measures that may be necessary to continue to meet the aims of the Management Plan

- Permits may be granted to enter the Area to carry out biological monitoring and site inspection activities, which may involve the collection of limited samples for analysis or review, or for protective measures.
- Any specific sites of long-term monitoring should be appropriately marked.
- 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 United States, before initiating the work.
- 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(xi) 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.

8. Supporting documentation

Acevedo, J., Vallejos, V., Vargas, R., Torres, J.P. & Torres, D. 2002. Informe científico. ECA XXXVIII (2001/2002). 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. Nº Ingreso 642/710, 11.ABR.2002.

Acevedo, J., Aguayo-Lobo, A. & Torres, D. 2009a. Albino Weddell seal at Cape Shirreff, 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.

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 antibodies in *Arctocephalus gazella* from Cape Shirreff, Livingston Island, Antarctica. WG-EMM- 01/59.

Bonin, C.A., Goebel, M.E., O'Corry-Crowe, G.M., & Burton, R.S. 2012. Twins or not? Genetic analysis of putative twins in Antarctic fur seals, Arctocephalus gazella, on the South Shetland Islands. *Journal of Experimental Marine Biology and Ecology* **412***:* 13–19. doi:10.1016/j.jembe.2011.10.010

Bonin, C.A., Goebel, M.E., Forcada, J., Burton, R.S., & Hoffman, J.I. 2013. Unexpected genetic differentiation between recently recolonized populations of a long-lived and highly vagile marine mammal. *Ecology and Evolution*: 3701–3712. doi:10.1002/ece3.732

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.

CCAMLR 2015. *CCAMLR Statistical Bulletin* **27**. CCAMLR, Hobart, Australia.

CCAMLR 2015b. Report of the 34th Meeting of the Commission. Hobart, Australia. 19-30 October 2015. CCAMLR, Hobart,

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.

Felix, N.A. & Raynolds, M.K. 1989. The role of snow cover in limiting surface disturbance caused by winter seismic exploration. *Arctic* **42**(1): 62-68.

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.

Goebel, M.E., Burner, R., Buchheit, R., Pussini, N., Krause, D., Bonin, C., Vasquez del Mercado, R. & Van Cise, A.M. 2011. Pinniped Research at Cape Shirreff, Livingston Island, Antarctica. In Van Cise, A.M. (ed.) AMLR (Antarctic Marine Living Resources) 2009-2010 Field Season Report, Ch. 6. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Goebel, M.E., Pussini, N., Buchheit, R., Pietrzak, K., Krause, D., Van Cise, A.M. & Walsh, J. 2014. Pinniped Research at Cape Shirreff, Livingston Island, Antarctica. In Walsh, J.G. (ed.) AMLR (Antarctic Marine Living Resources) 2010-2011 Field Season Report, Ch. 8. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Goebel, M.E., Perryman, W.L., Hinke, J.T., Krause, D.J., Hann, N.A., Gardner, S., & LeRoi, D.J. 2015. A small unmanned aerial system for estimating abundance and size of Antarctic predators. *Polar Biology* **38**:619–30.

Garcia, M., Aguayo, A. & Torres, D. 1995. Aspectos conductuales de los machos de lobo fino antártico, *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 of the 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.

Krause, D. J., Goebel, M. E., Marshall, G. J., & Abernathy, K. (2015). Novel foraging strategies observed in a growing leopard seal (*Hydrurga leptonyx*) population at Livingston Island, Antarctic Peninsula. *Animal Biotelemetry*, ***3***:24.

Krause, D.J., Goebel, M.E., Marshall. G.J. & Abernathy, K. *In Press*. Summer diving and haul-out behavior of leopard seals (*Hydrurga leptonyx*) near mesopredator breeding colonies at Livingston Island, Antarctic Peninsula. *Marine Mammal Science*.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.

McDonald, B.I., Goebel, M.E., Crocker, D.E., & Costa, D.P. 2012a. Dynamic influence of maternal and pup traits on maternal care during lactation in an income breeder, the Antarctic fur seal. *Physiological and Biochemical Zoology* **85**(3):000-000.

McDonald, B.I., Goebel, M.E., Crocker, D.E. & Costa, D.P. 2012. Biological and environmental drivers of energy allocation in a dependent mammal, the Antarctic fur seal. *Physiological and Biochemical Zoology* **85**(2):134-47.

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.

Mudge, M.L., Larned, A., Hinke, J. & Trivelpiece, W.Z. 2014. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2010-2011. In Walsh, J.G. (ed.) AMLR (Antarctic Marine Living Resources) 2010-2011 Field Season Report, Ch. 7. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

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., & Torres, 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) 2008-2009 Field Season Report, Ch. 6. Antarctic Ecosystem Research Division, Southwest Fisheries Science Center, La Jolla, California.

Pietrzak, K.W., Mudge, M.L. & Trivelpiece, W.Z. 2011. Seabird research at Cape Shirreff, Livingston Island, Antarctica 2009-2010. In Van Cise, A.M. (ed.) AMLR (Antarctic Marine Living Resources) 2009-2010 Field Season Report, Ch. 5. 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.

Polito, M.J., Trivelpiece, W.Z., Patterson, W.P., Karnovsky, N.J., Reiss, C.S., & Emslie, S.D. 2015. Contrasting specialist and generalist patterns facilitate foraging niche partitioning in sympatric populations of Pygoscelis penguins. *Marine Ecology Progress Series* **519***:* 221–37.

Reid, K., Jessop, M.J., Barrett, M.S., Kawaguchi, 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.

Schwarz, L.K., Goebel, M.E., Costa, D.P., & Kilpatrick, A.M. 2013. Top-down and bottom-up influences on demographic rates of Antarctic fur seals Arctocephalus gazella. *Journal of Animal Ecology* **82**(4): 903–11.

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. *Journal of South American Earth Sciences* **9** (3/4): 265-272.

Smith, R.I.L. & Simpson, H.W. 1987. Early Nineteenth 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. 2007. Evidencias del uso de armas de fuego en cabo Shirreff. *Boletín Antártico Chileno*, **26** (2): 22.

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, Livingston 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, Isla 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.

Torres, T. 1993. Primer hallazgo de madera fósil en cabo Shirreff, isla Livingston, Antártica. *Serie Científica Instituto Antártico Chileno* **43**: 31-39.

Torres, D., Acevedo, J., Torres, D.E., Vargas, R., & Aguayo-Lobo, A. 2012. Vagrant Subantarctic fur seal at Cape Shirreff, Livingston Island, Antarctica. *Polar Biology* **35** (3): 469–473.

Tufft, R. 1958. Preliminary biology report Livingston Island summer survey. Unpublished British Antarctic Survey report, BAS Archives Ref. AD6/2D/1957/N2.

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

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

Vargas, R., Osman, L.P. & Torres, D. 2009. Inter-sexual differences 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.

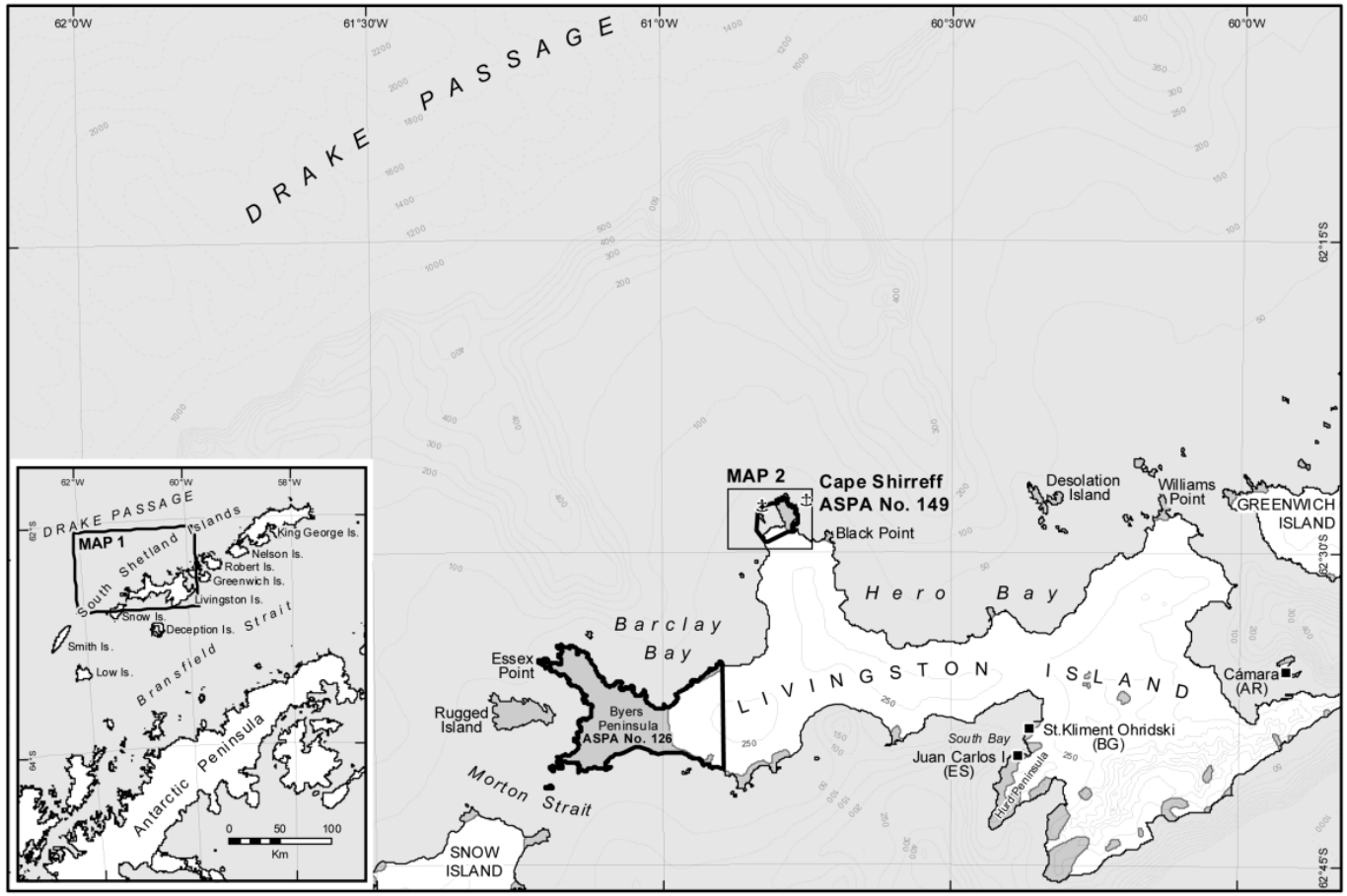
Vera, C., Vargas, R. & Torres, D. 2004. El impacto de la foca leopardo en la población de cachorros de lobo fino antártico en cabo Shirreff, Antártica, durante la temporada 2003/2004. *Boletín Antártico Chileno* **23** (1).

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.



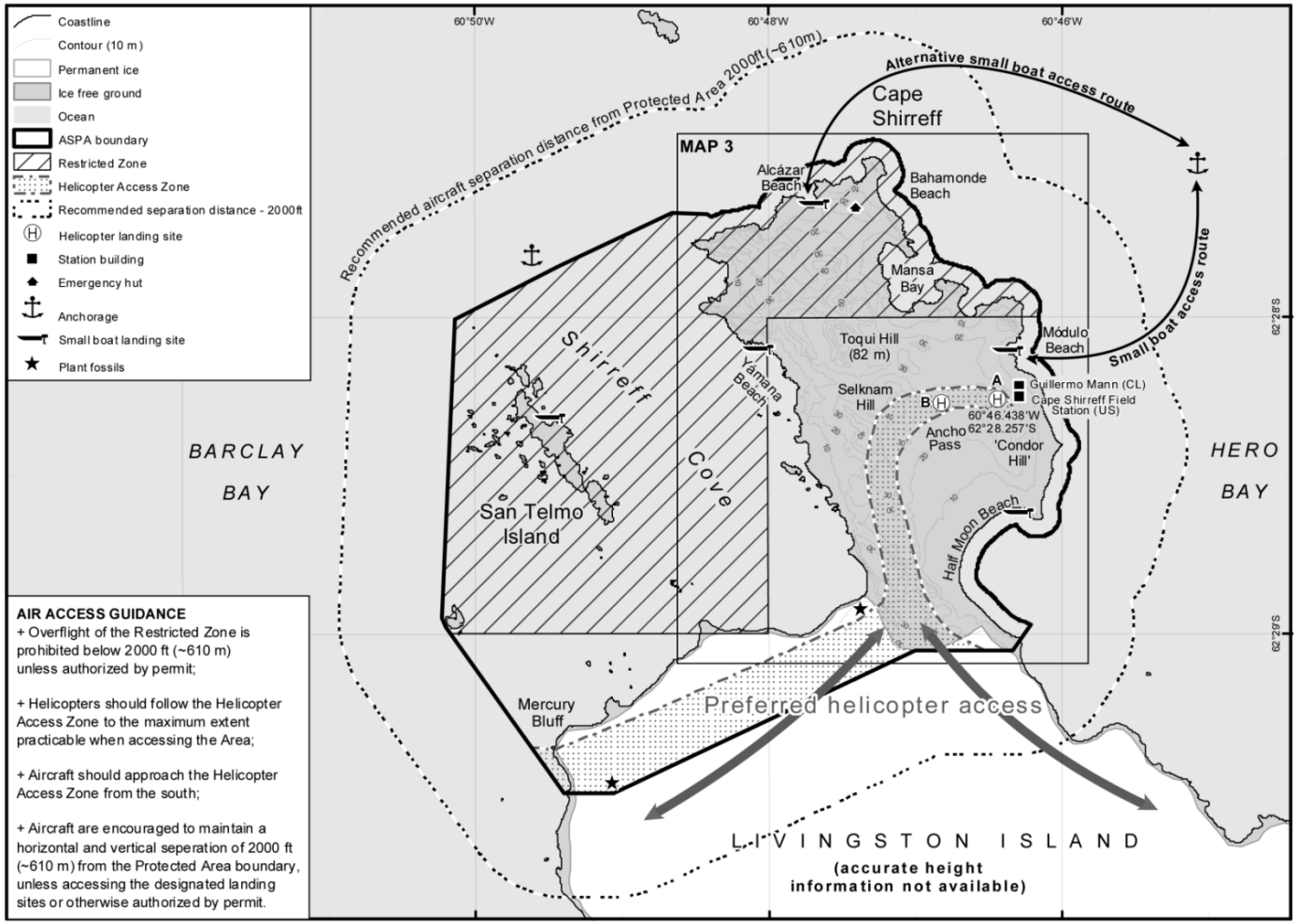
Map 1: ASPA No. 149 - Cape Shirreff & San Telmo Island - Regional overview

04 Mar 2016 (Map ID: 10069.0003.04)
United States Antarctic Program / INACH
Environmental Research & Assessment

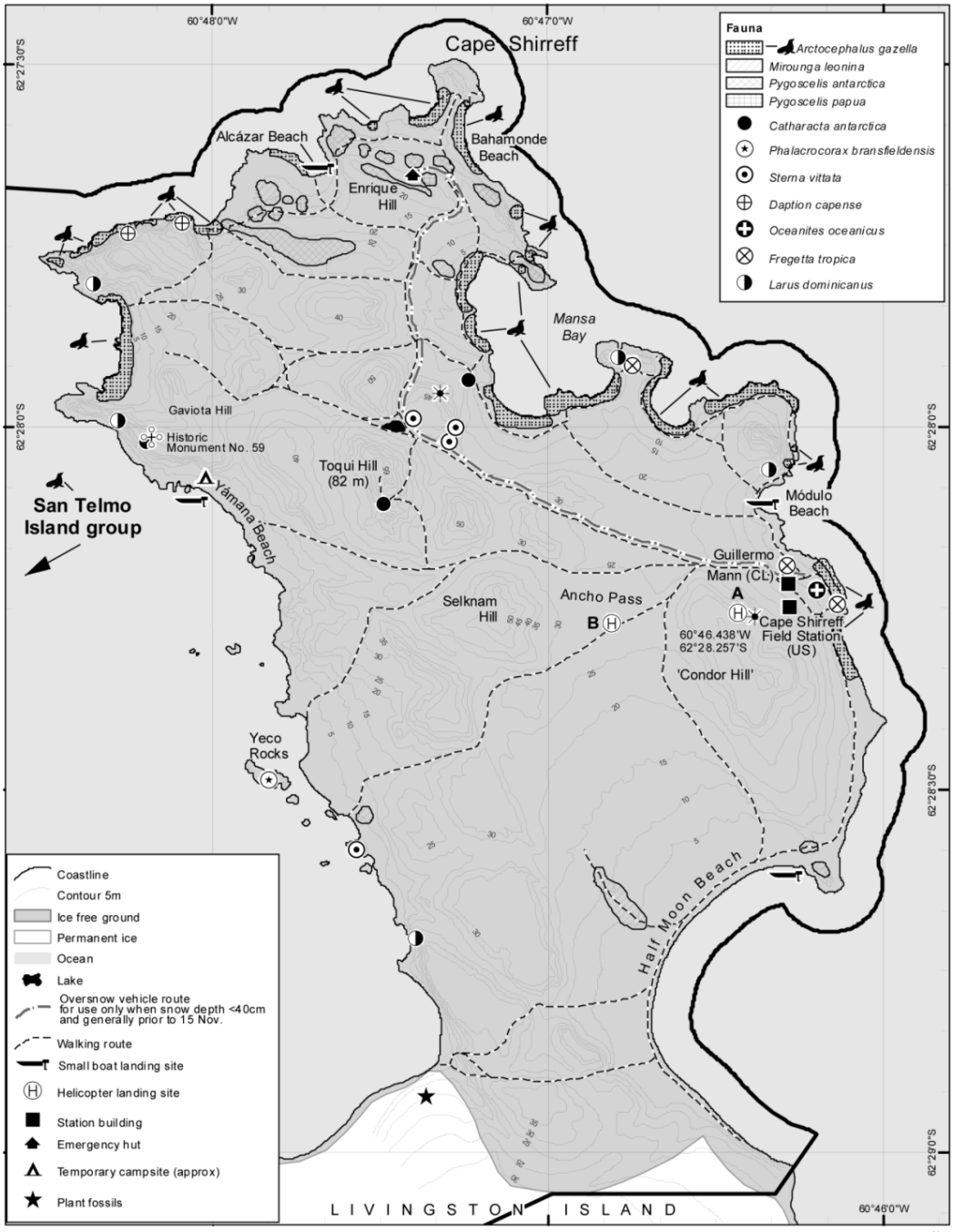
Coastline
Contour (250 m)
Bathymetry (50 m)
Bathymetry (200 m)
Ice free ground
Permanent ice
Ocean
Antarctic Specially Protected Area (ASPA) boundary
Permanent Station
Anchorage

0 10 20 N
Kilometers

Projection: Lambert Conic Conformal
Spheroid and horizontal datum: WGS84
Data sources:
Facilities: COMNAP (2014), revised by ERA;
Coastline & topography: SCAR Antarctic Digital Database (v6, 2012);
Bathymetry: supplied by D. Demer & U.S. AMLR, NOAA, 2002 & IBCSO (v1 2013).



Map 2: ASPA No. 149 Cape Shirreff & San Telmo Island - boundary and access guidelines



Map 3: ASPA No. 149 - Cape Shirreff & San Telmo Island - wildlife & human features

Antarctic Specially Protected Area No 167 (Hawker Island, Princess Elizabeth Land): Revised Management Plan

The Representatives,

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

Recalling
Measure 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;
Measure 9 (2011), which adopted a revised Management Plan for ASPA 167;

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, Princess Elizabeth Land), which is annexed to this Measure, be approved; and
2. the Management Plan for Antarctic Specially Protected Area No 167 annexed to Measure 9 (2011) be revoked.

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). A revised management plan for the Area was adopted under Measure 9 (2011). 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 southern elephant seals (*Mirounga leonina*) haul out there.

1. Description of values to be protected

The total population of southern giant petrels in East Antarctica represents less than one per cent of the global breeding population. Estimates of breeding populations are problematic, as birds may be occupying a nest site when monitoring occurs, but not breeding that season. There are currently about 280 occupied nests in East Antarctica, comprising about 40 occupied nests on Hawker Island (2014), 2 occupied nests on Giganteus Island (Rookery Islands group) (2015), about 230 occupied nests on the Frazier Islands (2013) and about 8 occupied nests at Pointe Géologie (2005). Southern giant petrels also breed on 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. From 1963 to 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 were recorded rather than total chick numbers.

Southern giant petrels 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.

Southern giant petrels are listed as Least Concern by the International Union for Conservation of Nature (IUCN, 2016). However, census data from a number of locations are decades old and the size and trend of the global population is not entirely certain. Hawker Island also supports breeding colonies of Adélie penguins, south polar skuas and Cape petrels. Occasionally southern elephant seals haul out on the southern beaches.

2. Aims and objectives

Management of the Hawker Island ASPA aims to:

- protect the breeding colony of southern giant petrels and other wildlife;
- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance;
- allow scientific research on the ecosystem, particularly on the avifauna, and physical environment, provided it is for compelling reasons which cannot be served elsewhere;
- minimise the possibility of introduction of pathogens which may cause disease in bird populations within the Area;
- minimise human disturbance to southern giant petrels in the Area;
- allow the Area to be used as a reference area for future comparative studies with other breeding populations of southern giant petrels;
- protect the values of Hawker Island as a reference area for future comparative studies with other breeding populations of southern giant petrels;
- minimise the possibility of the introduction of alien plants, animals and microbes to Hawker Island;
- allow for the gathering of data on the population status and related demography of the bird species on a regular basis; and
- allow visits for management purposes in support of the aims of the management plan.

3. Management activities

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

- research visits to assess population status 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);
- visits shall be made to the Area as necessary (preferably not less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure that management activities are adequate;
- if practicable the Area shall be visited outside the breeding season of southern giant petrels (i.e. during the period mid-April to mid-September), 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.

4. Period of designation

Designation is for an indefinite period.

5. Maps

Map A: Antarctic Specially Protected Area No 167, Hawker Island Vestfold Hills, Ingrid Christensen Coast, East Antarctica.

Map B: Antarctic Specially Protected Area No 167, Hawker Island Vestfold Hills, Ingrid Christensen Coast, East Antarctica, Topography and Fauna Distribution.

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 a 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. They 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 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 km^2. There are no boundary markers.

- *Environmental Domains and Antarctic Conservation Biogeographic Regions*

Based on the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)) Hawker Island is located within Environment T *Inland continental geologic*.

Based on the Antarctic Conservation Biogeographic Regions (Resolution 6 (2012)), Hawker Island is located within Biogeographic Region 7 *East Antarctica*.

- *Human History*

The first recorded sighting of the Vestfold Hills was on 9 February 1931 by Douglas Mawson on the BANZARE voyage of the '*Discovery*'. Four years later, on 20 February 1935, Captain Klarius Mikkelsen of the tanker *Thorshavn* (Lars Christensen Company), sighted the hills 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 Expedition (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. In summer, average temperatures range from -1°C to +3 °C and from -14°C to -21°C in winter. From 1957 to 2015, the maximum temperature recorded at Davis station was +13°C, while the lowest temperature was -41.8°C recorded on 27 April 1998. 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 at any time of the year, and gusts of over 200 km/h were recorded in 1972. 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 highest rainfall recorded at Davis was 55.6 mm in 2013. 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*

At Hawker Island, the colony of southern giant petrels is situated on slightly sloping 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 its discovery in 1963/64.

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. Images taken year round by automated cameras show 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 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 status and trends and did not appear to significantly benefit the breeding success of the southern giant petrels. With the development of new technology (automated cameras), some detailed information can now be obtained with little or no human presence during the breeding period.

During the 2013/14 breeding season, 43 nests were occupied at some stage but not all adults attending them attempted to breed. In February 2014, at least 23 well advanced chicks were present. Some nests are not in the field of view of the automated cameras so the number of chicks may have been slightly higher.

- *Other Birds*

Adélie penguins breed along the Vestfold Hills coastline and on 27 offshore islands, including Hawker Island. The total number of Adélie penguins in the Vestfold Hills coast and offshore islands was most recently estimated to be 330 000 pairs in 2009/10. The Hawker Island Adélie penguin colony is currently located in the vicinity of a small hill midway on the western side of the island and was estimated to be 5000 pairs in 2009/10. There has been an historical shift in the occupation of sub-colony areas. Some areas which were previously occupied are no longer occupied. This is common at Adélie penguin populations in the Davis region. As with other breeding sites in the Davis region, the first Adélie penguins usually appear in the area by the middle of October and eggs are laid about four weeks later. The laying interval between the first and second egg is 2 to 4 days, and the incubation period ranges from 32 to 35 days. The last moulted adults usually 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 breed in the fjords of the Vestfold Hills and occasionally near the south-east part of Hawker Island. The seals start to appear 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 occasionally haul out onto land. Most of the local population remains in the sea ice region close to 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 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 (water dwelling, eight legged, segmented invertebrates) 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 approached by vehicle, small boat or aircraft, all of which must remain outside the Area. There are no designated landing sites within the Area.

Access by small boat should be via a site that exceeds minimum wildlife separation distance and that, as far as possible, is separated by a geographic feature such as a low ridge line to minimise disturbance on approach.

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

There are no permanent structures within or adjacent to the Area. Three automated cameras are temporarily located in close proximity to the southern giant petrel colony, for the purposes of ongoing population monitoring.

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

Antarctic Specially Protected Area No. 143 Marine Plain (68°36'S, 78°07'E) is located approximately 8 km to the east.

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

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 compelling scientific reasons that cannot be served elsewhere, in particular for scientific study of the avifauna and ecosystem of the Area, or for essential management purposes consistent with plan objectives, such as inspection, management or review;
- the actions permitted will not jeopardise the values of the Area;
- 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 finite period; and
- the appropriate national authority shall be notified of any activities or measures undertaken that were not included in the authorised permit.

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

- Vehicles are prohibited within the Area. Movement within the Area is by foot only.
- 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. 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 reach the Area shall not be taken into the Area. Vehicles shall remain on the sea-ice at least 200 m 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 is observed, separation distance should be increased or the activity modified until there is no visible disturbance. Exceptions to this are only allowed when 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. Persons shall not approach closer than is necessary to obtain census data or biological data from any nesting southern giant petrels, and in no case closer than 20m;
- Disturbance can be minimised by leaving vehicles as far from the site as possible, approaching slowly and quietly, and using topography to screen your approach.
- 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 risking 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 southern giant petrel 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-engine helicopters and fixed-wing aircraft, and no less than 1500 m (5000 ft) for twin-engine helicopters;
- Landing of aircraft within 930 m of a wildlife concentration for single-engine helicopters and fixed-wing aircraft, and within 1500 m (5000 ft) of a wildlife concentration for twin-engine helicopters is prohibited;
- Overflight of the Area, including by unmanned aerial vehicles, is prohibited (except where essential for scientific or management purposes as authorised in a Permit).
- Clothing (particularly all footwear and outer clothing) and field equipment shall be thoroughly cleaned before entering the Area.

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)	**All vehicles 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 200 m from wildlife colonies.	Watercraft should maintain 200 m from wildlife during transit and should not be landed within 50 m of wildlife; in particular, the Adélie penguin colony on the eastern shore. Care shall be taken when in close proximity to the island.
Breeding/moulting emperor penguin	50 m		
All other breeding animals and birds	15 m		
Non-breeding seal or bird	5 m		

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

Activities undertaken within the breeding period of the southern giant petrel (16 September to 14 April) shall only be permitted if the activity is non-invasive and cannot reasonably be undertaken during the non-breeding period. Where practical, activities not relating to southern giant petrels shall be restricted to areas outside the visual catchment of the southern giant petrel breeding site.

The following activities may be conducted within the Area as authorised in a permit:

- scientific research consistent with the provisions of this management plan which cannot be undertaken elsewhere;
- essential management activities, including monitoring; and
- sampling which should be the minimum required for approved research programs.

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 or national agency, year of installation and date of expected removal.
- 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 and must be handled in a way that minimises the risk of accidental introduction into the environment.
- No depots of food or other supplies are to be left within the Area beyond the season for which they are required.
- 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. 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. 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.
- Ornithological research shall be limited to activities that are non-invasive and non-disruptive to the breeding seabirds present within the Area. Surveys, including aerial photographs for the purposes of population census, shall have a high priority.
- Disturbance of southern giant petrels or other wildlife shall be avoided at all times. Visitors should be alert to changes in wildlife behaviour, especially changes in posture or vocalisation. If birds are showing signs of wanting to leave the nest, all persons shall retreat immediately.

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 and approval obtained prior to removal.

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 Australian Antarctic Data Centre or the Antarctic Data Directory System through the appropriate national authority.
- Permits may be granted to enter the Area to carry out biological monitoring, Area inspection 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.

- Where practical, a census of southern giant petrels in the Area shall be conducted at least once in every five year period. Censuses of other species may be undertaken provided no additional disturbance is caused to the southern giant petrels.
- Where practical, activities not relating to southern giant petrels shall be restricted to areas outside the visual catchment of the southern giant petrel breeding site.
- 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

Visit reports shall provide detailed information on all census data; locations of any new colonies or nests not previously recorded, as texts and maps, a brief summary of research findings; copies of relevant photographs taken of the Area; and comments indicating measures taken to ensure compliance with permit conditions.

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

The report shall be submitted as soon as practicable after the visit to the ASPA has been completed to the appropriate national permitting authority who issue the permit, but no later than six months after the visit has occurred. A copy of the report shall be made available to the permit issuing authority and the Party responsible for development of the Management Plan (Australia - Australian Antarctic Division) (if different) for the purposes of reviewing the management plan. 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.

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.

ACAP (Agreement on the Conservation of Albatrosses and Petrels) (2012) *Species assessments: southern giant petrel Macronectes giganteus*. <www.acap.aq/en/acap-species/288-southern-giant-petrel/file>, downloaded 19 September 2012.

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.

DSEWPC (Department of Sustainability, Environment, Water, Population and Communities) (2011a): *Background Paper: Population status and threats to albatrosses and giant petrels listed as threatened under Environment Protection and Biodiversity Conservation Act 1999*<http://www.environment.gov.au/resource/national-recovery-plan-threatened-albatrosses-and-giant-petrels-2011%E2%80%942016> Downloaded on 10 February 2016.

DSEWPC (Department of Sustainability, Environment, Water, Population and Communities) (2011b): *National recovery plan for threatened albatrosses and giant petrels: 2011-2016*, <http://www.environment.gov.au/biodiversity/threatened/publications/recovery/albatrosses-and-giant-petrels.html>, Downloaded on 10 February 2016.

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 processes*, Siena: Museo Nazionale dell'Antartide, 829–834.

Garnett ST, Szabo JK and Dutson G (2011). *The action plan for Australian birds 2010*. CSIRO Publishing.

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 (International Union for Conservation of Nature) (2001): *IUCN Red List Categories: Version 3.1*, IUCN Species Survival Commission, <www.iucnredlist.org>. Downloaded on 25 January 2016.

IUCN (International Union for Conservation of Nature) (2015): *IUCN Red List of Threatened Species*. Version 2015.4<www.iucnredlist.org>. Downloaded on 25 January 2016.

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.

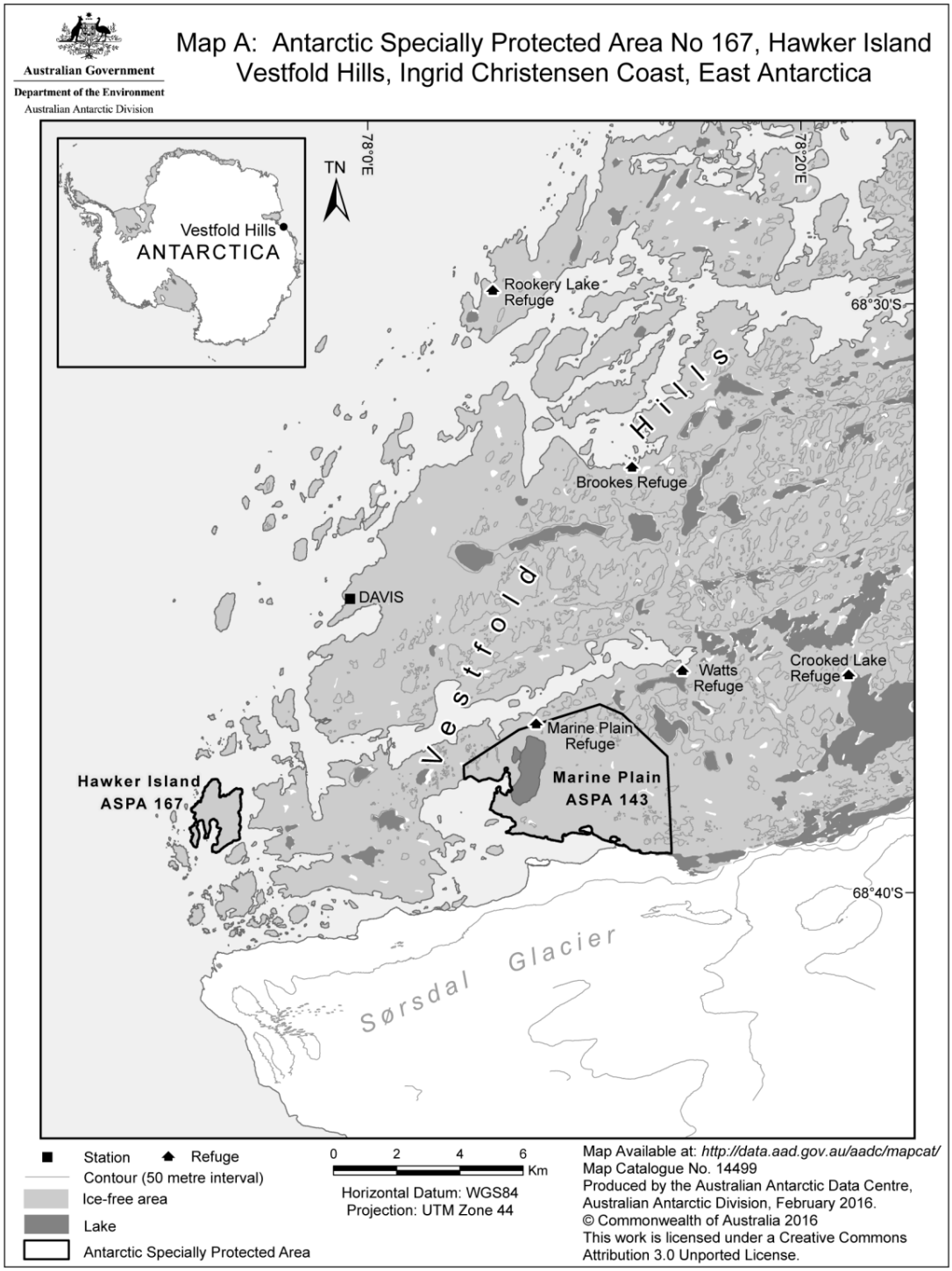
Southwell C., Emmerson L., McKinlay J., Newberry K., Takahashi A., Kato A., Barbraud C., DeLord K., Weimerskirch H. (2015) Spatially extensive standardized surveys reveal widespread, multi-decadal increase in East Antarctic Adélie penguin populations. PLoS ONE 10(10): e0139877. doi:10.1371/journal.pone.0139877

Stattersfield, A.J., Capper, D.R. (eds.) (2000): Threatened Birds of the World. Lynx Editions, Barcelona.

Terauds, A., Chown, S.L., Morgan, F., Peat, H.J., Watts, D.J., Keys, H., Convey, P., and Bergstrom, D.M. (2012): Conservation biogeography of the Antarctic, *Diversity and Distributions* Vol. 18. 726-741.

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.


Australian Government
Department of the Environment
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
Vestfold Hills
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. 14499
Produced by the Australian Antarctic Data Centre,
Australian Antarctic Division, February 2016.
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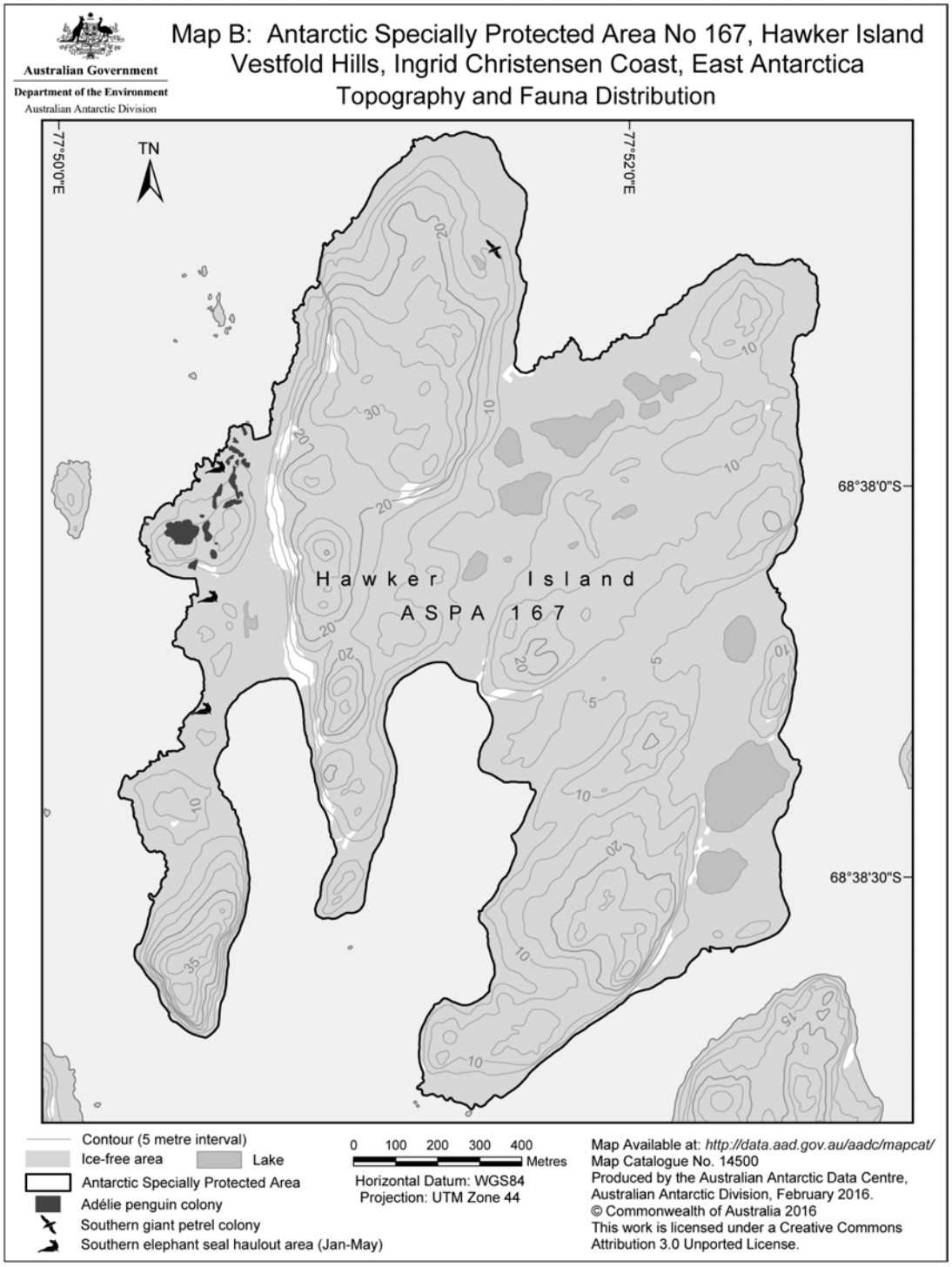
Australian Government
Department of the Environment
Australian Antarctic Division
Map B: Antarctic Specially Protected Area No 167, Hawker Island
Vestfold Hills, Ingrid Christensen Coast, East Antarctica
Topography and Fauna Distribution
77°50'0"E
77°52'0"E
TN
68°38'0"S
68°38'30"S
Hawker Island
ASPA 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. 14500
Produced by the Australian Antarctic Data Centre,
Australian Antarctic Division, February 2016.
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Measure 9 (2016)

Revised List of Antarctic Historic Sites and Monuments: Incorporation of a historic wooden pole to Historic Site and Monument No 60 (Corvette Uruguay Cairn), in Seymour Island (Marambio), Antarctic Peninsula

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 ("HSM"), and that such sites shall not be damaged, removed or destroyed;

Recalling
Recommendation XVII-3 (1992), which designated HSM 60 (Corvette Uruguay Cairn);
Measure 19 (2015), which revised and updated the List of HSM;

Desiring to modify the description of HSM 60;

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:

1. the description of Historic Site and Monument No 60 (Corvette Uruguay Cairn) be modified in order to read as follows:

"Wooden pole and cairn (I), and wooden plaque and cairn (II), both located at Penguins Bay, southern coast of Seymour Island (Marambio), James Ross Archipelago. The wooden pole and a cairn (I) were installed in 1902 during the Swedish South Polar Expedition led by Dr. Otto Nordenskjöld. This cairn used to have attached a 4 m high wooden pole – nowadays only 44 cm high –, guy-lines and a flag, and was installed to signal the location of a well stocked deposit, composed of few wooden boxes containing food supplies, notes and letters saved inside bottles. The deposit was to be used in case the Swedish South Polar Expedition was forced to retreat on its way to the south.
The wooden plaque (II) was placed on 10 November 1903 by the crew of a rescue mission of the Argentinean Corvette Uruguay in the site where they met the members of the Swedish expedition led by Dr Otto Nordenskjöld. The text of the wooden plaque reads as follows:
"10.XI.1903 Uruguay (Argentine Navy) in its journey to give assistance to the Swedish Antarctic expedition."
In January 1990, a rock cairn (II) was erected by Argentina in memory of this event in the place where the plaque is located."
Location:
(I): 64º 17' 47.2" S, 56º 41' 30.7" W
(II): 64 º 16' S, 56º 39' W
Original proposing Parties: Argentina and Sweden
Parties undertaking management: Argentina and Sweden

2. the revised and updated List of Historic Sites and Monuments be annexed to this Measure.

Revised List of Historic Sites and Monuments

No.	Description	Location	Designation/ Amendment
1.	Flag mast erected in December 1965 at the South Geographical Pole by the First Argentine Overland Polar Expedition. Original proposing Party: Argentina Party undertaking management: Argentina	90°S	Rec. VII-9
2.	Rock cairn and plaques at Syowa Station in memory of Shin Fukushima, a member of the 4th Japanese Antarctic Research Expedition, who died in October 1960 while performing official duties. The cairn was erected on 11 January 1961, by his colleagues. Some of his ashes repose in the cairn. Original proposing Party: Japan Party undertaking management: Japan	69°00'S, 39°35'E	Rec. VII-9
3.	Rock cairn and plaque on Proclamation Island, Enderby Land, erected in January 1930 by Sir Douglas Mawson. The cairn and plaque commemorate the landing on Proclamation Island of Sir Douglas Mawson with a party from the British, Australian and New Zealand Antarctic Research Expedition of 1929-31. Original proposing Party: Australia Party undertaking management: Australia	65°51'S, 53°41'E	Rec.VII-9
4.	Pole of Inaccessibility Station building. Station building to which a bust of V.I. Lenin is fixed, together with a plaque in memory of the conquest of the Pole of Inaccessibility by Soviet Antarctic explorers in 1958. As of 2007 the station building was covered by snow. The bust of Lenin is erected on the wooden stand mounted on the building roof at about 1.5 m high above the snow surface. Original proposing Party: Russia Party undertaking management: Russia	82°06'42" S, 55°01'57" E	Rec. VII-9 Measure 11(2012)

No.	Description	Location	Designation/ Amendment
5.	Rock cairn and plaque at Cape Bruce, Mac. Robertson Land, erected in February 1931 by Sir Douglas Mawson. The cairn and plaque commemorate the landing on Cape Bruce of Sir Douglas Mawson with a party from the British, Australian and New Zealand Antarctic Research Expedition of 1929-31. Original proposing Party: Australia Party undertaking management: Australia	67°25'S, 60°47'E	Rec. VII-9
6.	Rock cairn at Walkabout Rocks, Vestfold Hills, Princess Elizabeth Land, erected in 1939 by Sir Hubert Wilkins. The cairn houses a canister containing a record of his visit. Original proposing Party: Australia [1] Party undertaking management: Australia	68°22'S, 78°33'E	Rec. VII-9
7.	Ivan Khmara's Stone. Stone with inscribed plaque erected at Buromsky island in memory of Ivan Khmara, driver-mechanic, the member of the 1st Complex Antarctic Expedition of the USSR (1st Soviet Antarctic Expedition) who perished on fast ice in the performance of duties on 21.01.1956. Initially the stone was erected at Mabus Point, Mirny observatory. In 1974, 19th SAE, the stone was moved to Buromsky Island because of construction activity Original proposing Party: Russia Party undertaking management: Russia	66°32'04" S, 92°59'57" E	Rec. VII-9 Measure 11(2012)
8.	Anatoly Shcheglov's Monument. Metal stele with plaque in memory of Anatoly Shcheglov, driver-mechanic who perished in the performance of duties, erected on sledge on the Mirny – Vostok route, at 2 km from Mirny station. Original proposing Party: Russia Party undertaking management: Russia	66°34'43" S, 92°58'23" E	Rec. VII-9 Measure 11(2012)
9.	Buromsky Island Cemetery. Cemetery on Buromsky Island, near Mirny Observatory in which are buried citizens of the USSR (Russian Federation), Czechoslovakia, GDR and Switzerland (members of the Soviet and Russian Antarctic Expeditions) who perished in the performance of their duties. Original proposing Party: Russia Party undertaking management: Russia	66°32'04" S, 93°00'E	Rec. VII-9 Measure 11(2012)

No.	Description	Location	Designation/ Amendment
10.	Soviet Oasis Station Observatory. Magnetic observatory building at Dobrowolsky station (a part of the former Soviet station Oasis transferred to Poland) at Bunger Hills with a plaque in memory of the opening of Oasis station in 1956. Original proposing Party: Russia Party undertaking management: Russia	66°16'30" S, 100°45'03 "E	Rec. VII-9 Measure 11(2012)
11.	Vostok Station Tractor. Heavy tractor ATT 11 at Vostok station which participated in the first traverse to the Earth Geomagnetic Pole, with plaque in memory of the opening of the Station in 1957. Original proposing Party: Russia Party undertaking management: Russia	78°27'48" S, 106°50'06 "E	Rec. VII-9 Measure 11(2012)
12.	*Cross and plaque at Cape Denison, George V Land. (Removed from the Antarctic Treaty list of Historic Sites and Monuments subsumed with HSM 13 into HSM 77)*		
13.	*Hut at Cape Denison, George V Land, (Removed from the Antarctic Treaty list of Historic Sites and Monuments subsumed with HSM 12 into HSM 77)*		
14.	Site of ice cave at Inexpressible Island, Terra Nova Bay, constructed in March 1912 by Victor Campbell's Northern Party, British Antarctic Expedition, 1910-13. The party spent the winter of 1912 in this ice cave. A wooden sign, plaque and seal bones remain at the site. Original proposing Party: New Zealand Parties undertaking management: New Zealand/Italy/UK	74°54'S, 163°43'E	Rec. VII-9 Measure 5(1995)
15.	Hut at Cape Royds, Ross Island, built in February 1908 by the British Antarctic Expedition of 1907-09, led by Sir Ernest Shackleton. Restored in January 1961 by the Antarctic Division of New Zealand Department of Scientific and Industrial Research. Site incorporated within ASPA 157 Original proposing Parties: New Zealand/UK Parties undertaking management: New Zealand/UK	77°33'S, 166°10'E	Rec. VII-9

No.	Description	Location	Designation/ Amendment
16.	Hut at Cape Evans, Ross Island, built in January 1911 by the British Antarctic Expedition of 1910-1913, led by Captain Robert F. Scott. Restored in January 1961 by the Antarctic Division of New Zealand Department of Scientific and Industrial Research. Site incorporated within ASPA 155 Original proposing Parties: New Zealand /UK Parties undertaking management: New Zealand/UK	77°38'S, 166°24'E	Rec. VII-9
17.	Cross on Wind Vane Hill, Cape Evans, Ross Island, erected by the Ross Sea Party, led by Captain Aeneas Mackintosh, of Sir Ernest Shackleton's Imperial Trans-Antarctic Expedition of 1914-1916, in memory of three members of the party who died in the vicinity in 1916. Site incorporated within ASPA 155 Original proposing Parties: New Zealand/UK Parties undertaking management: New Zealand/UK	77°38'S, 166°24'E	Rec. VII-9
18.	Hut at Hut Point, Ross Island, built in February 1902 by the British Antarctic Expedition of 1901-04, led by Captain Robert F. Scott. Partially restored in January 1964 by the New Zealand Antarctic Society, with assistance from the United States Government. Site incorporated within ASPA 158 Original proposing Parties: New Zealand/UK Parties undertaking management: New Zealand/UK	77°50'S, 166°37'E	Rec. VII-9
19.	Cross at Hut Point, Ross Island, erected in February 1904 by the British Antarctic Expedition of 1901-04, in memory of George Vince, a member of the expedition, who died in the vicinity. Original proposing Parties: New Zealand/UK Parties undertaking management: New Zealand/UK	77°50'S, 166°37'E	Rec. VII-9

No.	Description	Location	Designation/ Amendment
20.	Cross on Observation Hill, Ross Island, erected in January 1913 by the British Antarctic Expedition of 1910-13, in memory of Captain Robert F. Scott's party which perished on the return journey from the South Pole in March 1912. Original proposing Parties: New Zealand/UK Parties undertaking management: New Zealand/UK	77°51'S, 166°41'E	Rec. VII-9
21.	Remains of stone hut at Cape Crozier, Ross Island, constructed in July 1911 by Edward Wilson's party of the British Antarctic Expedition (1910-13) during the winter journey to collect Emperor penguin eggs. Original proposing Party: New Zealand Parties undertaking management: New Zealand/UK	77°31'S, 169°22'E	Rec. VII-9
22.	Three huts and associated historic relics at Cape Adare. Two were built in February 1899 during the British Antarctic (*Southern Cross*) Expedition, 1898-1900, led by Carsten E. Borchgrevink. The third was built in February 1911 by Robert F. Scott's Northern Party, led by Victor L.A.Campbell. Scott's Northern Party hut has largely collapsed with only the porch standing in 2002. Site incorporated within ASPA 159. Original proposing Parties: New Zealand/UK Parties undertaking management: New Zealand/UK	71°18'S, 170°12'E	Rec. VII-9
23.	Grave at Cape Adare of Norwegian biologist Nicolai Hanson, a member of the British Antarctic (*Southern Cross*) Expedition, 1898-1900, led by Carsten E. Borchgrevink. A large boulder marks the head of the grave with the grave itself outlined in white quartz stones. A cross and plaque are attached to the boulder. Original proposing Parties: New Zealand/ UK Parties undertaking management: New Zealand/Norway	71°17'S, 170°13'E	Rec. VII-9

No.	Description	Location	Designation/ Amendment
24.	Rock cairn, known as 'Amundsen's cairn', on Mount Betty, Queen Maud Range erected by Roald Amundsen on 6 January 1912, on his way back to *Framheim* from the South Pole. Original proposing Party: Norway Party undertaking management: Norway	85°11'S, 163°45'W	Rec. VII-9
25.	*De-listed*		
26.	Abandoned installations of Argentine Station 'General San Martin' on Barry Island, Debenham Islands, Marguerite Bay, with cross, flag mast, and monolith built in 1951. Original proposing Party: Argentina Party undertaking management: Argentina	68°08'S, 67°08'W	Rec. VII-9
27.	Cairn with a replica of a lead plaque erected on Megalestris Hill, Petermann Island, in 1909 by the second French expedition led by Jean-Baptiste E. A. Charcot. The original plaque is in the reserves of the Museum National d'Histoire Naturelle (Paris). Original proposing Parties: Argentina/France/UK Parties undertaking management: France /UK	65°10'S, 64°09'W	Rec. VII-9
28.	Rock cairn at Port Charcot, Booth Island, with wooden pillar and plaque inscribed with the names of the first French expedition led by Jean-Baptiste E. A. Charcot which wintered here in 1904 aboard *Le Français*. Original proposing Party: Argentina Parties undertaking management: Argentina/France	65°03'S, 64°01'W	Rec. VII-9
29.	Lighthouse named 'Primero de Mayo' erected on Lambda Island, Melchior Islands, by Argentina in 1942. This was the first Argentine lighthouse in the Antarctic. Original proposing Party: Argentina Party undertaking management: Argentina	64°18'S, 62°59'W	Rec. VII-9

No.	Description	Location	Designation/ Amendment
30.	Shelter at Paradise Harbour erected in 1950 near the Chilean Base 'Gabriel Gonzalez Videla' to honour Gabriel Gonzalez Videla, the first Head of State to visit the Antarctic. The shelter is a representative example of pre-IGY activity and constitutes an important national commemoration. Original proposing Party: Chile Party undertaking management: Chile	64°49'S, 62°51'W	Rec. VII-9
31.	*De-listed*.		
32.	Concrete monolith erected in 1947, near Capitán Arturo Prat Base on Greenwich Island, South Shetland Islands. Point of reference for Chilean Antarctic hydrographic surveys. The monolith is representative of an important pre-IGY activity and is currently preserved and maintained by personnel from Prat Base. Original proposing Party: Chile Party undertaking management: Chile	62°28'S, 59°40'W	Rec. VII-9
33.	Shelter and cross with plaque near Capitán Arturo Prat Base (Chile), Greenwich Island, South Shetland Islands. Named in memory of Lieutenant-Commander González Pacheco, who died in 1960 while in charge of the station. The monument commemorates events related to a person whose role and the circumstances of his death have a symbolic value and the potential to educate people about significant human activities in Antarctica. Original proposing Party: Chile Party undertaking management: Chile	62°29'S, 59°40'W	Rec. VII-9
34.	Bust at Capitán Arturo Prat Base (Chile), Greenwich Island, South Shetland Islands, of the Chilean naval hero Arturo Prat, erected in 1947. The monument is representative of pre-IGY activities and has symbolic value in the context of Chilean presence in Antarctica. Original proposing Party: Chile Party undertaking management: Chile	62°50'S, 59°41'W	Rec. VII-9

No.	Description	Location	Designation/ Amendment
35.	Wooden cross and statue of the Virgin of Carmen erected in 1947 near Capitán Arturo Prat Base (Chile), Greenwich Island, South Shetland Islands. The monument is representative of pre-IGY activities and has a particularly symbolic and architectural value. Original proposing Party: Chile Party undertaking management: Chile	62°29'S, 59°40'W	Rec. VII-9
36.	Replica of a metal plaque erected by Eduard Dallmann at Potter Cove, King George Island, to commemorate the visit of his German expedition on 1 March, 1874 on board *Grönland*. Original proposing Parties: Argentina/UK Parties undertaking management: Argentina/Germany	62°14'S, 58°39'W	Rec. VII-9
37.	O'Higgins Historic Site located on Cape Legoupil, Antarctic Peninsula and comprising the following structures of historical value: • "Capitán General Bernardo O´Higgins Riquelme" Bust, erected in 1948 opposite the Base known under the same name. General O´Higgins was the first ruler of Chile to recognise the importance of Antarctica. It has a symbolic meaning in the history of Antarctic exploration since it was during his government that the vessel Dragon landed on the coast of the Antarctic Peninsula in 1820. This monument is also representative of pre-IGY activities in Antarctica. (63°19'14.3" S / 57°53'53.9"W) • Former "Capitán General Bernardo O'Higgins Riquelme" Antarctic Base, unveiled on 18th February, 1948 by the President of the Republic of Chile, Gabriel González Videla, the first President in the world to visit Antarctica. It is considered as a model pioneering base in the modern period of Antarctic exploration. (63°19' S, 57°54'W) • Plaque in memory of Lieutenants Oscar Inostroza Contreras and Sergio Ponce Torrealba, who perished in the Antarctic Continent for the sake of peace and science, on 12th August, 1957. (63°19'15.4" S / 57°53'52.9"W)	63°19'S, 57°54'W	Rec. VII-9 Measure 11(2012)

No.	Description	Location	Designation/ Amendment
	Virgen del Carmen Grotto, located in the surroundings of the base, built approximately forty years ago. It has served as a place of spiritual withdrawal for the staff of the different Antarctic stations and expeditions. (63°19'15.9" S / 57°54'03.2"W). Original proposing Party: Chile Party undertaking management: Chile		
38.	Wooden hut on Snow Hill Island built in February 1902 by the main party of the Swedish South Polar Expedition led by Otto Nordenskjöld. Original proposing Parties: Argentina/ UK Parties undertaking management: Argentina/Sweden	64°22'S, 56°59'W	Rec. VII-9
39.	Stone hut at Hope Bay, Trinity Peninsula, built in January 1903 by a party of the Swedish South Polar Expedition. Original proposing Parties: Argentina/UK Parties undertaking management: Argentina/Sweden	63°24'S, 56°59' W	Rec. VII-9
40.	Bust of General San Martin, grotto with a statue of the Virgin of Lujan, and a flag mast at Base 'Esperanza', Hope Bay, erected by Argentina in 1955; together with a graveyard with stele in memory of members of Argentine expeditions who died in the area. Original proposing Party: Argentina Party undertaking management: Argentina	63°24'S, 56°59'W	Rec. VII-9
41.	Stone hut on Paulet Island built in February 1903 by survivors of the wrecked vessel *Antarctic* under Captain Carl A. Larsen, members of the Swedish South Polar Expedition led by Otto Nordenskjöld, together with a grave of a member of the expedition and the rock cairn built by the survivors of the wreck at the highest point of the island to draw the attention of rescue expeditions. Original proposing Parties: Argentina/UK Parties undertaking management: Argentina/Sweden/Norway	63°34'S, 55°45'W	Rec. VII-9 Measure 5 (1997)

No.	Description	Location	Designation/ Amendment
42.	Area of Scotia Bay, Laurie Island, South Orkney Island, in which are found: stone hut built in 1903 by the Scottish Antarctic Expedition led by William S. Bruce; the Argentine meteorological hut and magnetic observatory, built in 1905 and known as Moneta House; and a graveyard with twelve graves, the earliest of which dates from 1903. Original proposing Party: Argentina Parties undertaking management: Argentina/UK	60°46'S, 44°40'W	Rec. VII-9
43.	Cross erected in 1955, at a distance of 1,300 metres north-east of the Argentine General Belgrano I Station (Argentina) and subsequently moved to Belgrano II Station (Argentina), Nunatak Bertrab, Confin Coast, Coats Land in 1979. Original proposing Party: Argentina Party undertaking management: Argentina	77°52'S, 34°37'W	Rec. VII-9
44.	Plaque erected at the temporary Indian station 'Dakshin Gangotri', Princess Astrid Kyst, Dronning Maud Land, listing the names of the First Indian Antarctic Expedition which landed nearby on 9 January 1982. Original proposing Party: India Party undertaking management: India	70°45'S, 11°38'E	Rec. XII-7
45.	Plaque on Brabant Island, on Metchnikoff Point, mounted at a height of 70 m on the crest of the moraine separating this point from the glacier and bearing the following inscription: This monument was built by François de Gerlache and other members of the Joint Services Expedition 1983-85 to commemorate the first landing on Brabant Island by the Belgian Antarctic Expedition, 1897-99: Adrien de Gerlache (Belgium) leader, Roald Amundsen (Norway), Henryk Arctowski (Poland), Frederick Cook (USA) and Emile Danco (Belgium) camped nearby from 30 January to 6 February 1898. Original proposing Party: Belgium Party undertaking management: Belgium	64°02'S, 62°34'W	Rec. XIII-16

No.	Description	Location	Designation/ Amendment
46.	All the buildings and installations of Port-Martin base, Terre Adélie constructed in 1950 by the 3rd French expedition in Terre Adélie and partly destroyed by fire during the night of 23 to 24 January 1952. Original proposing Party: France Party undertaking management: France	66°49'S, 141°24'E	Rec. XIII-16
47.	Wooden building called 'Base Marret' on the Ile des Pétrels, Terre Adélie, where seven men under the command of Mario Marret overwintered in 1952 following the fire at Port Martin Base. Original proposing Party: France Party undertaking management: France	66°40'S, 140°01'E	Rec. XIII-16
48.	Iron cross on the North-East headland of the Ile des Pétrels, Terre Adélie, dedicated as a memorial to André Prudhomme, head meteorologist in the 3rd International Geophysical Year expedition who disappeared during a blizzard on 7 January 1959. Original proposing Party: France Party undertaking management: France	66°40'S, 140°01'E	Rec. XIII-16
49.	The concrete pillar erected by the First Polish Antarctic Expedition at Dobrolowski Station on the Bunger Hill to measure acceleration due to gravity g = 982,439.4 mgal ±0.4 mgal in relation to Warsaw, according to the Potsdam system, in January 1959. Original proposing Party: Poland Party undertaking management: Poland	66°16'S, 100°45'E	Rec. XIII-16
50.	A brass plaque bearing the Polish Eagle, the national emblem of Poland, the dates 1975 and 1976, and the following text in Polish, English and Russian: In memory of the landing of members of the first Polish Antarctic marine research expedition on the vessels 'Profesor Siedlecki' and 'Tazar' in February 1976. This plaque, south-west of the Chilean and Soviet stations, is mounted on a cliff facing Maxwell Bay, Fildes Peninsula, King George Island. Original proposing Party: Poland Party undertaking management: Poland	62°12'S, 59°01'W	Rec. XIII-16

No.	Description	Location	Designation/ Amendment
51.	The grave of Wlodzimierz Puchalski, surmounted by an iron cross, on a hill to the south of Arctowski station on King George Island. W. Puchalski was an artist and a producer of documentary nature films, who died on 19 January 1979 whilst working at the station. Original proposing Party: Poland Party undertaking management: Poland	62°13'S, 58°28'W	Rec. XIII-16
52.	Monolith erected to commemorate the establishment on 20 February 1985 by the Peoples Republic of China of the 'Great Wall Station' on Fildes Peninsula, King George Island, in the South Shetland Islands. Engraved on the monolith is the following inscription in Chinese: 'Great Wall Station, First Chinese Antarctic Research Expedition, 20 February 1985'. Original proposing Party: China Party undertaking management: China	62°13'S, 58°58'W	Rec. XIII-16
53.	Bust of Captain Luis Alberto Pardo, monolith and plaques on Point Wild, Elephant Island, south Shetland Islands, celebrating the rescue of the survivors of the British ship *Endurance* by the Chilean Navy cutter *Yelcho* displaying the following words: " Here on August 30th, 1916, the Chilean Navy cutter *Yelcho* commanded by Pilot Luis Pardo Villalón rescued the 22 men from the Shackleton Expedition who survived the wreck of the 'Endurance' living for four and one half months in this Island". The Monolith and the plaques have been placed on Elephant Island and their replicas on the Chilean bases Capitan Arturo Prat (62°30'S, 59°49'W) and President Eduardo Frei (62°12'S, 62°12'W). Bronze busts of the pilot Luis Pardo Villalon were placed on the three above-mentioned monoliths during the XXIVth Chilean Antarctic Scientific Expedition in 1987-88. Original proposing Party: Chile Party undertaking management: Chile	61°03'S, 54°50'W	Rec. XIV-8 Rec. XV-13

No.	Description	Location	Designation/ Amendment
54.	Richard E. Byrd Historic Monument, McMurdo Station, Antarctica. Bronze bust on black marble, 5ft high x 2ft square, on wood platform, bearing inscriptions describing the polar achievements of Richard Evelyn Byrd. Erected at McMurdo Station in 1965. Original proposing Party: USA Party undertaking management: USA	77°51'S, 166°40'E	Rec. XV-12
55.	East Base, Antarctica, Stonington Island. Buildings and artefacts at East Base, Stonington Island and their immediate environs. These structures were erected and used during two U.S. wintering expeditions: the Antarctic Service Expedition (1939-1941) and the Ronne Antarctic Research Expedition (1947-1948). The size of the historic area is approximately 1,000 metres in the north-south direction (from the beach to Northeast Glacier adjacent to Back Bay) and approximately 500 metres in the east-west direction. Original proposing Party: USA Party undertaking management: USA	68°11'S, 67°00'W	Rec. XIV-8
56.	Waterboat Point, Danco Coast, Antarctic Peninsula. The remains and immediate environs of the Waterboat Point hut. It was occupied by the UK two-man expedition of Thomas W. Bagshawe and Maxime C. Lester in 1921-22. Only the base of the boat, foundations of doorposts and an outline of the hut and extension still exist. It is situated close to the Chilean station 'President Gabriel Gonzáles Videla'. Original proposing Party: Chile/UK Parties undertaking management: Chile/UK	64°49'S, 62°51'W	Rec. XVI-11
57.	Commemorative plaque at 'Yankee Bay' (Yankee Harbour), MacFarlane Strait, Greenwich Island, South Shetland Islands. Near a Chilean refuge. Erected to the memory of Captain Andrew MacFarlane, who in 1820 explored the Antarctic Peninsula area in the brigantine *Dragon*. Original proposing Parties: Chile/UK Parties undertaking management: Chile/UK	62°32'S, 59°45'W	Rec. XVI-11
58.	*De-listed*.		

No.	Description	Location	Designation/ Amendment
59.	A cairn on Half Moon Beach, Cape Shirreff, Livingston Island, South Shetland Islands and a plaque on 'Cerro Gaviota' opposite San Telmo Islets commemorating the officers, soldiers and seamen aboard the Spanish vessel *San Telmo,* which sank in September 1819; possibly the first people to live and die in Antarctica. Site incorporated within ASPA 149. Original proposing Parties: Chile/Spain/Peru Parties undertaking management: Chile/Spain/Peru	62°28'S, 60°46'W	Rec. XVI-11
60.	"Wooden pole and cairn (I), and wooden plaque and cairn (II), both located at Penguins Bay, southern coast of Seymour Island (Marambio), James Ross Archipelago. The wooden pole and a cairn (I) were installed in 1902 during the Swedish South Polar Expedition led by Dr. Otto Nordenskjöld. This cairn used to have attached a 4 m high wooden pole – nowadays only 44 cm high –, guy-lines and a flag, and was installed to signal the location of a well stocked deposit, composed of few wooden boxes containing food supplies, notes and letters saved inside bottles. The deposit was to be used in case the Swedish South Polar Expedition was forced to retreat on its way to the south. The wooden plaque (II) was placed on 10 November 1903 by the crew of a rescue mission of the Argentinean Corvette Uruguay in the site where they met the members of the Swedish expedition led by Dr Otto Nordenskjöld. The text of the wooden plaque reads as follows: "10.XI.1903 Uruguay (Argentine Navy) in its journey to give assistance to the Swedish Antarctic expedition." In January 1990, a rock cairn (II) was erected by Argentina in memory of this event in the place where the plaque is located. Original proposing Parties: Argentina/Sweden Parties undertaking management: Argentina/Sweden	(I): 64º 17' 47.2" S, 56º 41' 30.7" W (II): 64 º 16' S, 56º 39' W	Rec. XVII-3 Measure I (2016)

No.	Description	Location	Designation/ Amendment
61.	'Base A' at Port Lockroy, Goudier Island, off Wiencke Island, Antarctic Peninsula. Of historic importance as an Operation Tabarin base from 1944 and for scientific research, including the first measurements of the ionosphere, and the first recording of an atmospheric whistler, from Antarctica. Port Lockroy was a key monitoring site during the International Geophysical Year of 1957/58. Original Proposing Party: UK Party undertaking management: UK	64°49'S, 63°29'W	Measure 4 (1995)
62.	'Base F (Wordie House)' on Winter Island, Argentine Islands. Of historic importance as an example of an early British scientific base. Original proposing Party: UK Parties undertaking management: UK/Ukraine	65°15'S, 64°16'W	Measure 4 (1995)
63.	'Base Y' on Horseshoe Island, Marguerite Bay, western Graham Land. Noteworthy as a relatively unaltered and completely equipped British scientific base of the late 1950s. 'Blaiklock', the refuge hut nearby, is considered an integral part of the base. Original proposing Party: UK Party undertaking management: UK	67°48'S, 67°18'W	Measure 4 (1995)
64.	'Base E' on Stonington Island, Marguerite Bay, western Graham Land. Of historical importance in the early period of exploration and later British Antarctic Survey (BAS) history of the 1960s and 1970s. Original proposing Party: UK Party undertaking management: UK	68°11'S, 67°00'W	Measure 4 (1995)

No.	Description	Location	Designation/ Amendment
65.	Message post, Svend Foyn Island, Possession Islands. A pole with a box attached was placed on the island on 16 January 1895 during the whaling expedition of Henryk Bull and Captain Leonard Kristensen of the ship *Antarctic*. It was examined and found intact by the British Antarctic Expedition of 1898-1900 and then sighted from the beach by the USS *Edisto* in 1956 and USCGS *Glacier* in 1965. Original proposing Parties: New Zealand/Norway/UK Parties undertaking management: New Zealand/ Norway	71°56'S, 171°05'W	Measure 4 (1995)
66.	Prestrud's Cairn, Scott Nunataks, Alexandra Mountains, Edward VII Peninsula. The small rock cairn was erected at the foot of the main bluff on the north side of the nunataks by Lieutenant K. Prestrud on 3 December 1911 during the Norwegian Antarctic Expedition of 1910-1912. Original proposing Parties: New Zealand/ Norway/ UK Parties undertaking management: New Zealand/Norway	77°11'S, 154°32'W	Measure 4 (1995)
67.	Rock shelter, 'Granite House', Cape Geology, Granite Harbour. This shelter was constructed in 1911 for use as a field kitchen by Griffith Taylor's second geological excursion during the British Antarctic Expedition of 1910-1913. It was enclosed on three sides with granite boulder walls and used a sledge to support a seal-skin roof. The stone walls of the shelter have partially collapsed. The shelter contains corroded remnants of tins, a seal skin and some cord. The sledge is now located 50 m seaward of the shelter and consists of a few scattered pieces of wood, straps and buckles. Site incorporated within ASPA 154. Original proposing Parties: New Zealand/Norway/UK Parties undertaking management: New Zealand/UK	77°00'S, 162°32'E	Measure 4 (1995)

No.	Description	Location	Designation/ Amendment
68.	Site of depot at Hells Gate Moraine, Inexpressible Island, Terra Nova Bay.This emergency depot consisted of a sledge loaded with supplies and equipment which was placed on 25 January 1913 by the British Antarctic Expedition, 1910-1913. The sledge and supplies were removed in 1994 in order to stabilize their deteriorating condition. Original proposing Parties: New Zealand/Norway/UK Parties undertaking management: New Zealand/UK	74°52'S, 163°50'E	Measure 4 (1995)
69.	Message post at Cape Crozier, Ross Island, erected on 22 January 1902 by Captain Robert F. Scott's *Discovery* Expedition of 1901-04. It was to provide information for the expedition's relief ships, and held a metal message cylinder, which has since been removed. Site incorporated within ASPA 124 Original proposing Parties: New Zealand/Norway/UK Parties undertaking management: New Zealand/UK	77°27'S, 169°16'E	Measure 4 (1995)
70.	Message post at Cape Wadworth, Coulman Island. A metal cylinder nailed to a red pole 8 m above sea level placed by Captain Robert F. Scott on 15 January 1902. He painted the rocks behind the post red and white to make it more conspicuous. Original proposing Parties: New Zealand/Norway/UK Parties undertaking management: New Zealand/UK	73°19'S, 169°47'E	Measure 4 (1995)
71.	Whalers Bay, Deception Island, South Shetland Islands. The site comprises all pre-1970 remains on the shore of Whalers Bay, including those from the early whaling period (1906-12) initiated by Captain Adolfus Andresen of the Sociedad Ballenera de Magallanes, Chile; the remains of the Norwegian Hektor Whaling Station established in 1912 and all artefacts associated with its operation until 1931; the site of a cemetery with 35 burials and a memorial to ten men lost at sea; and the remains from the period of British scientific and mapping activity (1944-1969). The site also acknowledges and commemorates the historic value of other events that occurred there, from which nothing remains. Original proposing Parties: Chile/ Norway Parties undertaking management: Chile/Norway/UK	62°59'S, 60°34'W	Measure 4 (1995)

No.	Description	Location	Designation/ Amendment
72.	Mikkelsen Cairn, Tryne Islands, Vestfold Hills. A rock cairn and a wooden mast erected by the landing party led by Captain Klarius Mikkelsen of the Norwegian whaling ship *Thorshavn* and including Caroline Mikkelsen, Captain Mikkelsen's wife, the first woman to set foot on East Antarctica. The cairn was discovered by Australian National Antarctic Research Expedition field parties in 1957 and again in 1995. Original proposing Parties: Australia/Norway Parties undertaking management: Australia/Norway	68°22'S 78°24'E	Measure 2 (1996)
73.	Memorial Cross for the 1979 Mount Erebus crash victims, Lewis Bay, Ross Island. A cross of stainless steel which was erected in January 1987 on a rocky promontory three kilometers from the Mount Erebus crash site in memory of the 257 people of different nationalities who lost their lives when the aircraft in which they were travelling crashed into the lower slopes of Mount Erebus, Ross Island. The cross was erected as a mark of respect and in remembrance of those who died in the tragedy. Original proposing Party: New Zealand Party undertaking management: New Zealand	77°25'S, 167°27'E	Measure 4 (1997)
74.	The un-named cove on the south-west coast of Elephant Island, including the foreshore and the intertidal area, in which the wreckage of a large wooden sailing vessel is located. Original proposing Party: UK Party undertaking management: UK	61°14'S, 55°22'W	Measure 2 (1998)
75.	The A Hut of Scott Base, being the only existing Trans Antarctic Expedition 1956/1957 building in Antarctica sited at Pram Point, Ross Island, Ross Sea Region, Antarctica. Original proposing Party: New Zealand Party undertaking management: New Zealand	77°51'S, 166°46'E	Measure 1 (2001)
76.	The ruins of the Base Pedro Aguirre Cerda Station, being a Chilean meteorological and volcanological center situated at Pendulum Cove, Deception Island, Antarctica, that was destroyed by volcanic eruptions in 1967 and 1969. Original proposing Party: Chile Party undertaking management: Chile	62°59'S, 60°40'W	Measure 2 (2001)

No.	Description	Location	Designation/ Amendment
77	Cape Denison, Commonwealth Bay, George V Land, including Boat Harbour and the historic artefacts contained within its waters. This Site is contained within ASMA No. 3, designated by Measure 1 (2004). Part of this site is also contained within ASPA No. 162, designated by Measure 2 (2004). Original proposing Party: Australia Party undertaking management: Australia	67°00'30"S, 142°39'40"	Measure 3 (2004)
78	Memorial plaque at India Point, Humboldt Mountains, Wohlthat Massif, central Dronning Maud Land erected in memory of three scientists of the Geological Survey of India (GSI) and a communication technician from the Indian Navy - all members of the ninth Indian Expedition to Antarctica, who sacrificed their lives in this mountain camp in an accident on 8th January 1990. Original proposing Party: India Party undertaking management: India.	71°45'08"S, 11°12'30" E	Measure 3 (2004)
79	Lillie Marleen Hut, Mt. Dockery, Everett Range, Northern Victoria Land. The hut was erected to support the work of the German Antarctic Northern Victoria Land Expedition (GANOVEX I) of 1979/1980. The hut, a bivouac container made of prefabricated fiberglass units insulated with polyurethane foam, was named after the Lillie Glacier and the song "Lillie Marleen". The hut is closely associated with the dramatic sinking of the expedition ship "Gotland II" during GANOVEX II in December 1981. Original proposing Party: Germany Party undertaking management: Germany	71°12'S, 164°31'E	Measure 5 (2005)
80	Amundsen's Tent. The tent was erected at 90° by the Norwegian group of explorers led by Roald Amundsen on their arrival at the South Pole on 14 December 1911. The tent is currently buried underneath the snow and ice in the vicinity of the South Pole. Original proposing Party: Norway Party undertaking management: Norway	90°S	Measure 5 (2005)

No.	Description	Location	Designation/ Amendment
81	Rocher du Débarquement (Landing Rock), being a small island where Admiral Dumont D'Urville and his crew landed on 21 January 1840 when he discovered Terre Adélie. Original proposing Party: France Party undertaking management: France	66° 36.30'S, 140° 03.85'E	Measure 3 (2006)
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 official 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."[22] Original proposing Party: Chile Party undertaking management: Chile	62º 12' 01" S; 58º 57' 41" W	Measure 3 (2007) Measure 11 (2011)
83	Base "W", Detaille Island, Lallemande Fjord, Loubert Coast. Base "W" is situated on a narrow isthmus at the northern end of Detaille Island, Lallemand Fjord, Loubet Coast. The site consists of a hut and a range of associated structures and outbuildings including a small emergency storage building, bitch and pup pens, anemometer tower and two standard tubular steel radio masts (one to the south west of the main hut and the other to the east). Base "W" was established in 1956 as a British science base primarily for survey, geology and meteorology and to contribute to the IGY in 1957. As a relatively unaltered base from the late 1950s, Base "W" provides an important reminder of the science and living conditions that existed when the Antarctic Treaty was signed 50 years ago. Original proposing Party: United Kingdom Party undertaking management: United Kingdom	66°52'S; 66°48'W	Measure 14 (2009)

No.	Description	Location	Designation/ Amendment
84	Hut at Damoy Point, Dorian Bay, Wiencke Island, Palmer Archipelago. The site consists of a well-preserved hut and the scientific equipment and other artefacts inside it. It is located at Damoy Point on Dorian Bay, Wiencke Island, Palmer Archipelago. The hut was erected in 1973 and used for a number of years as a British summer air facility and transit station for scientific personnel. It was last occupied in 1993. Original proposing Party: United Kingdom Party undertaking management: United Kingdom	64° 49'S; 63°31'W	Measure 14 (2009)
85	Plaque Commemorating the PM-3A Nuclear Power Plant at McMurdo Station. The plaque is approximately 18 x 24 inches, made of bronze and secured to a large vertical rock at McMurdo Station, the former site of the PM-3A nuclear power reactor. It is approximately half way up the west side of Observation Hill. The plaque text details achievements of PM-3A, Antarctica's first nuclear power plant. Original proposing Party: United States Party Undertaking Management: United States	77º 51' S, 166º 41' E	Measure 15 (2010)
86	No.1 Building at Great Wall Station. The No.1 Building, built in 1985 with a total floor space of 175 square meters, 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 significance in commemorating China's Antarctic expedition. Original proposing Party: China Party undertaking management: China	62°13′ 4″ S, 58°57′ 44 ″ W	Measure 12 (2011)

No.	Description	Location	Designation/ Amendment
87	Location of the first permanently occupied German Antarctic research station "Georg Forster" at the Schirmacher Oasis, Dronning Maud Land. The original site is situated by the Schirmacher Oasis and marked by a commemorative bronze plaque with the label in German language: Antarktisstation Georg Forster 70° 46' 39'' S 11° 51' 03'' E von 1976 bis 1996 The plaque is well preserved and affixed to a rock wall at the southern edge of the location. This Antarctic research station was opened on 21 April 1976 and closed down in 1993. The entire site has been completely cleaned up after the dismantling of the station was successfully terminated on 12 February 1996. The site is located about 1.5 km east of the current Russian Antarctic research station Novolazarevskaya. Original proposing Party: Germany Party undertaking management: Germany	70°46'39'' S, 11°51'03'' E Elevation: 141 meters above sea level	Measure 18 (2013)
88	Professor Kudryashov's Drilling Complex Building. The drilling complex building was constructed in the summer season of 1983-84. Under the leadership of Professor Boris Kudryashov, ancient mainland ice samples were obtained. Original proposing Party: Russian Federation Party undertaking management: Russian Federation	78º28' S, 106º 48' E Height above sea level 3488 m.	Measure 19 (2013)
89	Terra Nova Expedition 1910-12, Upper "Summit Camp" used during survey of Mount Erebus in December 1912. Camp Site location includes part of a circle of rocks, which were likely used to weight the tent valences. The camp site was used by a science party on Captain Scott's Terra Nova Expedition, who undertook mapping and collected geological specimens on Mount Erebus in December 1912. Original proposing Parties: United Kingdom, New Zealand and United States Parties undertaking management: United Kingdom, New Zealand and United States	77⁰30.348' S, 167⁰10.223'E Circa 3,410m above sea level	Measure 20 (2013)

No.	Description	Location	Designation/ Amendment
90	Terra Nova Expedition 1910-12, Lower "Camp E" Site used during survey of Mount Erebus in December 1912. Camp Site location consists of a slightly elevated area of gravel and includes some aligned rocks, which may have been used to weight the tent valences. The camp site was used by a science party on Captain Scott's Terra Nova Expedition, who undertook mapping and collected geological specimens on Mount Erebus in December 1912. Original proposing Parties: United Kingdom, New Zealand and United States Parties undertaking management: United Kingdom, New Zealand and United States	77^0 30.348' S, 167^0 9.246'E Circa 3,410 m above sea level	Measure 21 (2013)
91	Lame Dog Hut at the Bulgarian base St. Kliment Ohridski, Livingston Island The Lame Dog Hut was erected in April 1988, and had been the main building of St. Kliment Ohridski base until 1998. It is presently the oldest preserved building on Livingston Island, used as radio shack and post office, and hosting a museum exhibition of associated artefacts from the early Bulgarian science and logistic operations in Antarctica Original proposing Party: Bulgaria Party undertaking management: Bulgaria	62 degrees 38' 29" S, 60 degrees 21' 53" W	Measure 19 (2015)
92	Oversnow heavy tractor "Kharkovchanka" that was used in Antarctica from 1959 to 2010. The oversnow heavy tractor "Kharkovchanka" was designed and produced at the Malyshev Transport Machine-Building Plant in Kharkov specially for organizing inland sledge-tractor traverses in Antarctica. This was the first non-serial transport vehicle of the Soviet machine-building produced exclusively for operations in Antarctica. This tractor was not used outside Antarctica. Thus, the STT "Kharkovchanka" is a unique historical sample of engineering-technical developments made for exploration of Antarctica. Original proposing Party: the Russian Federation Party undertaking management: the Russian Federation	69°22′ 41, 0″ S, 76°22′ 59, 1″ E.	Measure 19 (2015)