The Antarctic Treaty

Measures adopted at
the Forty-first Consultative Meeting
held at Buenos Aires, Argentina 13 – 18 May 2018

Presented to Parliament
by the Secretary of State for Foreign and Commonwealth Affairs
by Command of Her Majesty
May 2019

CP 101

This publication is available at www.gov.uk/government/publications

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

ISBN 978-1-5286-1301-9
CCS0519238318 05/19

Printed on paper containing 75% recycled fibre content minimum

Printed in the UK by the APS Group on behalf of the Controller of Her Majesty's Stationery Office

MEASURES ADOPTED AT THE FORTY-FIRST ANTARCTIC TREATY CONSULTATIVE MEETING

Buenos Aires, Argentina 13 – 18 May 2018

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

In accordance with Article IX, paragraph 4, of the Antarctic Treaty, the Measures adopted at Consultative Meetings become effective upon approval by all Contracting Parties whose representatives were entitled to participate in the meeting at which they were adopted (i.e. all the Consultative Parties). The full text of the Final Report of the Meeting, including the Decisions and Resolutions adopted at that Meeting 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 6 (2018).

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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, Thirty-eighth, Thirty-ninth and Fortieth 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 XLI Consultative Meeting held at Buenos Aires, Argentina 13 – 18 May 2018

Measure 1 (2018)

Antarctic Specially Protected Area No 108 (Green Island, Berthelot Islands, Antarctic Peninsula): 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-9 (1966), which designated Green Island, Berthelot Islands, Antarctic
- Peninsula as Specially Protected Area ("SPA") No 9;
- Recommendation XVI-6 (1991), which annexed a Management Plan for the Area;
- Decision 1 (2002), which renamed and renumbered SPA 9 as ASPA 108;
- Measures 1 (2002) and 1 (2013), which adopted revised Management Plans for ASPA 108;

Recalling that Recommendation IV-9 (1966) was designated as no longer current by Decision 1 (2011) and that Recommendation XVI-6 (1991) did not become effective and was withdrawn by Decision 3 (2017);

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 108;

Desiring to replace the existing Management Plan for ASPA 108 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 108 (Green Island, Berthelot Islands, Antarctic Peninsula), which is annexed to this Measure, be approved; and
2. the Management Plan for the Antarctic Specially Protected Area No 108 annexed to Measure 1 (2013) be revoked.

Management Plan for Antarctic Specially Protected Area No. 108

GREEN ISLAND, BERTHELOT ISLANDS, ANTARCTIC PENINSULA

Introduction

The primary reason for the designation of Green Island, Berthelot Islands, Antarctic Peninsula (65°19'S, 64°09'W; area 0.2 km²) as an Antarctic Specially Protected Area (ASPA) is to protect environmental values, and primarily the rich Chorisodontium-Polytrichum moss turf present within the Area.

Green Island was originally designated as a Specially Protected Area (SPA) through Recommendation IV-9 (1966, SPA No. 9) after a proposal by the United Kingdom. It was designated on the grounds that the vegetation "is exceptionally rich, [and] is probably the most luxuriant anywhere on the west side of the Antarctic Peninsula". The Recommendation noted: "in some places the humus is 2 metres thick and that this area, being of outstanding scientific interest, should be protected because it is probably one of the most diverse Antarctic ecosystems". A Management Plan for the site was prepared by the United Kingdom and adopted through Recommendation XVI-6 (1991). The original reasons for designation were extended and elaborated, although following comparisons to other sites in the vicinity, Green Island was no longer considered to be particularly diverse. Nevertheless, the vegetation on the island was described as extensive on the north-facing slopes, with well-developed continuous banks of moss turf formed by Chorisodontium aciphyllum and Polytrichum strictum that, over much of their extent, overlie peat of more than one metre in depth. Antarctic hair grass (Deschampsia antarctica), one of only two native vascular plants that grow within the Antarctic Treaty area, was noted as frequent in small patches near an Antarctic shag (Phalacrocorax [atriceps] bransfieldensis) colony. The colony of Antarctic shags, located on the steep, rocky northwestern corner of the island, was noted as being possibly one of the largest along the Antarctic Peninsula. The Management Plan was revised through Measure 1 (2002).

The Area fits into the wider context of the Antarctic Protected Area system by protecting moss turf and peat which are rare in the west Antarctic Peninsula area and, unlike moss banks within more northerly ASPAs, are largely unimpacted by Antarctic fur seal damage (Arctocephalus gazella). 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 (see also Morgan et al., 2007). Using this model, ASPA No. 108 is contained within Environment Domain B (Antarctic Peninsula mid-northern latitudes geologic). Other protected areas containing Domain B include ASPA Nos. 115, 134, 140 and 153 and ASMA No. 4. ASPA No. 108 sits within Antarctic Conservation Biogeographic Region (ACBR) 3 Northwest Antarctic Peninsula.

1. Description of values to be protected

Following a management visit to the ASPA in April 2017, the values specified in the earlier designation were reaffirmed. These values are set out as follows:

- The primary value worthy of protection is the Polytrichum strictum moss banks, with associated Chorisodontium aciphyllum, which may be one of the most extensive examples of this vegetation feature in the west Antarctic Peninsula region, occupying an area of over 0.5 ha. Moreover, in recent years many comparable moss banks on more northerly islands have suffered damage as a result of an increase in Antarctic fur seals. The vegetation at Green Island has thus far escaped any significant damage.
- Chorisodontium aciphyllum is close to the southern-most limit of its range at the Berthelot Islands.
- The area contains a large number of breeding Antarctic shags (Phalacrocorax [atriceps] bransfieldensis), which may represent one of the largest breeding populations known within the Antarctic Peninsula.
- Green Island has been afforded protection throughout most of the period of scientific activity in the region, with entry permits having been issued for only the most compelling scientific reasons. The island has not been subjected to intensive visitation, research or sampling and is potentially valuable as a baseline site for future studies.

2. Aims and objectives

Management at Green Island aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- prevent or minimise the introduction to the Area of non-native plants, animals and microbes;
- minimise the possibility of the introduction of pathogens which may cause disease in fauna populations within the Area;
- allow scientific research in the Area provided it is for compelling reasons which cannot be served elsewhere and which will not jeopardize the natural ecological system in that Area; and
- preserve the natural ecosystem of the Area as a reference area for future studies.

3. Management activities

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

- Copies of this Management Plan shall be made available to vessels and aircraft planning to visit the vicinity of the Area.

- Markers, signs or other structures (e.g. cairns) erected within the Area for scientific or management purposes shall be secured and maintained in good condition and removed when no longer required.
- The Management Plan shall be reviewed at least every five years and updated as required.
- A copy of this Management Plan shall be made available at Akademik Vernadsky Station (Ukraine; 65°15'S, 64°16'W).
- All scientific and management activities undertaken within the Area should be subject to an Environmental Impact Assessment, in accordance with the requirements of Annex I of the Protocol on Environmental Protection to the Antarctic Treaty.
- 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 and photographs

Map 1. Overview map, showing the location of Green Island on the Antarctic Peninsula. Map specifications: WGS84 Antarctic Polar Stereographic. Central meridian -55°, Standard parallel: -71°.

Map 2. Local area map showing the location of ASPA No. 108 Green Island, Berthelot Island, in relation to stations and other protected Areas in the vicinity. Map specifications: WGS84 Antarctic Polar Stereographic. Central meridian -64°, Standard parallel: -71°.

Map 3. ASPA No. 108 Green Island, Berthelot Islands, Antarctic Peninsula, topographic map. Map derived from ground survey 24 February 2001 and digital orthophotography (source aerial photography taken 14 February 2001 by the British Antarctic Survey). Map specifications – Projection: UTM Zone 20S; Spheroid: WGS84; Datum: mean sea level (EGM96).

6. Description of the Area

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

- *General description*

Green Island (65°19'S, 64°09'W, approximately 0.2 km²; Map 1) is a small island situated 150 m north of the largest of the Berthelot Islands group, within Grandidier Channel, approximately 3 km off the Graham Coast of the Antarctic Peninsula (Map 2). Green Island is 520 m from north to south and 500 m from east to west, rising to a rounded peak at a height of 83 m. The island rises steeply on all sides, with high precipitous cliffs on the south and east side. The largest extent of low ground occurs above the northern coast, which comprises a gently sloping rock platform. There are several permanent snow patches with the largest occurring around the summit and to the south and east of the summit. There are no permanent freshwater bodies on the island.

- *Boundaries*

The designated Area comprises all of Green Island, with the boundary defined as the low tide level. Offshore islets and rocks are not included within the Area. Boundary markers have not been installed. The coast itself is a clearly defined and visually obvious boundary feature.

- *Climate*

No climate data are available for Green Island, but conditions are expected to be similar to those at Akademik Vernadsky Station (Ukraine) on Galindez Island, Argentine Islands, 8 km to the north. The mean summer temperature at Vernadsky is 0 °C while the extreme maximum summer temperature is 11.7 °C. In winter, the mean temperature is -10 °C and the extreme minimum temperature is -43.3 °C. The mean wind speed is 7.5 knots.

- *Geology and soils*

Green Island, together with the rest of the Berthelot Islands, is composed of gabbro of Lower Jurassic to Lower Tertiary age (British Antarctic Survey, 1981). Excluding the large peat deposits, soil is sparse and seldom exceeds 20 cm in depth, except occasionally in rock depressions and gullies. This is predominantly an ahumic coarse mineral soil derived from weathering of the parent rock. Ledges and gullies close to the Antarctic shag colony contain an organically richer soil derived in part from decayed moss and guano. Over much of the steep northern slopes the mosses Chorisodontium aciphyllum and Polytrichum strictum have developed a deep turf of living moss overlying at least 1 m of barely altered or decomposed moss peat (Smith, 1979, Fenton and Smith, 1982). The moss peat may of use in determining climatic characteristics over the late Holocene (Royles et al., 2012). The permafrost layer is found 20-30 cm below ground level. Elsewhere on the island, notably the north-eastern side, there are small areas of scree. There are no well-developed periglacial features, although a few small stone circles are evident occasionally.

- *Vegetation*

The most significant feature of the vegetation is the extensive continuous stand of Polytrichum strictum on the northern slopes of the island (Map 3). The stand is approximately 140 m wide, extends from an elevation of approximately 25 m up to 70 m, and covers over 0.5 ha (Bonner and Smith, 1985). Use of satellite remote sensing techniques (Normalised Difference Vegetation Index) showed the total area of green vegetation within the ASPA to be 0.036 km² (c. 16.5% of the ASPA area). Growth is lush and the permanently frozen peat in places reaches two metres deep. The surface of the hard compact moss is stepped, which is thought to be a result of slumping of the active layer on the steep slope. Extensive erosion of the moss banks is evident in places, but this appears to be a consequence of the peat bank reaching a maximum sustainable depth on the steep slope and is not due to fur seal damage, as observed in banks in more northerly ASPAs (e.g. ASPA No. 113). Chorisodontium aciphyllum is abundant at the edges of the bank and around the periphery of small gullies in the bank, where there is some shelter and moisture available from drifted snow. Both these tall turf-forming mosses are usually intimately intermixed in such communities further north in the maritime Antarctic; however, in the Grandidier Channel region the more xeric P. strictum often occurs alone. C. aciphyllum is close to its southernmost limit on Green Island (Smith, 1996). Amongst the C. aciphyllum, Pohlia nutans is frequent, together with the liverworts Barbilophozia hatcheri and Cephaloziella varians. Epiphytic lichens are not abundant on the live Polytrichum and Chorisodontium, but Sphaerophorus globosus is frequent in the more exposed north-western area. Several species of Cladonia are widespread on the moss banks. The white encrusting epiphyte Ochrolechia frigida is present but not abundant here; black crustose species occur on moribund moss.

Wet hollows among rocks and melt runnels support small stands of the mosses Warnstorfia fontinaliopsis, Brachythecium austro-salebrosum and Sanionia uncinata. Elsewhere lichens dominate the vegetation. On rocks and boulders away from the shore and the influence of seabirds, a community dominated by Usnea antarctica and species of Umbilicaria (U. antarctica, U. decussate, U. hyperborea and U. umbilicarioides) prevail, with the mosses Andreaea depressinervis and A. regularis and various crustose lichens associated. Cliffs above the shore possess the most diverse and heterogeneous communities, composed predominantly of lichens. These are a modification of the Usnea-Umbilicaria community with various nitrophilous taxa, especially close to seabird nests, including species of Acarospora, Buellia, Caloplaca, Lecanora, Mastodia, Omphalodina, Physcia and Xanthoria. Plant records from the Area have been used in studies to predict moss and lichen species diversity on the Antarctic Peninsula at both a regional scale and a local scale (Casanovas et al., 2012). The only flowering plant thus far recorded on Green Island is Antarctic hair grass (Deschampsia antarctica), which is frequent in small patches above the cormorant colony and on rock ledges on the western side of the island. The green foliose alga Prasiola crispa is widespread in wet areas of the island

- *Breeding birds*

A sizeable colony of Antarctic shags (Phalacrocorax atriceps) is present on the steep, rocky northwestern flank of the island (65°19’21”S, 64°09’11”W; Map 3). This is one of the largest known Antarctic shag colonies along the Antarctic Peninsula (Bonner and Smith, 1985), although numbers may vary substantially from year to year (Casaux and Barrera-Oro, 2006). Approximately 50 pairs were estimated as present in 1971 (Kinnear, 1971), while 112 birds were recorded in

1973 (Schlatter and Moreno, 1976). During a visit in March 1981, 500-600 individuals (of which 300-400 were immature) were present. Harris (2001) recorded 71 chicks on 24 February 2001, while approximately 100 birds were noted on 15 February 2011 and 200-250 birds on 22 January 2013, of which c. 100 were adults. In April 2017, c. 100 adult birds were observed. Brown skuas (Stercorarius antarcticus) are numerous over much of the island, particularly on the extensive moss banks. South polar skuas (Stercorarius maccormicki) are also present, along with a few possible hybrids. Over 80 birds were noted in March 1981, but only ten breeding pairs were confirmed, most of which were rearing two chicks. No other breeding birds were noted.

- *Invertebrates*

There is little information on the invertebrate fauna at Green Island, although 15 species were recorded in a study that suggested the invertebrate fauna on Green Island was comparatively diverse for the region (Usher and Edwards, 1986). The most abundant species were Cryptopygus antarcticus, Belgica antarctica and Nanorchestes gressitti. Larval B. antarctica were particularly abundant on Green Island compared to neighbouring Darboux Island. Other species recorded in the Area are Alaskozetes antarcticus, Ereynetes macquariensis, Eupodes minutus, Eupodes parvus grahamensis, Friesea grisea, Gamasellus racovitzai, Halozetes belgicae, N. berryi, Oppia loxolineata, Parisotoma octo-oculata, Rhagidia gerlachei and Stereotydeus villosus.

- *Human activities and impacts*

There have been few reported visits to Green Island. The first recorded landing on the island was by the Première Expédition Antarctiques Française in 1903-05. The Deuxième Expédition Antarctiques Française visited Green Island several times during the winter in 1909. The British Graham Land Expedition landed on the island on 18 March 1935. Vegetation studies were undertaken on Green Island by Smith in 1981 (Bonner and Smith, 1985) and Komárková in 1982-83 (Komárková, 1983). Numerous 30 cm lengths of 2.5 mm diameter iron wire, marking the corners of 50 m square quadrats of the Polytrichum strictum moss turf overlying the peat banks, were recorded (and left in situ) by an inspection team in January 1989 (Heap, 1994). It is not known precisely when these markers were installed. The number of markers, their distribution and the nature of any possible contamination these may have had on the moss is unknown. In January 2013, a metal rod, approximately 20 cm long and of unknown origin, was found located on the moss bank at 65°19'23"S, 64°09'02"W.

In recent years a number of important vegetation sites in the Antarctic Peninsula region have been subjected to damage from trampling and nutrient enrichment by increasing numbers of Antarctic fur seals (Arctocephalus gazella). No Antarctic fur seals were observed on Green Island during a site visit made on 24 February 2001, although there was some evidence of recent trampling and nutrient enrichment on parts of the lower moss banks. However, damage appeared limited and most of the extensive moss banks remained intact. During a site visit in April 2017, no evidence of further seal damage was noted.

6(ii) Access to the Area

- Access to the Area shall be by boat, or over sea ice by vehicle or foot. No special restrictions apply to the routes used to move to and from the Area by boats or over sea ice.
- The recommended landing site for small boats is on the rocky northern coast, with the recommended landing site located in a small cove at 65°19'17.6"S, 64°08'46.0"W (Map 3). 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.
- When access over sea ice is viable, there are no special restrictions on the locations where vehicle or foot access may be made, although vehicles are prohibited from being taken on land.
- Aircraft are prohibited from landing within the Area.
- Boat crew, or other people on boats, are prohibited from moving on foot beyond the immediate vicinity of the landing site unless specifically authorised by Permit.

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

There are no structures present in the Area. The nearest scientific research station is Akademik Vernadsky (Ukraine) (65°15'S, 64°16'W), approximately 8 km north of the Area on Galindez Island.

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

Other protected areas in the vicinity include:

- ASPA No. 113, Lichfield Island, Arthur Harbour, Anvers Island, Palmer Archipelago, 64°46'S, 64°06'W, 62 km to the north.
- ASPA No. 139, Biscoe Point, Anvers Island, Palmer Archipelago, 64°48'S, 63°46'W, 60 km to the north.
- ASPA No. 146, South Bay, Doumer Island, Palmer Archipelago, 64°51'S, 63°34'W, 60 km to the north west.

ASPA Nos. 113 and 139 lie within Antarctic Specially Managed Area 7 Southwest Anvers Island and Palmer Basin.

6(v) Special zones within the Area

There are no special zones within the Area.

7. Permit conditions

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 for compelling scientific reasons which cannot be served elsewhere, or for reasons essential to the management of the Area;
- the actions permitted are in accordance with this Management Plan;
- any management activities are in support of the objectives of this Management Plan;
- the actions permitted will not jeopardise the natural ecological system in the Area;
- the activities permitted will give due consideration via the environmental impact assessment process to the continued protection of the environmental or scientific values of the Area;
- the Permit shall be issued for a finite period; and
- the Permit, or an authorised copy, shall be carried when in the Area.

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

- Vehicles are prohibited within the Area and all movement within the Area should be on foot.
- The operation of aircraft over the Areas should be carried out, as a minimum requirement, in compliance with the 'Guidelines for the operations of aircraft near concentrations of birds' contained in Resolution 2 (2004).
- Overflight of bird colonies within the Area by Remotely Piloted Aircraft Systems (RPAS) shall not be permitted unless for scientific or operational purposes, and in accordance with a permit issued by an appropriate national authority.
- All movement should be undertaken carefully so as to minimise disturbance.to the soil and vegetated surfaces and birds present, walking on snow or rocky terrain if practical.
- Pedestrian traffic should be kept to the minimum necessary to undertake permitted activities and every reasonable effort should be made to minimise trampling effects.

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

Activities which may be conducted in the Area include:

- essential management activities, including monitoring;
- compelling scientific research that cannot be undertaken elsewhere and which will not jeopardize the ecosystem of the Area; and
- sampling, which should be the minimum required for approved research programmes.

7(iv) Installation, modification or removal of structures

- Permanent structures or installations are prohibited.
- No 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.
- All markers, structures or scientific equipment installed in the Area must be 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, spores) and non-sterile soil (see section 7(vi)), and be made of materials that can withstand the environmental condition and pose minimal risk of contamination of the Area.
- Removal of specific structures or equipment for which the permit has expired shall be the responsibility of the authority which granted the original permit and shall be a condition of the Permit.

7(v) Location of field camps

When necessary for purposes specified in the Permit, temporary camping is allowed within the Area on the low platform on the northern coast (65°19’18’’S, 64°08’55’’W; Map 3). Camps should be located on snow surfaces that typically persist at this location or on gravel/rock when snow cover is absent. Camping on vegetated ground is prohibited.

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

No living animals, plant material or microorganisms shall be deliberately introduced into the Area. To ensure that the floristic and ecological values of the Area are maintained, 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 sterilized. 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. Further guidance can be found in the CEP non-native species manual (CEP, 2017) and the Environmental code of conduct for terrestrial scientific field research in Antarctica (SCAR, 2009). In view of the presence of breeding bird colonies within the Area, 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 and fauna is prohibited, except in accordance with a 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 (2011). Any soil or vegetation sampling is to be kept to an absolute minimum required for scientific or management purposes, and carried out using techniques which minimise disturbance to surrounding soil, ice structures and biota.

7(viii) The 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, and 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 national authority must be notified and approval obtained.

7(ix) Disposal of waste

All wastes, including all human wastes, shall be removed from the Area. Human wastes may be disposed of into the sea.

7(x) Measures that may be necessary to continue to met the aims of the Management Plan

- Permits may be granted to enter the Area to carry out scientific research, monitoring and site inspection activities, which may involve the collection of a small number of samples for analysis or to carry out protective measures.
- Any long-term monitoring sites shall be appropriately marked and the markers or signs maintained.
- Scientific activities shall be performed in accordance with the

Environmental code of conduct for terrestrial scientific field research in Antarctica (SCAR, 2009).

7(xi) Requirements for reports

The principal Permit holder for each visit to the Area shall submit a report to the appropriate national authority as soon as practicable, and no later than six months after the visit has been completed. Such reports should include, as appropriate, the information identified in the Antarctic Specially Protected Area visit report form contained in the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas (Appendix 2). The appropriate authority should be notified of any activities/measures undertaken that were not included in the authorised Permit. Wherever possible, 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, 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. Supporting documentation

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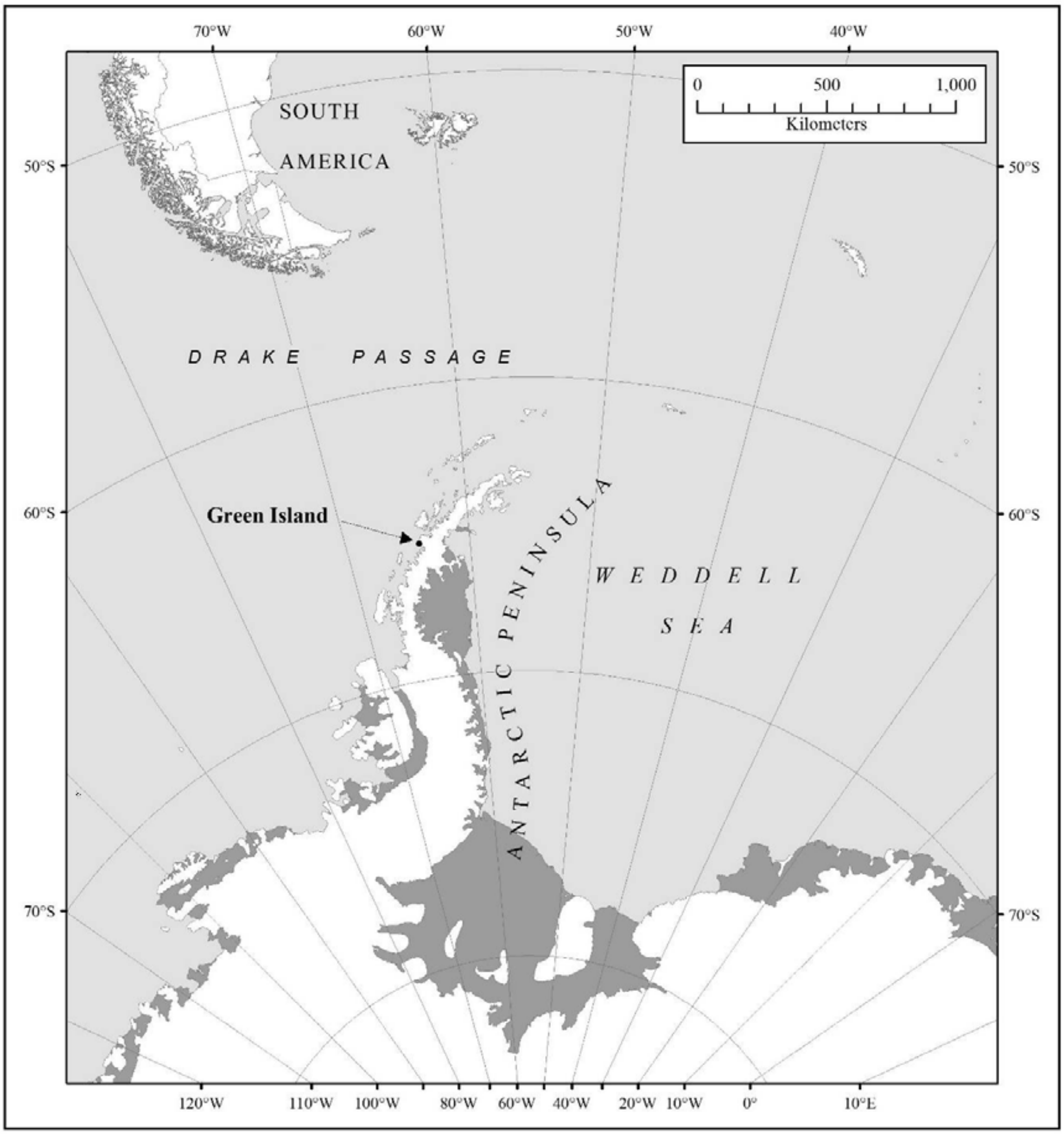
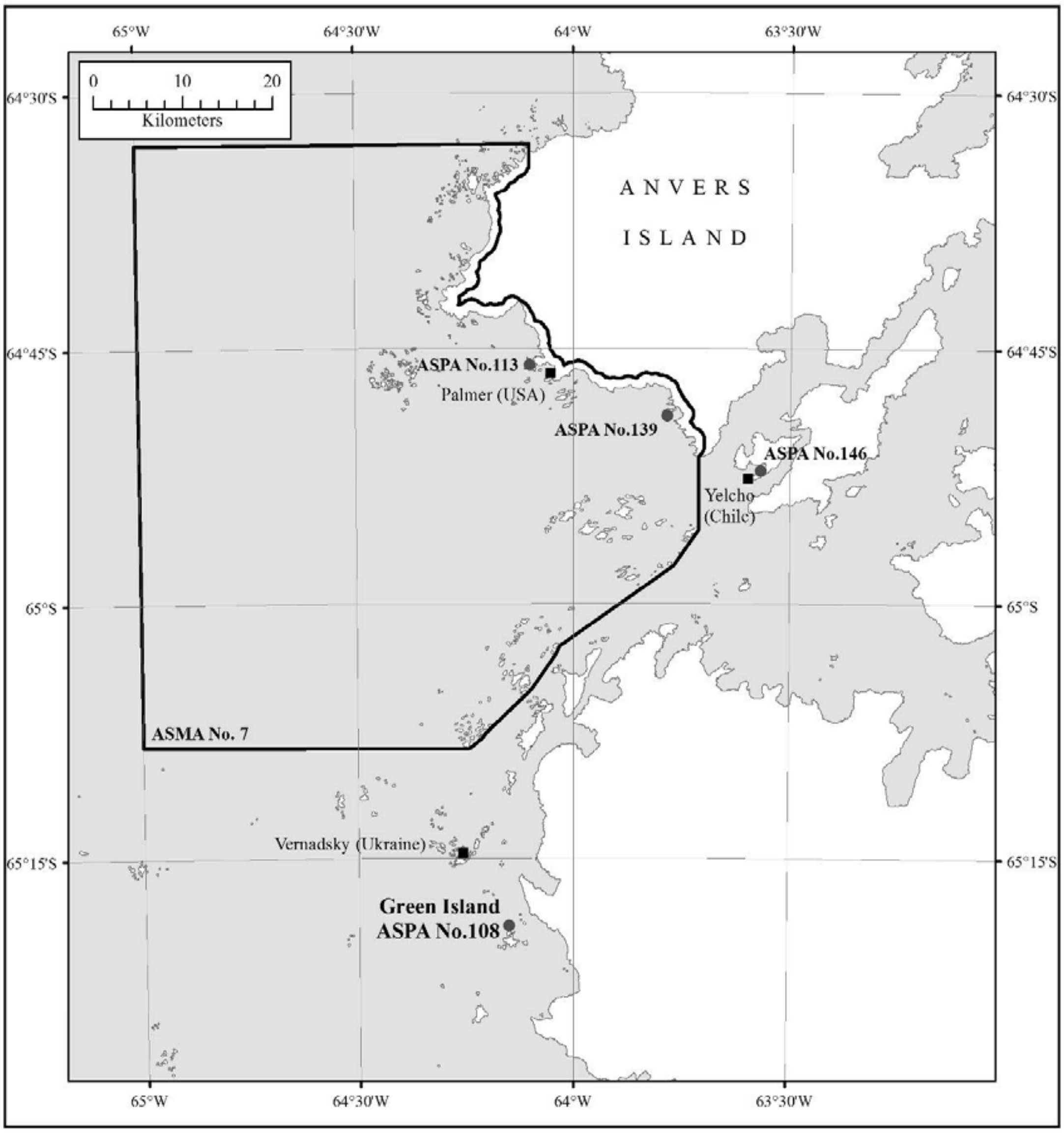
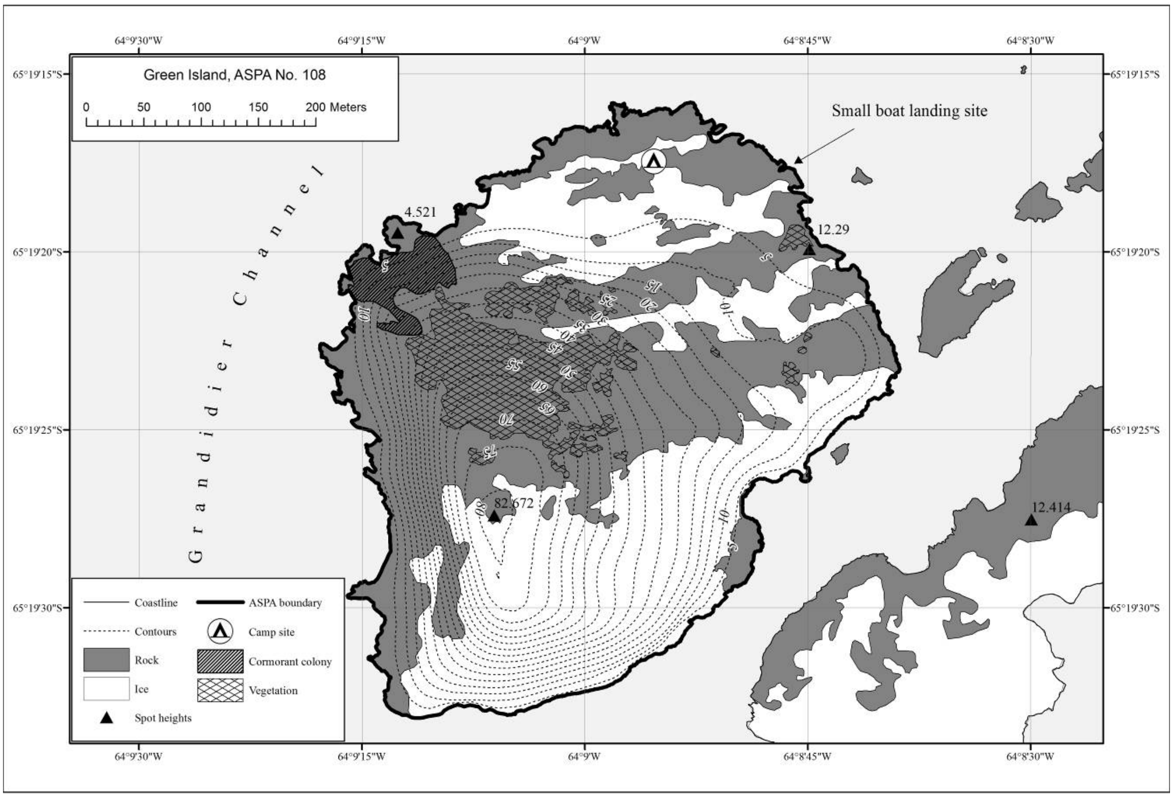
Map 1. Overview map, showing the location of Green Island on the Antarctic Peninsula. Map specifications: WGS84 Antarctic Polar Stereographic. Central meridian -55°, Standard parallel: -71°.



Map 2. Local area map showing the location of ASPA No. 108 Green Island, Berthelot Island, in relation to stations and other protected Areas in the vicinity. Map specifications: WGS84 Antarctic Polar Stereographic. Central meridian -64°, Standard parallel: -71°.



Map 3. ASPA No. 108 Green Island, Berthelot Islands, Antarctic Peninsula, topographic map. Map derived from ground survey 24 February 2001 and digital orthophotography (source aerial photography taken 14 February 2001 by the British Antarctic Survey). Map specifications – Projection: UTM Zone 20S; Spheroid: WGS84; Datum: mean sea level (EGM96).



Measure 2 (2018)

Antarctic Specially Protected Area No 117 (Avian Island, Marguerite Bay, Antarctic Peninsula): 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 XV-6 (1989), which designated Avian Island, North-West Marguerite Bay as Site of Special Scientific Interest ("SSSI") No 30 and annexed a Management Plan for the site;
- Recommendation XVI-4 (1991), which redesignated SSSI 30 as Specially Protected Area ("SPA") No 21 and annexed a revised Management Plan for the Area;
- Decision 1 (2002), which renamed and renumbered SPA 21 as ASPA 117;
- Measures 1 (2002) and 2 (2013), which adopted revised Management Plans for ASPA 117;

Recalling that Recommendations XV-6 (1989) and XVI -4 (1991) did not become effective and 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 117;

Desiring to replace the existing Management Plan for ASPA 117 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 117 (Avian Island, Marguerite Bay, Antarctic Peninsula), which is annexed to this Measure, be approved; and
2. the Management Plan for Antarctic Specially Protected Area No 117 annexed to Measure 2 (2013) be revoked.

Management Plan for Antarctic Specially Protected Area No. 117

AVIAN ISLAND, MARGUERITE BAY, ANTARCTIC PENINSULA

Introduction

The primary reason for the designation of Avian Island, Marguerite Bay, Antarctic Peninsula (67°46'S, 68°54'W; 0.49 km^2) as an Antarctic Specially Protected Area (ASPA) is to protect environmental values and primarily the abundance and diversity of breeding seabirds on the island.

Avian Island is situated in northwestern Marguerite Bay, 400 m south of Adelaide Island on the western side of the central Antarctic Peninsula. It was originally designated as Site of Special Scientific Interest (SSSI) No. 30 under Recommendation XV-6 in 1989 after a proposal by the United Kingdom. Included was the island together with its littoral zone, but excluded was a small area near a refuge on the northwestern coast of the island. Values protected under the original designation were described as the abundance and diversity of breeding seabirds present on the island, that the southern giant petrel (Macronectes giganteus) colony is one of the most southerly known breeding population of this species, and that the Antarctic shags (Phalacrocorax [atriceps] bransfieldensis) are breeding close to the southern limit of their range. The Area was therefore considered of outstanding ornithological importance, meriting protection from unnecessary human disturbance.

Designation as an SSSI was terminated with redesignation of Avian Island as a Specially Protected Area (SPA) through Recommendation XVI-4 (1991, SPA No. 21) after a proposal by the United Kingdom. The boundaries were similar to the original SSSI, but included the entire island and the littoral zone without the exclusion zone near the refuge on the northwestern coast. After re-designation as ASPA 117 through Decision 1 (2002), the ASPA Management Plan was approved through Measure 1 (2002).

The Area fits into the wider context of the Antarctic Protected Area system by protecting the breeding site of seven seabird species, including southern giant petrels which are vulnerable to disturbance. No other ASPA in the region protects such a wide diversity of breeding bird species. 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 (see also Morgan et al., 2007). Using this model, Avian Island is described as Domain E (Antarctic Peninsula and Alexander Island main ice fields), which is also found in ASPAs 113, 114, 126, 128, 129, 133, 134, 139, 147, 149, 152 and ASMAs 1 and 4. However, given that Avian Island is predominantly ice-free this domain may not be fully representative of the environment encompassed within the Area. Although not specifically described as such in Morgan et al., Avian Island may be better represented by Domain B (Antarctic Peninsula mid-northern latitudes geologic). Other protected areas containing Domain B include ASPAs 108, 115, 129, 134, 140 and 153 and ASMA 4. The ASPA sits within Antarctic Conservation Biogeographic Region (ACBR) 3 Northwest Antarctic Peninsula (Terauds et al., 2012; Terauds and Lee, 2016). Through Resolution 5 (2015) Parties recognised the usefulness of the list of Antarctic Important Bird Areas (IBAs) in planning and conducting activities in Antarctica. Important Bird Area ANT095 Avian Island has the same boundary as ASPA 117, and qualifies on the basis of the Adélie penguins (Pygoscelis adeliae), Antarctic shags (Phalacrocorax [atriceps] bransfieldensis), and south polar skuas (Stercorarius maccormicki).

1. Description of values to be protected

The outstanding environmental value of the Area, which is the primary reason for designation as an ASPA, is based on the following:

- the Adélie penguin (Pygoscelis adeliae) colony is one of the largest in Palmer Land, containing around 77,515 breeding pairs;
- the Antarctic shag (Phalacrocorax [atriceps] bransfieldensis) colony is one of the largest known breeding sites in the Antarctic and is close to the southern limit of this species' breeding range;
- the outstanding and unique attribute of being the only known site on the Antarctic Peninsula where seven seabird species are breeding in such close proximity to each other within the confined space of a single, small island, with unusually high population densities and virtually the whole island occupied by breeding birds throughout the summer;
- the southern giant petrel (Macronectes giganteus) colony is one of the two largest on the Antarctic Peninsula;
- the kelp gull (Larus dominicanus) colony is also large and is breeding near the southern extent of its range; and
- the moss Warnstorfia fontinaliopsis on Avian Island is near the southern limit of its known range.

2. Aims and objectives

The aims and objectives of this Management Plan are to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- prevent or minimise the introduction to the Area of non-native plants, animals and microbes;
- minimise the possibility of the introduction of pathogens which may cause disease in fauna populations within the Area;
- allow scientific research in the Area provided it is for compelling reasons which cannot be served elsewhere and which will not jeopardize the natural ecological system in that Area; and
- preserve the natural ecosystem of the Area as a reference area for future

studies.

3. Management activities

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

- A copy of this Management Plan shall be made available at Teniente Luis Carvajal Station (Chile; 67°46'S, 68°55'W), Rothera Research Station (UK; 67°34' S, 68°07'W) and General San Martín Station (Argentina; 68°08' S, 67°06'W).
- The Management Plan shall be reviewed at least every five years and updated as required.
- Visiting field parties shall be briefed fully by the national authority on the values that are to be protected within the Area and the precautions and mitigation measures detailed in this Management Plan.
- All scientific and management activities undertaken within the Area should be subject to an Environmental Impact Assessment, in accordance with the requirements of Annex I of the Protocol on Environmental Protection to the Antarctic Treaty.
- Copies of this Management Plan shall be made available to vessels and aircraft planning to visit the vicinity of the Area.
- All pilots operating in the region shall be informed of the location, boundaries and restrictions applying to entry and over-flight in the Area.
- 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.
- In accordance with the requirements of Annex III of the Protocol on Environmental Protection to the Antarctic Treaty, abandoned equipment or materials shall be removed to the maximum extent possible provided doing so does not adversely impact on the environment and the values of the Area.
- 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 and photographs

Map 1. Avian Island, ASPA No. 117, in relation to Marguerite Bay, showing the locations of the stations Teniente Luis Carvajal (Chile), Rothera (UK) and General San Martín (Argentina). The location of other protected areas within Marguerite Bay (ASPA No. 107 at Emperor Island (Dion Islands), ASPA No. 115 at

Lagotellerie Island, and ASPA No. 129 at Rothera Point) are also shown. Inset: the location of Avian Island on the Antarctic Peninsula.

Map 2. Avian Island, ASPA No. 117, topographic map. Map specifications – projection: Lambert conformal conic; standard parallels: 1st 67° 30' 00"S; 2nd 68° 00' 00"S; central meridian: 68° 55' 00"W; latitude of origin: 68° 00' 00"S; spheroid: WGS84; datum: mean sea level; vertical contour interval 5 m; horizontal accuracy: ±5 m; vertical accuracy ±1.5 m.

Map 3. Avian Island, ASPA No. 117, breeding wildlife sketch map. Positions of nests and colonies are accurate to ±25 m. Information was derived from Poncet (1982). Map specifications – projection: Lambert conformal conic; standard parallels: 1st 67° 30' 00"S; 2nd 68° 00' 00"S; central meridian: 68° 55' 00"W; latitude of origin: 68° 00' 00"S; spheroid: WGS84; datum: mean sea level; vertical contour interval 5 m; horizontal accuracy: ±5 m; vertical accuracy ±1.5 m.

6. Description of the Area

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

- *General description*

Avian Island (67°46'S, 68°54'W, 0.49 km²), is situated in the northwest of Marguerite Bay, 400 m south of the southwestern extremity of Adelaide Island (Map 1). The island is 1.45 km long by 0.8 km at its widest, and is of roughly triangular shape. It is rocky with a low relief of generally less than 10 m in the north, rising to about 30 m at the centre, and 40 m in the south where several rock and ice slopes of up to 30 m drop steeply to the sea. The coastline is irregular and rocky with numerous offshore islets, although there are several accessible beaches on the northern and eastern coasts. The island is usually ice-free in summer. It contains habitat particularly suitable for a variety of breeding birds: well-drained north-facing slopes suitable for Antarctic shags (Phalacrocorax [atriceps] bransfieldensis); broken rock and boulders with crevices suitable for small nesting birds such as Wilson's storm petrels (Oceanites oceanicus); elevated rocky heights suitable for southern giant petrels (Macronectes giganteus); extensive expanses of snow-free ground for Adélie penguins (Pygoscelis adeliae). The presence of the latter attracts skuas (Stercorarius maccormicki and Stercorarius antarcticus) and kelp gulls (Larus dominicanus).

- *Boundaries*

The designated Area comprises the whole of Avian Island and the littoral zone, offshore islets and rocks, and a buffer zone of the surrounding marine environment (including sea ice when present) within 100 m of the shoreline of the main island (Map 2). Boundary markers have not been installed because the coast forms a visually obvious reference for the marine boundary.

- *Climate and sea ice*

No extended meteorological records are available for Avian Island, but records from 1962-74 for Adelaide Base (formerly UK; now Teniente Luis Carvajal, Chile), 1.2 km distant, show a mean daily maximum temperature of 3ºC in February (extreme maximum 9ºC) and a mean daily minimum of -8ºC in August (extreme minimum -44ºC). The same general pattern was observed in year-round observations made on the island in 1978-79 (Poncet and Poncet, 1979). Precipitation on the island in this year was usually as snow, most of which fell between August and October, but with occasional snowfalls and some rain in the summer.

Marguerite Bay may freeze in winter, although the extent and character of sea ice shows considerable inter-seasonal variation. Despite the extent and frequent persistence of regional sea ice, a recurrent polynya has been observed near Avian Island, which can provide ice-free conditions locally from October onward. In addition, strong tidal currents around Avian Island help to keep surrounding waters ice-free for much of the year, which facilitates easy access to feeding grounds for several species. The island is not particularly windy, with an annual average of 10 knots in 1978-79. However, the strong katabatic winds that descend from Adelaide Island, perhaps for 1-3 days a few times every month, reduce snow accumulation on the island and push sea ice away from the coast, helping to form the polynya. The relatively snow-free conditions are important for bird colonisation.

- *Geology, geomorphology and soils*

The bedrock of Avian Island forms part of a down-faulted block at the southwestern end of Adelaide Island and is composed of interbedded lithic-rich and feldspar-rich volcaniclastic sandstones. Bedded tuffaceaous sandstones, pebbly sandstones rich in volcanic lithics, and a volcanic granule breccia also occur. The latter is probably a primary volcanic deposit, while the rest of the sequence is largely composed of reworked volcanic material. The sequence forms part of the Mount Liotard Formation of Adelaide Island and is probably late Cretaceous in age (Griffiths, 1992; Moyes et al., 1994; Riley et al., 2012). Apart from rock outcrop, the surface consists mainly of frost-shattered rock with permafrost. Ornithogenic soils are widespread, particularly in the north; organic peat soil is virtually absent, but where present is not well-developed and is associated with moss growth. Several raised beaches have been noted on Avian Island, but the geomorphology has not otherwise been described.

- *Streams and lakes*

Avian Island has several ephemeral freshwater ponds of up to 10,000 m² and of about 40 cm in depth, the largest being on the eastern coast, at about 5 m altitude, and on the north-western coast near sea level. Numerous small pools and meltwater channels develop from seasonal snow melt, and small streams drain valleys in the vicinity of the ponds. Both the ponds and melt-pools freeze solid in winter. Freshwater bodies on the island are organically enriched by guano, a source of nutrients, and in summer a number of the ponds show a rich benthic flora and fauna of algae, Phyllopoda, Copepoda, Nematoda, Protozoa, Rotifera, and Tardigrada. Large numbers of the crustacean Branchinecta sp. have been observed (Poncet and Poncet, 1979). The freshwater ecology of the island has not been studied in detail.

- *Breeding birds*

Seven species of birds breed on Avian Island, which is a high number compared to other sites on the Antarctic Peninsula. Several species have unusually high populations, being some of the largest for their species in the Antarctic Peninsula region (Map 3). Detailed year-round data for all species were collected in 1978-79 (Poncet and Poncet, 1979), while data are otherwise sporadic. Descriptions below are thus often based on a single season's observations and it should be emphasised that these data are therefore not necessarily representative of longer term population trends. However, this is the best information that is presently available.

The Avian Island Adélie penguin (Pygoscelis adeliae) colony occupies the northern half and central eastern coast of the island (Map 3). The initial management plan referred to the Adélie penguin colony as "the largest on the Antarctic Peninsula [containing] a third of the total population breeding in the region". While this is not substantiated by recent data (e.g. one Antarctic Peninsula colony has over 120,000 pairs (Woehler 1993)), the Avian Island colony still represents one of the largest breeding populations in Palmer Land. Recent research suggests that Adélie penguin numbers are decreasing at almost all locations on the Antarctic Peninsula (Lynch et al., 2012). The most recent population estimate for Adélie penguins on Avian Island is for the 2015/16 season which recorded 65,888 breeding pairs (W. Fraser, pers. comm. 2018). Two sets of population data available for Adélie penguins on Avian Island collected in 2013 indicated populations of 77,515 breeding pairs (± 5%; January 2013) (W. Fraser, pers. comm. 2013; Sailley et al., 2013) and 47,146 pairs (Casanovas et al., 2015), although the reasons for the discrepancy between counts is unclear. These data compare with an estimate of Adélie penguin numbers, based on aerial photographs taken in December 1998, that revealed 87,850 birds (± 0.16 S.D.; Woehler, 1993) and an earlier count recorded on 11 November 1978, of 36,500 breeding pairs (Poncet and Poncet, 1979).

In 1978-79 Adélie penguins were recorded on the island from October until the end of April, with egg laying occurring through October and November, and the first chicks hatching around mid-December. Chick créches were observed around mid-January, with the first chicks becoming independent near the end of January. Most of the moulting adults and independent chicks had departed the island by the third week of February, although groups returned periodically throughout March and April.

A large colony of Antarctic shags (Phalacrocorax [atriceps] bransfieldensis) has been recorded in three groups located on the south-western coastal extremity of the island (Map 3). However, during a visit on 26-27 January 2011, it was noted that the two more northerly colony sites were not occupied and the nesting mounds were in a poor state, suggesting that these sites may have been abandoned for some time. Stonehouse (1949) reported about 300 birds present in October 1948; a similar number of birds was recorded in mid-November 1968, most of which were breeding (Willey 1969). Poncet and Poncet (1979) observed 320 pairs in 1978, and approximately 670 pairs on 17 January 1989 (Poncet, 1990). A count on 23 February 2001 recorded 185 chicks, although it is probable some had departed by the time of the count; approximately 250 nest sites were counted. A count in mid- to late January 2013 recorded 302 breeding pairs (W. Fraser, pers. comm., 2013). In 1968 Antarctic shags were observed to be present on the island from 12 August, with egg laying occurring from November, and chicks hatching in December (Willey 1969). In 1978-79 they were observed from September until June, with egg laying occurring from November through to January, when the first chicks hatched, and chicks started to become independent in the third week of February (Poncet and Poncet, 1979).

Of the southern giant petrel (Macronectes giganteus) colonies known south of the South Shetland Islands, Avian Island is one of the two largest, and may comprise a substantial proportion of the breeding population in the southern Antarctic Peninsula region (estimated at 1190 pairs in 1999/2000; Patterson et al., 2008). In 1979 the southern giant petrels occupied principally the elevated rocky outcrops of the central and southern half of the island in four main groups (Map 3). Data on the numbers of birds present on the island are shown in Table 1.

Table 1: Southern giant petrel (Macronectes giganteus) numbers at Avian Island.

Year	Number of birds	Number of pairs	Number of chicks	Source
1948	~100	n/a	n/a	Stonehouse, 1949
1968	400	163	n/a	Willey, 1969
1979	n/a	197	n/a	Poncet and Poncet, 1979
1989	n/a	250	n/a	Poncet, 1990
2001	n/a	n/a	237	Harris, 2001
2013	n/a	470	n/a	W. Fraser, pers. comm., 2013

[n/a - not available]

In 1978-79 the birds were present on Avian Island from mid-September through to as late as June. In this season, egg laying occurred from late October through to the end of November, with hatching occurring throughout January and chicks generally achieving independence by April. In the 1978-79 austral summer up to 100 non-breeders were observed on the island during the courtship period in October, with these numbers decreasing to a few non-breeders as the season progressed.

Approximately 200 adult kelp gulls (Larus dominicanus), of which over 60 pairs were breeding, were recorded on Avian Island in 1978-79. These birds were distributed widely, but principally in the elevated central and southern parts of the island (Poncet and Poncet 1979) (Map 3). In the 1978-79 austral summer the majority of breeders arrived in early October, followed by egg laying around mid-November and hatching a month later. Detailed data are not available because of concern that human disturbance by data collection would seriously impair the breeding performance of this species. However, no more than 12 chicks were observed on the island near the end of January 1979, which would suggest breeding performance in this season was low: the exact cause – whether human disturbance or natural factors – could not be determined. In 1967, 19 pairs and 80-120 birds were recorded (Barlow, 1968).

An estimate of at least several hundred pairs of breeding Wilson's storm petrels (Oceanites oceanicus) on the island was made in 1978-79 (Poncet and Poncet, 1979). Wilson's storm petrels were observed on the island from the second week of November, with laying and incubation probably occurring through to mid-December. Departure of adults and independent chicks was largely complete by the end of March. Most of the rocky outcrops on the northern half of the island and all of the stable rocky slopes in the south are ideal habitat for this species.

In 1978-79 about 25-30 pairs of south polar skuas (Stercorarius maccormicki) were breeding on Avian Island. The skua nests were distributed widely over the island, although the majority were on the central and eastern part of the island, especially on slopes overlooking the Adélie penguin colony (Map 3). Large groups of non-breeders (around 150 birds; Poncet and Poncet 1979) were observed to congregate around the shallow lake on the eastern side of the island. Barlow (1968) reported approximately 200 non-breeding birds in 1968. Approximately 195 pairs of south polar skuas were breeding in the central and eastern parts of the island in 2004 (W. Fraser pers. comm. 2015), with 880 non-breeding individuals also counted on the island (W. Fraser pers. comm. 2015, in correction of data reported in Ritz et al. 2006). In the 1978-79 austral summer the south polar skuas took up residence around the end of October, with egg laying in early December and hatching complete by the end of January. Independent chicks and adults generally departed by the end of March, with some late-breeders remaining until mid-April. A breeding success of one chick per nest was reported in the 1978-79 austral summer. Barlow (1968) reported 12 breeding pairs of brown skuas (Stercorarius antarcticus), although this number could include south polar skuas. One breeding pair of brown skuas was recorded on the southwest of the island in the 1978-79 austral summer. This is the southernmost record of this species breeding along the Antarctic Peninsula. Several non-breeding brown skuas were also recorded in the same season.

Several other bird species, known to breed elsewhere in Marguerite Bay, are frequent visitors to Avian Island, notably Antarctic terns (Sterna vittata), snow petrels (Pagodroma nivea), and southern fulmars (Fulmarus glacialoides). These species have not been observed nesting on Avian Island. Small numbers of

Antarctic petrels (Thalassoica antarctica) have been seen on a few occasions. The cape petrel (Daption capense) was observed on Avian Island in October 1948 (Stonehouse, 1949). Solitary individuals of king (Aptenodytes patagonicus) and chinstrap (Pygoscelis antarctica) penguins were observed in 1975 and 1989, respectively.

- *Terrestrial biology*

Vegetation on Avian Island is generally sparse, and the flora has not been described in detail. Phanerogams are absent from the island and there is a limited range of cryptogams, although there is a rich lichen flora. To date, nine moss and 11 lichen species have been identified within the Area.

Mosses described are Andreaea depressinervis, Brachythecium austro-salebrosum, Bryum argenteum, B. pseudotriquetrum, Ceratodon purpureus, Pohlia cruda, P. nutans, Sanionia georgico-uncinata, S. uncinata, Syntrichia magellanica and Warnstorfia fontinaliopsis. The latter species is at the southern limit of its known range on Avian Island (Smith, 1996). Moss development is confined to those parts of the island that are unoccupied by breeding Adélie penguins or Antarctic shags, and occurs in moist depressions or by melt pools. Patches of moss of up to 100 m² surround the shore of a small pond on the hill in the south of the Area, at ca. 30 m elevation. The green foliose alga Prasiola crispa is widespread in wet areas of the island and a liverwort, Cephaloziella varians, has also been identified.

Lichens identified on Avian Island are Acarospora macrocyclos, Cladonia fimbriata, C. gracilis, Dermatocarpon antarcticum, Lecanora dancoensis, Lecidea brabantica, Physcia caesia, Rinodina egentissima, Siphulina orphnina, Thamnolecania brialmontii, and Usnea antarctica. The most extensive communities are on the rocky outcrops in the south of the island.

The microinvertebrate fauna, fungi and bacteria on Avian Island have yet to be investigated in detail. Thus far only one mesostigmatid mite (Gamasellus racovitzai) (BAS Invertebrate Database, 1999) has been described, although a Collembollan (springtail) and several species of Acari (mites) have been observed but not identified (Poncet, 1990). A number of nematode species (dominated by Plectus sp.) (Spaull, 1973) and one fungus (Thyronectria hyperantarctica) (BAS Invertebrate Database, 1999) have been recorded on the island.

- *Breeding mammals and marine environment*

Weddell seals (Leptonychotes weddellii) were common on and around Avian Island in 1978-79. During the winter more than a dozen remained, hauled out on coastal ice (Poncet, 1990). Several pups were born on the shores of the island in the last week of September 1978. An elephant seal (Mirounga leonina) was reported pupping on the northeastern coast of Avian Island on 10 October 1969 (Bramwell, 1969). Aerial photography taken on 15 December 1998 revealed 182 elephant seals hauled out in groups, mostly close to the ponds. Leopard seals (Hydrurga leptonyx) have been observed around the shoreline, and one was observed ashore in winter 1978. A number of non-breeding Antarctic fur seals (Arctocephalus gazella) were reported on the island in March 1997 (Gray and Fox, 1997), at the end of January 1999 (Fox, pers. comm., 1999) and January 2011. At least several hundred were present on 23 February 2001 (Harris, 2001), particularly on beaches and low-lying ground in the central and northern parts of the island. Crabeater seals (Lobodon carcinophagus) are regularly seen in Marguerite Bay, but have not been reported on Avian Island. The marine environment surrounding Avian Island has not been investigated.

- *Human activities / impacts*

Human activity at Avian Island has been sporadic. The first record of a visit was made in October 1948, when members of the UK Stonington Island expedition discovered the large Adélie penguin colony on Avian Island (then referred to as one of the Henkes Islands). Subsequent visits have comprised a mixture of science, base personnel recreation, tourism and logistic activity (survey, etc.). Refuges were constructed on the island in 1957 and 1962 by Argentina and Chile, respectively (see section 6(iii)).

A geological field party of two camped for about 10 days on the southeast of the island in November 1968 (Elliott, 1969). In the same year, a UK Naval hydrographic survey team camped on the eastern coast of Avian Island over the summer. Permanent chains and rings for mooring lines to the survey vessel were installed in a small bay on the northwestern coast, and were still present in 1989 (Poncet, 1990).

In 1969, a field party camped on the island for a month conducting research on the common cold virus: accompanying dogs were inoculated with a virus and then returned to base (Bramwell, 1969). Dogs often accompanied personnel on the regular visits to Avian Island during the period of operation of the UK base on Adelaide Island, but impacts are unknown.

A two-person party spent a year on the island in 1978-79, based on the yacht Damien II, making detailed observations of the avifauna and other aspects of the biology and natural environment of the island (Poncet and Poncet, 1979; Poncet, 1982; Poncet, 1990). The yacht was moored in a small cove on the northwest coast. This yacht party regularly visited the island over the next decade before SPA designation.

Map survey work and aerial photography was conducted on and over the island in 1996-98 (Fox and Gray, 1997, Gray and Fox, 1997), and 1998-99 (Fox, pers. comm., 1999).

The impacts of these activities have not been described and are not known, but are believed to have been relatively minor and limited to transient disturbance to breeding birds, campsites, footprints, occasional litter, human wastes, scientific sampling and markers. Despite the likely transient nature of most disturbance, it has been reported that human visits have caused loss of eggs and chicks, either through nest abandonment or by opportunistic predation. Several species, such as southern giant petrels and kelp gulls are particularly vulnerable to disturbance, and have been observed to abandon nests at particular periods of the nesting cycle, perhaps at the sight of people as much as 100 m distant (Poncet, 1990). Approximately 140 people, including a tour vessel of 100, were reported to have visited Avian Island in the 1989-90 summer. Growing concern over the number and unregulated nature of visits prompted SPA designation.

The most lasting and visually obvious impacts are associated with the two refuges and two beacon structures described in section 6(iii), which are situated close to breeding birds. Both refuges were in poor repair in February 2001 and, during an environmental management visits in January 2011 and January 2016, further deterioration was noted in both refuges. Birds and seals were observed among rubbish around the refuges in February 2001, January 2011 and January 2016. The refuge erected on the eastern coast (67°46'26"S, 68°53'01"W) in 1957 was open to the weather; the door, having come off its hinges, lay on the floor and the base of the southern wall of the refuge contained a large hole (c. 0.25 m^2). Rusting tins and broken glass were found on the floor. Rusting metal work, (including corrugated cladding, stakes and guy lines), decomposing timber fragments and broken glass were found in the immediate area around the refuge. To the south of the hut lay an empty corroding 205 L fuel drum.

In January 2011, the larger refuge erected on the northwestern coast (67°46'08"S, 68°53'29"W) in 1962 was also in a poor state of repair. The refuge showed significant deterioration due to damp, with warping of timbers and extensive areas of mould and algae on the walls and ceiling material. A large portion of the ceiling had collapsed revealing the roof above. In January 2016 it was observed that attempts had been made to secure the refuge from further degradation (e.g. the windows and door have been boarded).

The older of the two beacon structures is disused and its iron structure, while standing, is rusting and deteriorating. The new beacon, erected in February 1998, appeared to be in good repair in January 2011.

6(ii) Access to the Area

- Small boat landings should be made at the designated locations on the central north western coast (67°46'08.1"S, 68°53'30.1"W) or on the central eastern coast of the island (67°46'25.5"S, 68°52'57.0"W) (Map 2). If sea or ice conditions render this impractical, small boat landings may be made elsewhere along the coast as conditions allow.
- Access by vehicle to the coast when sea ice is present should also use these access points, and vehicles shall be parked at the shore.
- Travel by small boat or vehicle within the marine part of the Area is not confined to specific routes, but shall be by the shortest route consistent with the objectives and requirements of the permitted activities.
- Vehicle or boat crew, or other people on vehicles or boats, are prohibited

from moving on foot beyond the immediate vicinity of the landing site unless specifically authorised by Permit.

- Aircraft should avoid landing within the Area throughout the year.
- A Permit may be granted for helicopter use when this is considered necessary for essential purposes and where there is no practical alternative, such as for the installation, maintenance or removal of structures. In such instances the need for helicopter access, including alternatives, and the potential disturbance to breeding birds shall be adequately assessed before a Permit may be granted. Such a Permit shall clearly define the conditions for helicopter access based on the findings of the assessment.

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

Two small abandoned refuges and two beacon structures are present within the Area. A refuge erected by Chile in 1962 is located on the northwestern coast of the island at 67°46'08"S, 68°53'29"W. A refuge constructed by Argentina in 1957 is 650 m SE of this position, on the eastern coast at 67°46'26"S, 68°53'01"W. Both refuges were in a poor state of repair in January 2016. Attempts have been made to secure the Chilean refuge from further degradation. Taking into account the construction date of the Argentine refuge, which was prior to the signing of the Antarctic Treaty, Argentina will review the potential historical value of its remains. Action will then be taken to ensure appropriate protection of any historical values and ensure the refuge does not cause damage to the environment.

An old iron frame structure, believed to have been erected by the UK during the operation of Adelaide Base and used as a navigational aid, is located at approximately 38 m near the highest point of the island (67°46'35.5" S, 68°53'25.2" W). The structure remains standing, although is rusting.

A new beacon was constructed by Chile in February 1998 on an adjacent site at a similar elevation (67°46'35.3" S, 68°53'26.0" W). This structure is a solid cylindrical painted iron tower of approximately 2 m diameter and 2.5 m in height, set in a concrete pad of approximately 2.5 x 2.5 m. A lit beacon, protective rails and solar panels are fixed to the top of the structure. No other structures are known to exist on the island.

Four survey control markers were installed on the island on 31 January 1999 (Map 2). The southernmost marker is located adjacent to the navigation beacon and consists of a survey nail in bedrock covered by a cairn. A similar marker is installed on the high point of the low ridge on the northeastern coast of the island, also covered by a cairn. The remaining two markers are survey nails affixed to the roof of each of the refuges.

The nearest scientific research station is 1.2 km northwest at Teniente Luis Carvajal (Chile), on southern Adelaide Island (latitude 67°46'S, longitude 68°55'W). Since 1982 this has been operated as a summer-only facility, open from October until March. Over this period the station has generally accommodated up to 10 personnel. Formerly, this facility was established and operated continuously by the UK from 1961 until 1977.

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

Other protected areas in the vicinity include:

- ASPA 107, Emperor Island, Dion Islands, Marguerite Bay, Antarctic Peninsula, 67°52'S, 68°42'W, 12.5 km south-southeast;
- ASPA 129, Rothera Point, Adelaide Island, 67°34'S, 68°08'W, 40 km to the northeast; and
- ASPA 115, Lagotellerie Island, Marguerite Bay, Graham Land, 67°53'20"S, 67°25'30"W, 65 km east (Map 1).

6(v) Special zones within the Area

None.

7. Permit conditions

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 for compelling scientific reasons which cannot be served elsewhere, or for reasons essential to the management of the Area;
- the actions permitted are in accordance with this Management Plan;
- any management activities are in support of the objectives of this Management Plan;
- the actions permitted will not jeopardise the natural ecological system in the Area;
- the activities permitted will give due consideration via the environmental impact assessment process to the continued protection of the environmental or scientific values of the Area;
- the Permit shall be issued for a finite period; and
- the Permit, or an authorised copy, shall be carried when in the Area.

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

- Land vehicles (skidoos, quad bikes, etc.) are prohibited on land within the Area.
- All movement on land within the Area shall be on foot. Pedestrian traffic should be kept to the minimum necessary to undertake permitted activities and every reasonable effort should be made to minimise trampling effects.

- Movement within the Area on foot shall be by routes that minimise any disturbance to breeding birds, and to achieve this it may be necessary to take a longer route to the destination than would otherwise be the case.
- Walking routes have been designated with the intention of avoiding the most sensitive bird breeding sites, and should be used when it is essential to traverse across the island (Map 2). Visitors should bear in mind that specific nest sites may vary from year to year, and some variations on the recommended route may be preferable. Routes are provided as a guide, and visitors are expected to exercise good judgement to minimise the effects of their presence. In other areas, and where practical and safe, it is usually preferable to adopt a route that follows the coastline of the Area. Three routes are designated (Map 2): Route 1 crosses the central part of the island, linking the Chilean and Argentine refuges. Route 2 facilitates access to the beacons on the south of the island, and extends from the central eastern coast up the eastern slopes of the hill. However, during a management visit in 2011, this route was found to be colonized by birds. Consequently, Route 3 has also been designated, which runs directly east from the Argentine refuge to a narrow inlet on the western side of the island, and then proceeds southwest up a gully/slope to a flat area above the abandoned (as of January 2011) Antarctic shag colonies. From this point the route proceeds east to the beacons. Care should be taken to avoid trampling moss patches in the vicinity of a melt water pool c. 70 m north of the beacons.
- Access into areas where southern giant petrels are nesting (Map 3) shall only be undertaken for purposes specified in the Permit. When access to the beacon is necessary (e.g. for maintenance), visitors shall follow the most appropriate designated access route as closely as possible, trying to avoid nesting birds. Much of the area leading up to and surrounding the beacon is occupied by breeding petrels, so great care must be exercised.
- Movements should be slow, noise kept to a minimum, and the maximum distance practicable should be maintained from nesting birds.
- Visitors shall watch carefully for signs of agitation and preferably retreat from approach if significant disturbance is observed.
- The operation of aircraft over the Areas should be carried out, as a minimum requirement, in compliance with the 'Guidelines for the operations of aircraft near concentrations of birds' contained in Resolution 2 (2004).
- Overflight of bird colonies within the Area by Remotely Piloted Aircraft Systems (RPAS) shall not be permitted unless for scientific or operational purposes, and in accordance with a permit issued by an appropriate national authority.

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

Activities which may be conducted in the Area include:

- essential management activities, including monitoring;
- compelling scientific research that cannot be undertaken elsewhere and

which will not jeopardize the ecosystem of the Area; and

- sampling, which should be the minimum required for approved research programmes.

Restrictions on times at which activities may be conducted apply within the Area, and are specified in the relevant sections of this Management Plan.

7(iv) Installation, modification or removal of structures

- Any new or additional permanent structures or installations are prohibited.
- Existing abandoned or dilapidated structures should be removed or renovated.
- Installation, modification, maintenance or removal of structures shall be undertaken in a manner that minimises disturbance to breeding birds. Such activities shall be undertaken between 1 February and 30 September inclusive to avoid the main breeding season.
- No 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.
- All markers, structures or scientific equipment installed in the Area must be 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, spores) and non-sterile soil (see section 7(vi)), and be made of materials that can withstand the environmental condition and pose minimal risk of contamination of the Area.
- Removal of specific structures or equipment for which the permit has expired shall be the responsibility of the authority which granted the original permit and shall be a condition of the Permit.

7(v) Location of field camps

Camping should be avoided within the Area. However, when necessary for purposes specified in the Permit, temporary camping is allowed at two designated campsites: one on the central eastern coast of the island (67°46'25.8"S, 68°53'00.8"W), the other on the central northwestern coast of the Area (67°46'08.2"S, 68°53'29.5"W) (Map 2).

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

No living animals, plant material or microorganisms shall be deliberately introduced into the Area. To ensure that the floristic and ecological values of the Area are maintained, 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 sterilized. 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. Further guidance can be found in the CEP non-native species manual (CEP, 2017) and the Environmental code of conduct for terrestrial scientific field research in Antarctica (SCAR, 2009). In view of the presence of breeding bird colonies within the Area, no poultry products, including wastes from such products and products containing uncooked dried eggs, shall be released into the Area, including the marine component of the Area.

No herbicides or pesticides shall be brought into the Area. Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the Permit, shall be removed from the Area at or before the conclusion of the activity for which the Permit was granted. 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 and fauna is prohibited, except in accordance with a 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 (2011). Any soil or vegetation sampling is to be kept to an absolute minimum required for scientific or management purposes, and carried out using techniques which minimise disturbance to surrounding soil and biota.

7(viii) The 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, and 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 national authority must be notified and approval obtained. Permits shall not be granted if there is a reasonable concern that the sampling proposed would take, remove or damage such quantities of soil, native flora or fauna that their distribution or abundance on Avian Island would be significantly affected. Samples of flora or fauna found dead within the Area may be removed for analysis or audit without prior authorisation by Permit.

7(ix) Disposal of waste

All wastes, except human wastes, shall be removed from the Area. Preferably, all human wastes should be removed from the Area, but if this is not possible, they may be disposed of into the sea.

7(x) Measures that may be necessary to continue to met the aims of the Management Plan

- Permits may be granted to enter the Area to carry out scientific research, monitoring and site inspection activities, which may involve the collection of a small number of samples for analysis or to carry out protective measures.
- Any long-term monitoring sites shall be appropriately marked and the markers or signs maintained.
- Scientific activities shall be performed in accordance with the Environmental code of conduct for terrestrial scientific field research in Antarctica (SCAR, 2009).

7(xi) Requirements for reports

The principal Permit holder for each visit to the Area shall submit a report to the appropriate national authority as soon as practicable, and no later than six months after the visit has been completed. Such reports should include, as appropriate, the information identified in the Antarctic Specially Protected Area visit report form contained in the Guide to the preparation of Management Plans for Antarctic Specially Protected Areas (Appendix 2). The appropriate authority should be notified of any activities/measures undertaken that were not included in the authorised Permit. Wherever possible, 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, 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.

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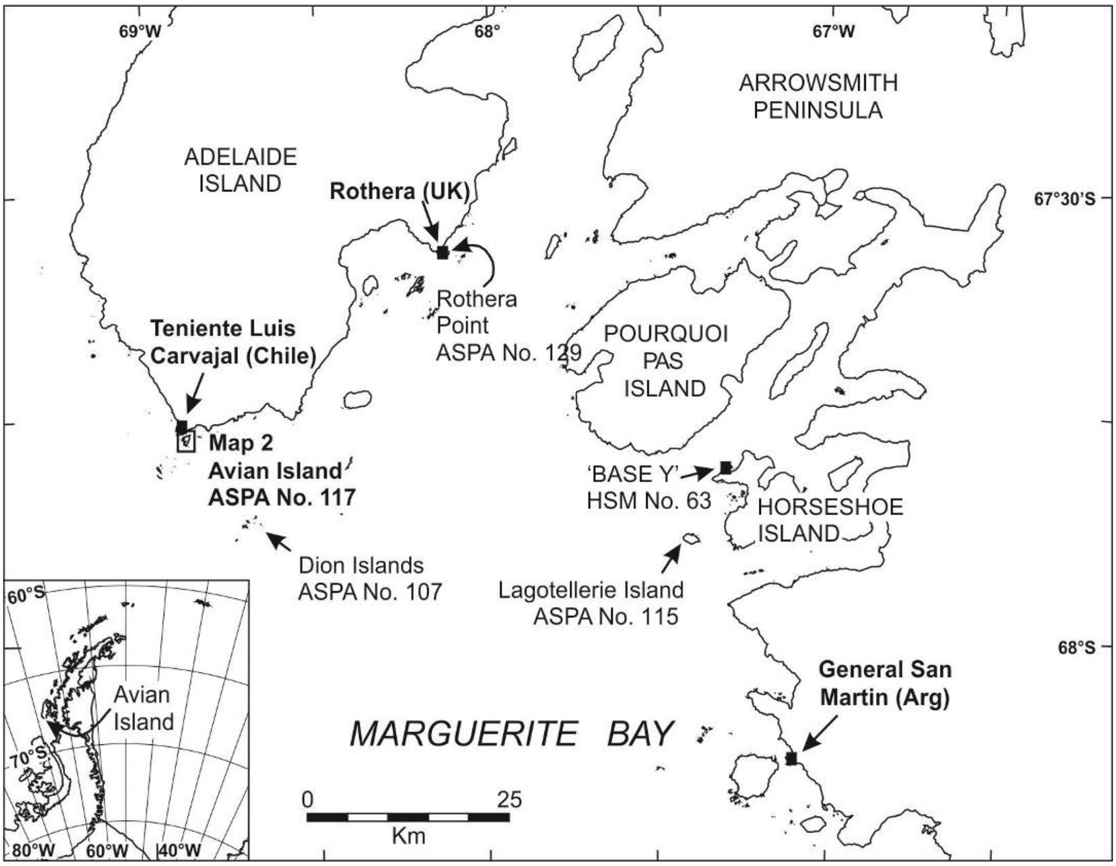
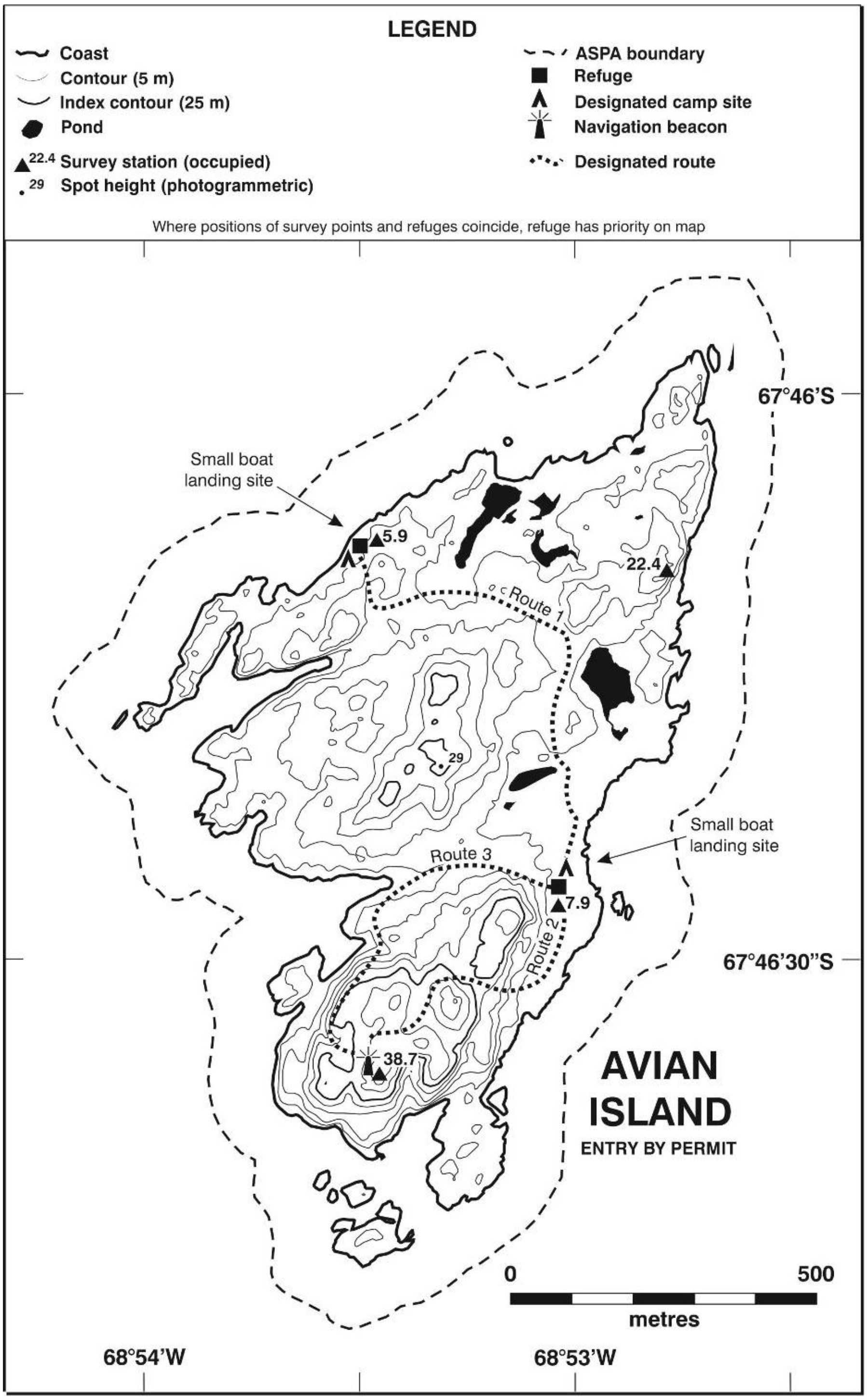
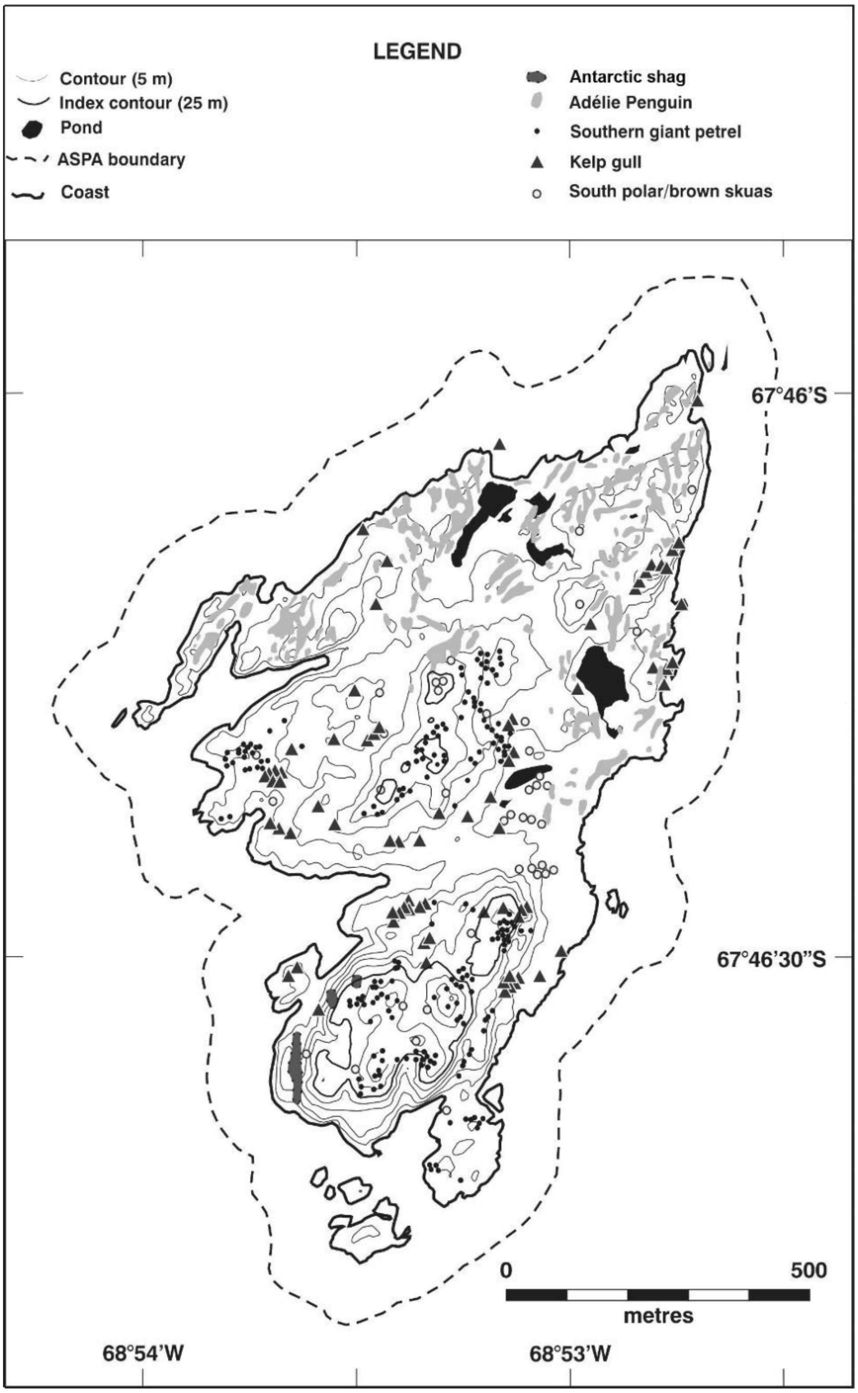
Map 1. Avian Island, ASPA No. 117, in relation to Marguerite Bay, showing the locations of the stations Teniente Luis Carvajal (Chile), Rothera (UK) and General San Martín (Argentina). The location of other protected areas within Marguerite Bay (ASPA No. 107 at Emperor Island (Dion Islands), ASPA No. 115 at Lagotellerie Island, and ASPA No. 129 at Rothera Point) are also shown. Inset: the location of Avian Island on the Antarctic Peninsula.



Map 2. Avian Island, ASPA No. 117, topographic map. Map specifications – projection: Lambert conformal conic; standard parallels: 1st 67° 30' 00"S; 2nd 68° 00' 00"S; central meridian: 68° 55' 00"W; latitude of origin: 68° 00' 00"S; spheroid: WGS84; datum: mean sea level; vertical contour interval 5 m; horizontal accuracy: ±5 m; vertical accuracy ±1.5 m.



Map 3. Avian Island, ASPA No. 117, breeding wildlife sketch map. Positions of nests and colonies are accurate to ±25 m. Information was derived from Poncet (1982). Map specifications – projection: Lambert conformal conic; standard parallels: 1st 67° 30' 00"S; 2nd 68° 00' 00"S; central meridian: 68° 55' 00"W; latitude of origin: 68° 00' 00"S; spheroid: WGS84; datum: mean sea level; vertical contour interval 5 m; horizontal accuracy: ±5 m; vertical accuracy ±1.5 m.



Measure 3 (2018)

Antarctic Specially Protected Area No 132 (Potter Peninsula, King George Island [Isla 25 de Mayo], 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 XIII-8 (1985), which designated Potter Peninsula, King George Island (Isla 25 de Mayo), South Shetland Islands as Site of Special Scientific Interest ("SSSI") No 13 and annexed a Management Plan for the site;
- Measure 3 (1997), which annexed a revised Management Plan for SSSI 13;
- Decision 1 (2002), which renamed and renumbered SSSI 13 as ASPA 132;
- Measures 2 (2005) and 4 (2013), which adopted revised Management Plans for ASPA 132;

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

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 132;

Desiring to replace the existing Management Plan for ASPA 132 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 132 (Potter Peninsula, King George Island (Isla 25 de Mayo), South Shetland Islands), which is annexed to this Measure, be approved; and
2. the Management Plan for the Antarctic Specially Protected Area No 132 annexed to Measure 4 (2013) be revoked.

Management Plan for Antarctic Specially Protected Area (ASPA) No. 132

POTTER PENINSULA

Introduction

This area was originally designated as a Site of Special Scientific Interest No. 1 (Recommendation XIII-8 ATCM XIII, Brussels, 1985) following a proposal by Argentina, due to its diverse and extensive vegetation and wildlife, which are a representative sample of the Antarctic ecosystem.

In 1997, the management plan was adapted to the requirements of Annex V of the Protocol on Environmental Protection to the Antarctic Treaty and approved by Measure 3 (1997) This is the revised version of the Management Plan approved in conformity with Measure 2 (2005) and is the second revision since Annex V became effective.

The original objectives for the designation of this area remain valid. The Potter Peninsula is designated as an Antarctic Specially Protected Area to protect its outstanding environmental value and to facilitate on-going and future research. Anthropogenic disturbances may pose a risk to long term studies being conducted in the area, especially during breeding season, or alter baseline levels in biotic and/or abiotic matrices of critical chemical pollutants (for example, trace elements and persistent organic compounds)

The main reason for the designation of the Potter Peninsula as an ASPA is that it is a representative sample of sets of species in the Antarctic ecosystem. The coastal areas are host to important bird colonies, sea mammal breeding areas and diverse plant species. These coasts are currently among the most susceptible to climate change and its indirect effects, such as glacial thawing (Hernando et al. 2015), which has been proven to affect biodiversity (Sahade et al. 2015). It is thus of great scientific value, as many studies can be carried out in the area on the impact of climate change on biotic and abiotic factors, as well as its consequences in the food chain (i.e. Carlini et al. 2009, Carlini et al. 2010, Casaux et al. 2006 Daneri and Carlini 1999, Rombolá et al. 2010, Torres et al. 2012, Quillfeldt et al. 2017, Juáres et al., 2018). It is vital to maintain these scientific activities, such as the monitoring program that has been carried out since 1982, including the CCAMLR Ecosystem Monitoring Program (CEMP), which began in 1995, since it produces invaluable scientific data for this purpose. In addition, knowledge on the dynamics of plankton (Bers et al., Schloss et al. 2014) and krill (Di Fonzo et al. 2014, 2017a, 2017b, Fuentes et al. 2016), which are the food base for the larger organisms in the food web, are highly important.

There are several characteristics that make this area especially susceptible to human interference, such as the configuration of the area, i.e. a relatively narrow coastal area, enclosed between the sea and a cliff, where there is no area of movement that does not interfere with the breeding colonies. High activity levels, scientific stations and easy access to the area by sea and land, even by small boats, are a potential threat to the biological values and research activities.

According to recent studies, the environmental situation in the South Shetland Islands shows that the Bransfield Strait, of the South Atlantic Ocean near the Potter Peninsula has been seriously altered, first due to the almost complete extraction of the abundant fur seal colonies (Arctocephalus spp.) that feed on fish and krill, followed by the Baleen whale. More recently, the fur seals have begun to recover to a significant extent and the whales are also starting to do so (Ainley et al. 2010), but climate change is progressively altering the ecological processes through physical changes in temperature, water circulation and sea ice extension, among others. As a result of the reduction of prey, not only due to climate change and the recovery of competing species, but also due to other currently unknown factors, the penguin populations are decreasing (Ducklow et al. 2007, Ainley and Blight 2009, Ainley et al. 2010, Trivelpiece et al. 2011, Juáres et al. 2015). In this aspect, ASPA No. 132 has currently acquired special relevance, as the study on pygoscelis penguins in the area offers answers regarding the environmental changes observed in the Antarctic Peninsula, in particular, especially the lower frequency of cold years associated with the reduction of sea ice extensions and its effects on the abundance of krill. (Garcia et al. 2015). It also contributes to detecting and recording significant changes in the marine ecosystem and aims to differentiate between the changes caused by the commercial collection of species and those caused by environmental variables, both physical and biological.

The Potter Peninsula provides exceptional opportunities for other scientific studies of land and marine biological communities.

The research and monitoring programs currently being carried out in ASPA No. 132 including the following:

- Coastal biomonitoring: effect of global climate change and xenobiotics on the key species of the Antarctic food web.
- The persistent organic pollutants and traces of elements in the biotic and abiotic matrices of the Antarctic environment.
- Energy Acquisition, type of prey and possible reaction of Pinnipeds to climate anomalies and to the extension of sea ice in the Antarctic Peninsula and in the Scotia Arc.
- Reaction of the Antarctic bird population to the interannual variability of prey in areas with clear global warming effects.
- Phylogeography of the Deschampsia Antarctica, based on molecular, morphological and karyological studies
- Distribution and nutritional status of the Brown skua and the South polar skua.
- CCAMLR Ecosystem Monitoring Programme - CEMP site since 1995.

1. Description of the values to be protected

The coastal areas are host to important bird colonies, sea mammal breeding colonies and abundant vegetation (great extensions of moss and lichen, patches of Antarctic grass and tillandsia (Deschampsia antarctica and Colobanthus quitensis) in the coastal areas). Scientific research programmes on the reproductive ecology of birds' species and sea mammals have been conducted since 1982, such as on elephant seals (Mirounga leonina), the Adélie penguin (Pygoscelis adeliae) and the Gentoo penguin (Pygoscelis papua), including the CCAMLR Ecosystem Monitoring Programme, among others. The breeding colonies are located in a specific coastal location. The area is composed mainly of high beaches, covered mostly by medium sized rocks, basaltic structures and lateral and terminal moraines. The coast is highly irregular and has a series of small bays formed between the rocky promontories, where several species of Antarctic pinnipeds are usually found. They usually arrive to this area to breed or moult their fur. Due to the above-mentioned reasons, the area is of exceptional scientific and aesthetic value.

Although it is true that Antarctica is considered one of the few unpolluted areas on our planet, as it is relatively isolated from large industrial and urban centres, there are studies that show the existence of pollution halos near the scientific stations. This has also been reported for the nearby Carlini station (Curtosi et al. 2010, Vodopivez et al. 2015). This makes it necessary to increase precautions in ASPA 132.

According to Morgan et al. (2007) ASPA 132 represents the Environmental Domain of the "Islands near the coast of the Antarctic Peninsula". Furthermore, according to Terauds et al. (2012) the area represents the "Northeast of the Antarctic Peninsula" of the "Antarctic Conservation Biogeographic Regions" According to the "Important Bird Areas in Antarctica 2015" (Harris et al., 2015), Potter Peninsula is area 047.

For more detailed characteristics, please refer to section 6.

2. Aims and Objectives

- preserve the natural ecosystem and avoid unnecessary human disturbances;
- allow the conduct of any scientific research, provided that it does not pose a risk to the area's values;
- avoid significant changes in the structure and composition of the flora and fauna communities;
- preserve the area's flora as reference organisms, free from anthropogenic impact.
- prevent or minimise the introduction to the Area of non-native plants, animals and microbes;
- reduce to a minimum the possibility of the introduction of pathogens that may cause diseases in fauna populations within the area;
- avoid the introduction, production or dissemination of chemical pollutants that may affect the area.

3. Management activities

- The staff assigned to the Carlini Base (previously Jubany Base, the Argentinian base together with the ASPA), and in particular the personnel authorized to enter the ASPA, will be specifically trained in the terms of the Management Plan;
- Copies of this Management Plan must be available at the Carlini Base.
- Maximum distances from the fauna must be respected, except when otherwise required by scientific projects and provided that the relevant permits have been issued.
- Sample collection will be kept to the minimum required for the implementation of the approved research plans.
- All markers and structures established within the ASPA for scientific or management purposes must be well attached and kept in good conditions.
- In accordance with the requirements of Annex III of the Protocol on Environmental Protection to the Antarctic Treaty, abandoned equipment or materials will be removed to the greatest extent possible, provided that doing so does not adversely impact the environment and the values of the area.
- The Management Plan will be reviewed at least every five years and updated when required.
- All pilots operating within the region will be informed of the location, boundaries and restrictions that apply to entry and overflight in the area.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

Map 1, included at the end of this Management Plan, shows the location of ASPA 132 (in diagonal lines) in relation to Potter Peninsula, King George Island.

6. Description of the Area

6 (i) Geographic coordinates, boundaries and natural characteristics.

- *Geographic coordinates and boundaries*

This area is located on the coast of Maxwell Bay, southeast of King George Island, between the southernmost part of Mirounga Point (northeast of the Potter Peninsula) and the outcrop known as “Peñón 7” (Rock 7) on the northeast border with Stranger Point. The area extends along the coastal strip towards the low sea water levels and up to the edge of a cliff that reaches heights from 15 to 50 meters. The front part of the edge of the cliff is included within the ASPA. This coastal strip has variable width, extending to up to 500 metres from the coast at low tide water levels. The area is composed mainly of high beaches, covered mostly by medium sized pebbles, basaltic structure and lateral and terminal moraines. The coast is very irregular and has a series of small bays that have formed between the rocky capes.

This topography is a natural border for the settling of breeding colonies of sea mammals and penguins, which justify the extension of the ASPA.

6 (ii) Natural characteristics

The area contains significant scientific values due to the presence of breeding colonies of elephant seals (Mirounga leonina), non-breeding groups of Antarctic fur seals (Arctocephalus gazella) and, occasionally, Weddell Seals (Leptonychotes weddelli), crabeater Seals (Lobodon carcinophagus) and leopard seals (Hydrurga leptonyx). During breeding season, about 400 female southern elephant seals arrive to this area with their respective offspring and approximately 60 adult males of this species (Carlini et al. 2006, Negrete 2011), while during moulting season, 200 to 800 specimens of southern elephant seals arrive to the ASPA 132 coast. The non-breeding groups of Antarctic fur seals usually include about 300 specimens, although this number may change drastically from one year to the next and sometimes exceeds 1000 (Durante et al 2007)

There are also important colonies of Gentoo penguins (P. Papua) and Adélie penguins (P. Adeliae), of which there are about 3800 and 3000 pairs respectively. The petrel population (mostly Oceanites oceanicus and to a much lesser extent, Fregetta tropica) is approximately 200 pairs. The area is also a reproduction site for kelp gulls (Larus dominicanus), greater sheathbills (Chionis alba), Antarctic terns (Sterna vittata), Southern giant petrels (Macronectes giganteus) and skuas (Catharacta sp.). As the location of some of the nesting sites around the Potter Peninsula change with time, the population data are considered estimates.

Gentoo and Adélie penguins are distributed around Stranger Point, between the Elefante shelter and Rock 7. Mammal concentrations are distributed along the coastal strip, between Rock 1 and Rock 7, and giant petrel nests are usually distributed around the Three Brothers Hill (outside of the ASPA) and between Rock 7 and Rock 4 (see map 1). There is an abundant development of plant communities in the Area, mostly composed of lichens and moss, on the rocky hillsides and on the flat surfaces of fossil beaches, respectively.

- *Natural flora characteristics*

The spatial pattern of vegetation is the combination of related variables: the type of substrate, exposure, slope stability and drainage (water availability). The Potter Peninsula is composed of various square kilometres, free of snow and fast ice cover. A relatively stable substrate is found around Three Brothers Hill. The moraines near the glacier have a sparse plant cover, while the plant cover and the richness of species increase with distance from the moraines. A plateau located southwest of the Three Brothers Hill is covered with rich and exceptional vegetation. It consists of two layers of plants that provide up to 100% cover. Several moss and lichen species that are found in the Potter Peninsula are exclusively located in this area. The two species of native vascular Antarctic plants Colobanthus quitensis and Deschampsia antarctica are found in this area (Dopchiz et al. 2017A, 2017b) near the coast or in places with high nutrient supply.

Pleurocarpous mosses, such as the Sanionia uncinata and the Calliergon sarmentosum, are predominant, while the rocks are commonly covered with Lecidea sciatrapha encrusting lichens. Higher up the mountainside, where the soil has greater drainage and the snow cover time is shorter, mosses that form cushions, such as Andreaea regularis and Andreaea gainii are predominant and often found with Himantormia lugubris. Associations of bryophile lichens, such as the Psoroma hypnorum, and some acrocarpous mosses area also frequently found. When the snow cover is thicker than 10 cm, which rarely occurs, even in winter, a two-layer foliage of lichen and moss is formed.

The top layer is uneven and is made up of fruticose lichen, such as the Usnea aurantiaco-atra, U. antarctica and Pseudephebe pubescens. The bottom layer is composed of a set of several moss and epilithic species. Tapestries of U. aurantiaco-atra and Himantormia lugubris are often intertwined. (Bubach et al., 2016, Rivera et al. 2018). In the openings, there are dicranum mosses such as Chorisodontium aciphyllum and fruticose lichen that form mattresses, such as Sphaerophorus globosus. The most abundant bryophile lichen is the Ochrolechia frigida. (Wiencke et al. 1998)

6 (iii) Access to the Area

Except in the event of authorized exceptions, access to the area will be on foot, from the northern point, near the heliport of the Carlini base (62° 14' 17" S; 58º 40' 42" W), or from behind the northern side of Three Brothers Hill (see map 1). Access to the area by sea to the beaches must be avoided when there is fauna present, especially between October and December, since this is the period of greatest activity in relation to bird egg-laying and elephant seal lactation.

Additional information is found in section 7 (ii).

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

- *Structures within the Area*

Shelters: The Argentinian Elefante Shelter is located about 150 metres from the coast, 1,000 meters northwest of Stranger Point. From March to October it is used by research teams that conduct activities within the ASPA. The shelter has a capacity for a maximum of 6 people (refer to section 7 (ix) on Waste Disposal).

Signage: the warning signs for entrance to the protected area are located at: Mirounga Point (near the landing strip), at the north base of Three Brothers Hill and on the beach area near Rock 1. The signs contain information on the existence of the ASPA and the mandatory Access Permit.

- *Structures adjacent to the area*

Carlini is a permanent Argentinian station located at 62° 14' Lat. S and 58º 39' Long. W, on the Potter Cove, Potter Peninsula, in the SW part of King George Island. It is equipped with several facilities, such as the Dallmann Argentinian-German laboratory, which is a business initiative between the Alfred Wegener Institute (AWI) and the Argentine Antarctic Institute (IAA).

The Albatros is an Argentinian shelter located at 62° 15' 09" Lat. S and 58° 39' 23" Long. W / -62.2525, -58.65639 at Potter Cove, Potter Peninsula.

Other nearby stations are Korea's King Sejong (62º 13' 394" S / 58° 47' 190" W) and Poland's Arctowski, (62° 9' 586" S / 58º 28' 399" W)

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

- ASPA No. 125, Fildes Peninsula, King George Island (isla 25 de Mayo), and the South Shetland Islands is located about 20 km to the east.
- ASPA No. 128, Western shore of Admiralty Bay, King George Island, is located about 10 km to the northeast.
- ASPA No. 171 Narębski Point Barton Peninsula, King George Island, southeast of the coast of the Barton Peninsula.
- ASPA No. 133 Harmony Point, Nelson Island, South Shetland Islands is about 30 kilometres to the west-southwest.

6 (v) Special Zones within the Area

There are no special zones within the Area.

7. Permit Conditions

7(i) General permit conditions

Access to the Area is prohibited except in conformity with a Permit issued by the national competent authority.

Conditions for issuing a permit to enter the Area:

- The activity serves a scientific purpose, an ASPA management plan purpose or a dissemination purpose in accordance with Management Plan objectives, which cannot be fulfilled in any other place and all the management activities (inspection, maintenance or revision) are in accordance with the Management Plan.
- The permit is carried by personnel authorized to access the area.

- Once the activity has been completed, a report is submitted to the national competent authorities mentioned in the Permit after the visit, under the terms established by the national authorities that issued the Permit.

Tourism is prohibited, as well as any recreational activities.

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

Whenever possible, movement within the Area will be on foot, along the existing trails known to personnel that is familiar with the area, as well as regular visitors. This includes the beach and the upper limit of the Area, to the northeast of Three Brothers Hill.

Vehicles of any kind are prohibited within the area, with the exception of those that are essential for maintenance of the shelter, which will only be operated by logistics staff members and in conformity with the access Permit. In this case, access to the ASPA will be through a slight slope next to the Albatros shelter and vehicles must be driven avoiding the areas of vegetation, as well as bird and mammal groups (refer to map 1).

Aircraft operations over the Area will be carried out in compliance with the provisions of Resolution 2 (2004), "Guidelines for the Operation of Aircraft near Concentrations of Birds in Antarctica," as a minimum requirement. As a general rule, no aircraft will fly over the ASPA at an altitude lower than 610 metres (2,000 feet). A horizontal separation of 460 metres (1/4 nautical mile) from the coast must be maintained to the extent possible. Aircraft landing operations in the area are prohibited, except in cases of emergency or air safety.

The use of RPAs is not allowed within the ASPA boundaries, except if it is previously studied, on a case by case basis, during the environmental impact evaluation process. They may only be used when indicated on the entry permit and under the condition thereby established. During the analysis and authorization process, applicable Antarctic Treaty directives will be considered.

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

- Scientific research that cannot be carried out elsewhere and that does not endanger the Area's ecosystem.
- Essential management activities, including visits to evaluate the efficacy of the management plan and management activities.
- Activities for educational or dissemination purposes, which contribute to promoting scientific activities, under the National Antarctic Programmes.
- Maintenance of the Elefante shelter, except between October and December. During this period, maintenance of the shelter must be avoided, or in any case, reduced to the extent possible and tasks must always be performed in conformity with a Permit. This period is considered especially sensitive, as it is the period with the highest activity in relation to egg-laying and elephant seal lactation.

7 (iv) Installation, modification or removal of structures

No structure will be assembled with the Area and no scientific equipment will be installed, except for essential scientific or management reasons and subject to the relevant Permit.

Any scientific equipment installed in the Area, as well as any research marker, must be approved by a Permit and clearly labelled, indicating the country, name of the principal investigator and year of installation. The nature of all of these materials must be such as to pose a minimal risk of pollution in the Area and of interference with the fauna or damage to vegetation.

Structures and facilities must be removed when they are no longer required, or on the expiration date of the permit, whichever occurs first. Research markers must be removed after the Permit has expired. If a specific project cannot be concluded within the time frame established in the Permit, such circumstance must be indicated in the report after the visit, and an extension of the effective term of the Permit will be requested for authorization of the continued presence of any material in the Area.

Tents will be allowed for the sole purpose of storing scientific equipment and instruments or for use as an observation post.

7(v) Location of field camps.

To avoid significant disturbances to the fauna, and considering that there are alternative lodging areas, camping in ASPA 132 is prohibited. Projects authorized to work in the ASPA may request accommodation at the Carlini Base, subject to availability. When required for scientific purposes, the Elefante shelter (located within the area) or the Albatros shelter (outside of the area, but very nearby) may be used. Use of the Elefante shelter for scientific purposes by personnel other than that of the Argentinian Antarctic Programme will be agreed beforehand with such Programme.

The establishment of camp sites near the ASAP is the responsibility of the relevant National Antarctic Programme, but for safety reasons, it is recommended that the head of the Carlini Base be informed.

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

- No living animal or plant material may be deliberately introduced in the ASPA. All reasonable precautions against the unintentional introduction of foreign species in the area will be taken. It should be noted that foreign species are most often and effectively introduced by human beings. Clothing (pockets, boots, Velcro strips on clothing) and personal equipment (bags, backpacks, camera bags, tripods) as well as scientific instruments and work tools may carry insect larvae, seeds, propagules, etc. For more information, please refer to the "Non-native Species Manual - CEP 2016".

- Raw poultry products may not be introduced in the Area.
- No herbicides or pesticides may be introduced in the Area. Any other chemical product introduced with the relevant permit will be removed from the Area once the activity for which the Permit was granted has been completed. The purpose and type of chemical products must be recorded in as much detail as possible, in order to obtain information from other scientists.
- No fuel, food or any other material must be stored in the Area, unless it is necessary for essential purposes related to the activity for which the Permit was issued, provided that it is stored in the Elefante shelter or near it, for its disposal once the activity has been completed. Any fuel used in the Elefante shelter will be handled according to the contingency plan established by the Argentine Antarctic Programme for the Carlini Station.

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

The collection of or harmful interference with native flora and fauna are prohibited, except in conformity with a Permit.

Maximum distances from the fauna must be respected, except when otherwise required by scientific projects and provided that the relevant permits have been issued.

The recommended distance from penguins is 10 metres during breeding and moulting periods and 5 metres for young penguins. It is recommended that a distance of 100 metres be maintained from giant petrels' nests, while for Antarctic fur seals, Weddell seals, leopard seals and Crabeater seals, a minimum distance of 10 metres must be maintained. It is important to note that these distances are established as general guidelines and may vary and increase if the proximity of human beings is clearly stressful to the animals.

When an activity involves collection or harmful interference, it must be carried out in conformity with the SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica, as a minimum requirement, according to its last available version.

Information on collection and harmful interference will be duly exchanged through the Antarctic Treaty Information Exchange system and it will be recorded, at least, in the Antarctic Master Directory, or in Argentina at the National Antarctic Data Centre.

Scientists taking any kind of samples will indicate this in the EIES (Electronic Information Exchange System) and/or will contact the relevant National Antarctic Programmes in order to minimize the risk of possible duplication.

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

Materials will only be collected or removed from the Area in accordance with a Permit. Collection of dead specimens for scientific purposes will be analysed on a case by case basis, to ensure that it does not reach levels that may lead to the deterioration of the nutritional base of local scavengers. This will depend on the species to be collected and, if necessary, specialists must be consulted before the Permit is issued.

7(ix) Disposal of waste

All non-physiological waste will be removed from the Area. Waste water and domestic liquid waste may be discharged into the sea, in conformity with Annex III, Article 5 of the Madrid Protocol.

Waste from research activities carried out in the Area may temporarily be stored next to the Elefante shelter until its removal, under conditions ensuring that it is not spread and cannot be accessed by fauna. This waste will be transferred as often as possible to the Carlini Base or removed by the Antarctic Programme by which it is generated, to be disposed of in conformity with Annex III of the Madrid Protocol.

7(x) Measures that may be necessary to continue meeting the aims of the Management Plan

Area access Permits may be granted for biological monitoring and inspection of the sites, including the collection of plant material and animal samples for scientific purposes, the construction or maintenance of signs, and other management measures.

7(xi) Requirements for reports

The main permit holder of each issued permit will submit a report on the activities conducted in the Area, once the activity has been completed. This report must comply with the previously established form and must be submitted, along with the Permit, to the authority that issued the Permit.

The information provided in the reports will be used for Management Plan revisions and organization of the scientific use of the Area.

ASPA permit records and the reports issued after visits will be exchanged with other Consultative Parties, within the Information Exchange System, as established in article 10.1 of Annex V.

These reports must be stored and available for inspection by all interested Parties, SCAR, CCAMLR and COMNAP, as well as to provide information on the necessary human activities in the Area to guarantee proper management.

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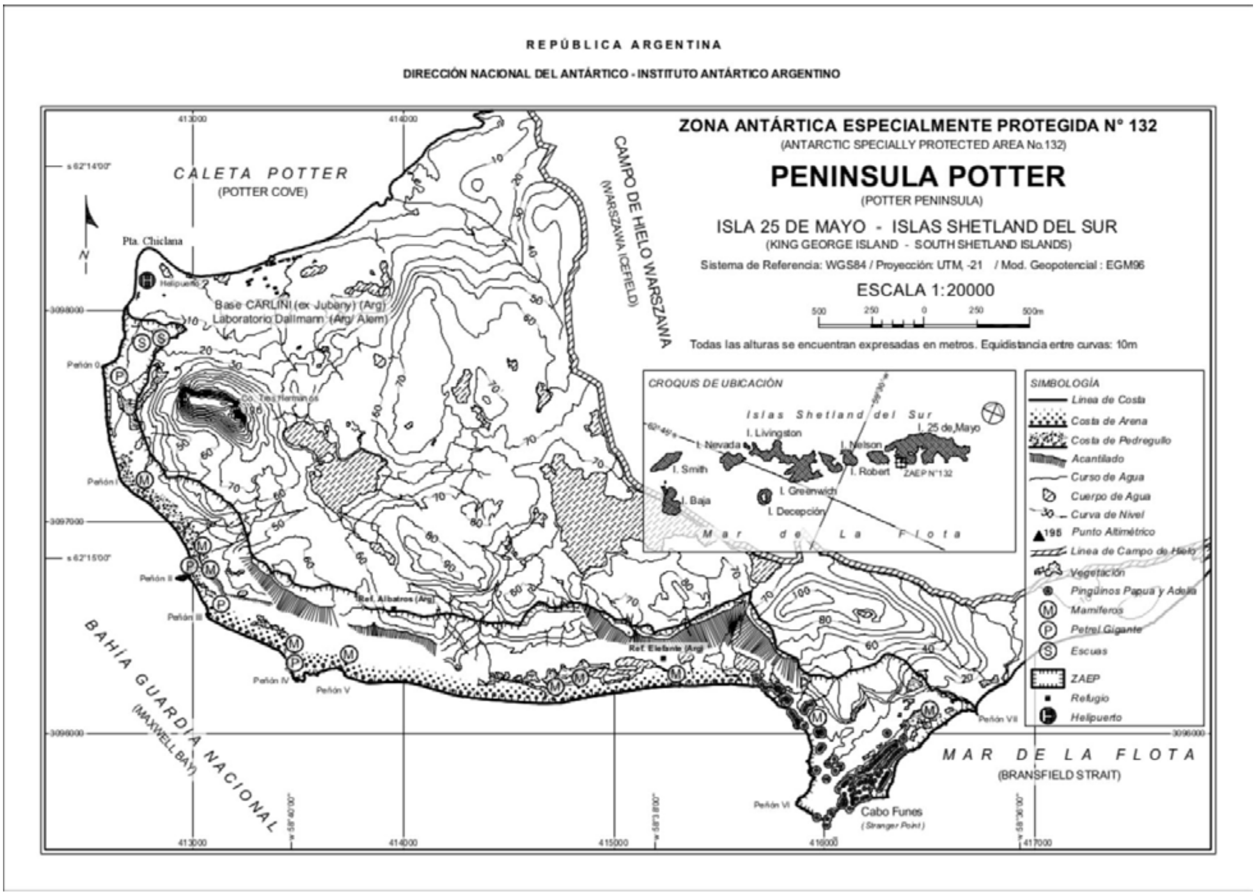
Map 1: Antarctic Specially Protected Area No. 132, Potter Peninsula.



Measure 4 (2018)

Antarctic Specially Protected Area No 147 (Ablation Valley and Ganymede Heights, Alexander 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 XV-6 (1989), which designated Ablation Valley and Ganymede Heights, Alexander Island as Site of Special Scientific Interest ("SSSI") No 29 and annexed a Management Plan for the site;
- Resolution 3 (1996), which extended the expiry date for SSSI 29;
- Measure 2 (2000), which extended the expiry date for the Management Plan for SSSI 29;
- Decision 1 (2002), which renamed and renumbered SSSI 29 as ASPA 147;
- Measures 1 (2002) and 10 (2013), which adopted revised Management Plans for ASPA 147;

Recalling that Recommendation XV-6 (1989) and Resolution 3 (1996) were designated as no longer current by Decision 1 (2011);

Recalling that Measure 2 (2000) did not become effective and was withdrawn by Measure 5 (2009);

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 147;

Desiring to replace the existing Management Plan for ASPA 147 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 147 (Ablation Valley and Ganymede Heights, Alexander Island), which is annexed to this Measure, be approved; and
2. the Management Plan for Antarctic Specially Protected Area No 147 annexed to Measure 10 (2013) be revoked.

Management Plan for Antarctic Specially Protected Area No. 147

ABLATION VALLEY AND GANYMEDE HEIGHTS, ALEXANDER ISLAND

Introduction

The primary reason for the designation of Ablation Valley and Ganymede Heights, Alexander Island (70°48’S, 68°30’W, approximately 180 km²) as an Antarctic Specially Protected Area (ASPA) is to protect scientific values, relating particularly to the geology, geomorphology, glaciology, limnology and ecology of this extensive ablation area.

Ablation Valley and Ganymede Heights, Alexander Island, was designated originally in 1989 as Site of Special Scientific Interest (SSSI) No. 29 Ablation Point – Ganymede Heights, Alexander Island, through Recommendation XV-6, after a proposal by the United Kingdom. Included was a largely ice-free region between latitudes 70°45’S and 70°55’S and from longitude 68°40’W to the George VI Sound coastline. The Area comprised several valley systems separated by ridges and plateau of about 650-760 m high. The original management plan (Recommendation XV-6) described the Area as “one of the largest ablation areas in West Antarctica…[with]…a complex geology, the main rock types being conglomerates, arkosic sandstones and shales with subordinate pebbly mudstones and sedimentary breccias. The base of the succession is formed of a spectacular mélange, including large blocks of lava and agglomerate. This outcrops on the valley floors and at the base of several cliffs. [The Area] possesses a wide range of geomorphological features including raised beaches, moraine systems and patterned ground. There are several permanently frozen freshwater lakes and many ice-free ponds supporting a diverse flora (including aquatic bryophytes) and fauna. The vegetation is generally sparse, with the unique moss and liverwort-dominated community type being restricted to ‘oases’ where water issues from otherwise dry barren hillsides. The terrestrial and freshwater ecosystems are vulnerable to human impact and therefore merit protection from uncontrolled human presence”. In summary, the principal values of the Area were considered to be the geological, geomorphological, glaciological, limnological, and ecological features, and the associated outstanding scientific interest of one of the largest ice-free ablation area in West Antarctica. The Area was renumbered as ASPA No. 147 through Decision 1 (2002) and a revised Management Plan was adopted through Measure 1 (2002).

ASPA No. 147 Ablation Valley and Ganymede Heights, Alexander Island, fits into the wider context of the Antarctic Protected Area system by protecting one of the largest ablation areas in West Antarctica. Equivalent environmental and scientific values are not protected in other ASPAs within the Antarctic Peninsula area. 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 (see also Morgan et al., 2007). Using this model, small parts of ASPA 147 are contained within Environment Domain E Antarctic Peninsula and Alexander Island main ice fields); however, although not stated specifically in Morgan et al., the Area may also include Domain C (Antarctic Peninsula southern geologic). Other protected areas containing Domain E include ASPA Nos. 113, 114, 117, 126, 128, 129, 133, 134, 139, 149, 152, 170 and ASMA Nos. 1 and 4. Other protected areas containing Domain C include ASPA 170 (although not stated specifically in Morgan et al., 2007). The ASPA sits within Antarctic Conservation Biogeographic Region (ACBR) 4 Central South Antarctic Peninsula, and is one of only two ASPAs in ACBR 4, the other being ASPA No. 170 (Terauds et al., 2012; Terauds and Lee, 2016).

1. Description of values to be protected

The values noted in the original designation are reaffirmed in the present Management Plan. Further values evident from scientific descriptions of Ablation Valley and Ganymede Heights are also considered important as reasons for special protection of the Area. These values are:

- The presence of exposures of the Fossil Bluff Formation, which is of prime geological importance because it is the only known area of unbroken exposure of rocks spanning the Jurassic – Cretaceous boundary in the Antarctic, which makes this a critical locality for understanding the change in flora and fauna at this temporal boundary.
- The presence of an exceptional and unique contiguous geomorphological record of glacier and ice-shelf fluctuations extending over several thousand years, together with an outstanding assemblage of other geomorphological features derived from glacial, periglacial, lacustrine, aeolian, alluvial and slope processes.
- Two perennially frozen freshwater lakes (Ablation and Moutonnée lakes) which have the unusual property of contact with the saline waters of George VI Sound.
- The presence of marine biota, including the fish Trematomus bernacchii, in Ablation Lake, where several seals have also been observed, despite the fact that it is almost 100 km from open sea.
- The Area has the greatest bryophyte diversity of any site at this latitude in Antarctica (at least 21 species); it also has a diverse lichen (>35 taxa), algal and cyanobacterial biota. Many of the bryophytes and lichens are at the southern limit of their know distributions. There are several species which are very rare in the Antarctic.
- Several mosses occur in lakes and ponds to depths of 9 m. Although these are all terrestrial species, they tolerate inundation for several months each year when their habitat floods. One species, Campylium polygamum, has adapted to an aquatic existence, and some permanently submerged colonies reach large dimensions, with shoots in excess of 30 cm length. These are the best examples of aquatic vegetation in the Antarctic Peninsula region.
- Several bryophyte species within the Area are fertile (producing sporophytes), and some of these are not known or are very rare in this condition elsewhere in the Antarctic (e.g. the liverwort Cephaloziella

varians, and mosses Bryoerythrophyllum recurvirostrum, Distichium capillaceum, Schistidium spp.).

- The Area has one of the most extensive stands of vegetation on Alexander Island. Many of these occur on seepage areas where the bryophyte and lichen communities cover up to 100 m² or more. In the sheltered seepage areas, assemblages of terricolous species develop communities not known elsewhere in Antarctica, while exposed rock ridges and stable boulder fields support a community of locally abundant lichens, usually dominated by Usnea sphacelata.
- The Area is comparatively rich in the number and abundance of microarthropod species for its locality this far south, with representation of the springtail Friesia topo which is thought to be endemic to Alexander Island. Ablation Valley is also the only site on Alexander Island where the predatory mite Rhagidia gerlachei has been described, making the food web more complex than other sites at this latitude.

2. Aims and objectives

The aims and objectives of this Management Plan are to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- prevent or minimise the introduction to the Area of non-native plants, animals and microbes;
- allow scientific research in the Area provided it is for compelling reasons which cannot be served elsewhere and which will not jeopardize the natural ecological system in that Area; and
- preserve the natural ecosystem of the Area as a reference area for future studies.

3. Management activities

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

- Markers, signs or other structures (e.g. cairns) erected within the Area for scientific or management purposes shall be secured and maintained in good condition and removed when no longer required.
- Copies of this Management Plan shall be made available to aircraft planning to visit the vicinity of the Area.
- The Management Plan shall be reviewed at least every five years and updated as required.
- A copy of this Management Plan shall be made available at Rothera Research Station (UK; 67°34'S, 68°07'W) and General San Martín Station (Argentina; 68°08'S, 67°06'W).
- All scientific and management activities undertaken within the Area should

be subject to an Environmental Impact Assessment, in accordance with the requirements of Annex I of the Protocol on Environmental Protection to the Antarctic Treaty.

- 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 and photographs

Map 1. Location of Ablation Valley and Ganymede Heights on the Antarctic Peninsula. Map specifications: WGS84 Antarctic Polar Stereographic. Central Meridian -55°, Standard Parallel: -71°.

Map 2. ASPA No. 147, Ablation Valley and Ganymede Heights, location map. Map specifications: WGS 1984 Antarctic Polar Stereographic. Central Meridian: -71°, Standard Parallel: -71°.

Map 3. ASPA No. 147, Ablation Valley and Ganymede Heights, topographic sketch map. Map specifications: WGS 1984 Antarctic Polar Stereographic. Central Meridian: -68.4°, Standard Parallel: -71.0°.

6. Description of the Area

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

- *General description*

Ablation Valley and Ganymede Heights (between latitudes 70°45'S and 70°55'S and longitudes 68°21'W and 68°40'W, approximately 180 km²) is situated on the east side of Alexander Island, the largest island off the western coast of Palmer Land, Antarctic Peninsula (Maps 1 and 2). The Area has a central west–east extent of about 10 km and a north–south extent of about 18 km, flanked to the west by the upper part of Jupiter Glacier, to the east by the permanent ice shelf in George VI Sound, to the north by Grotto Glacier and to the south by the lower reaches of Jupiter Glacier. Ablation Valley and Ganymede Heights contain the largest contiguous ice-free area in the Antarctic Peninsula sector of Antarctica, with the smaller permanent ice fields and valley glaciers within the massif representing only about 17% of the Area. The topography of the region is mountainous, comprising steep-sided valleys separated by gently undulating plateau-like ridge crests lying generally between 650-750 m, rising to a maximum altitude of 1070 m (Clapperton and Sugden, 1983). The region has been heavily glaciated, although the relatively flat-lying attitude of the sedimentary rocks and rapid weathering have contributed to a generally rounded form of topography, coupled with sheer cliff 'steps' of thickly-bedded sandstones and conglomerates (Taylor et al., 1979).

The Area includes four principal ice-free valleys (Ablation, Moutonnée, Flatiron and Striation), the first three of which contain large ice-covered freshwater lakes (Heywood, 1977, Convey and Smith, 1997). The largest of these is the proglacial Ablation Lake (approximately 7 km²), which has been impounded by shelf ice penetrating up-valley under pressure from the westward movement of the 100-500 m thick George VI Ice Shelf, the surface of which lies 30 m above sea level (Heywood, 1977; Clapperton and Sugden, 1982). Biologically, the terrestrial ecosystem is intermediate between the relatively mild maritime Antarctic farther north and the colder, drier continental Antarctic to the south. As a "dry valley" area it is extremely rich in biota and serves as a valuable contrast to the more extreme and biologically impoverished ablation areas on the Antarctic continent (Smith, 1988).

- *Boundaries*

The designated Area comprises the entire Ablation Valley – Ganymede Heights massif, bounded in the west by the principal ridge dividing Jupiter Glacier from the main Ablation – Moutonnée – Flatiron valleys (Map 3). In the east, the boundary is defined by the western margin of George VI Ice Shelf. The northern boundary of the Area is defined as the principal ridge dividing Grotto Glacier from Erratic Valley and other tributary valleys feeding into Ablation Valley, immediately to the south. In the northwest of the Area, the boundary extends across the mostly-glaciated col separating upper Jupiter Glacier from Ablation Valley. The southern boundary of the Area, from east of the principal ridge on the west side of Flatiron Valley to where Jupiter Glacier joins George VI Ice Shelf, is defined as the northern lateral margin of Jupiter Glacier. As the margin between Ablation Lake and George VI Ice Shelf is in places indistinct, the eastern boundary of the Area at Ablation Valley is defined as a straight line extending due south from the eastern extremity of Ablation Point to where the ice shelf abuts land, and from where the eastern boundary follows the land/ice shelf margin. The physiography is similar further south at Moutonnée Lake, and the eastern boundary in this locality is defined as a straight line extending from the eastern extremity of the point on the northern side of (and partially enclosing) Moutonnée Lake to the locality of a prominent meltwater pool where the ice shelf abuts land, and from where the boundary follows the land/ice shelf margin south to where Jupiter Glacier and George VI Ice Shelf adjoin. The Area thus includes the entirety of Ablation and Moutonnée lakes and those parts of the ice shelf behind which they are impounded. The boundary co-ordinates are given in Annex 1.

- *Climate*

No extended meteorological records are available for the Ablation Valley – Ganymede Heights area, but the climate has been described as dominated by the dual influences of easterly-moving cyclonic depressions of the Southern Ocean, against the more continental, north to northwesterly, flow of cold anticyclonic air from the West Antarctic Ice Sheet (Clapperton and Sugden, 1983). The former bring relatively mild weather, strong northerly winds and a heavy cloud cover to the region, whereas the latter induces clear, cold and stable conditions with temperatures below 0°C, and relatively light winds from the south. Based on data recorded nearby (25 km) in the early 1970s, the mean summer temperature was estimated as just below freezing point, with mean annual temperature estimated at about -9°C (Heywood, 1977); precipitation was estimated at <200 mm of water equivalent per year, with little snow falling in summer. A thin snow cover is common after winter, but the region is generally snow-free by the end of the summer, apart from isolated snow patches that may persist in places.

- *Geology*

The geology of Ablation Valley – Ganymede Heights is complex, but is dominated by well-stratified sedimentary rocks. The most prominent structural feature of the massif is a large asymmetrical anticline with a northwest–southeast orientation, extending from Grotto Glacier to Jupiter Glacier (Bell, 1975, Crame and Howlett, 1988). Thrust faults in the central part of the massif suggest vertical displacements of strata of up to 800 m (Crame and Howlett, 1988). The main lithologies are conglomerates, arkosic sandstones and fossiliferous shales, with subordinate pebbly mudstones and sedimentary breccias (Elliot, 1974; Taylor et al., 1979; Thomson 1979). A range of fossils have been found in the strata, which are of Upper Jurassic–Lower Cretaceous age, including bivalves, brachiopods, belemnites, ammonites, shark teeth and plants (Taylor et al., 1979; Thomson, 1979; Crame and Howlett, 1988; Howlett, 1989). Several interstratified lavas have been observed in the lowest exposures at Ablation Point (Bell, 1975). The base of the succession is formed of a spectacular mélange, including large blocks of lava and agglomerate which crop out on the valley floors and at the base of several cliffs (see Bell, 1975; Taylor et al., 1979). The presence of exposures of the Fossil Bluff Formation is of prime geological importance because it is the only known area of unbroken exposure of rocks spanning the Jurassic – Cretaceous boundary in the Antarctic, which makes this a critical locality for understanding the change in floras and faunas at this temporal boundary.

- *Geomorphology and soils*

The entire area was at one time over-run by glacier ice from the interior of Alexander Island. Thus, landforms of both glacial erosion and deposition are widespread throughout the Area, providing evidence of a former general eastward flow of ice into George VI Sound (Clapperton and Sugden 1983). Misfit glaciers, striated bedrock and erratics indicate considerable deglaciation since the Pleistocene glacial maximum (Taylor et al., 1979; Roberts et al., 2009). Numerous terminal moraines fronting present remnant glaciers, several unexpectedly talus-free sites, and polished and striated roches moutonnées indicate that glacial retreat may have been rapid (Taylor et al., 1979). There is evidence that George VI Ice Shelf was absent between c. 9600 and 7730 calendar years BP, which suggests that the Ablation Valley – Ganymede Heights massif is likely to have been largely free of permanent ice around that time, although there have been a number of subsequent glacier fluctuations in the region (Clapperton and Sugden, 1982; Bentley et al., 2005; Smith et al., 2007a,b; Roberts et al., 2008; Bentley et al., 2009). The absence of the ice shelf suggests that early Holocene ocean-atmosphere variability in the Antarctic Peninsula was greater than that measured in recent decades (Bentley et al., 2005). Roberts et al. (2009) examined deltas adjacent to Ablation and Moutonnée Lakes that were formed higher than the present day lake level and concluded that sea level had fallen by c. 14.4 m since the mid-Holocene in this part of Alexander Island.

The landforms within the Area have been modified by periglacial, gravitational and fluvial processes. Bedrock on the upper plateau surfaces (where it has been largely scraped free of till overburden) has been shattered by frost action into platy or blocky fragments (Clapperton and Sugden, 1983). On valley slopes gelifluction lobes and stone stripes and circles are common, while on valley floors stone circles and polygonal patterned ground are frequently found in glacial till and in fluvioglacial sediments subjected to frost action. Valley walls are also dominated by landforms derived from frost action, rock/ice-fall activity, and seasonal meltwater flows, which have led to ubiquitous talus slopes and, commonly, boulder fans below incised gullies. Mass wasting of fissile sedimentary rocks has also led to the development of steep (about 50°) horizontally rectilinear bedrock slopes thinly veneered with debris. Occasional aeolian landforms have been observed, with dunes of up to 1 m in height and 8 m in length as, for example, in Erratic Valley (Clapperton and Sugden, 1983). Thin layers of peat of up to 10-15 cm in depth are occasionally associated with vegetated areas, and these are the most substantial developments of soil within the Area.

- *Freshwater ecology*

Ablation Valley – Ganymede Heights is an exceptional limnological site that contains a number of lakes, ponds and streams and a generally rich benthic flora. From late December until February running water develops from three main sources: precipitation, glaciers and from melting on George VI Ice Shelf, with run-off generally converging toward the coast (Clapperton and Sugden, 1983). Most of the streams, which are up to several kilometres in length, drain glaciers or permanent snowfields. The principal streams drain into Ablation Lake and Moutonnée Lake, both dammed by the ice shelf. Surveys in the early 1970s recorded these lakes as frozen to 2.0–4.5 m depth year-round, with maximum water depths of around 117 m and 50 m respectively (Heywood, 1977). A stable upper layer of fresh water, down to approximately 60 m and 30 m respectively, overlies increasingly saline waters influenced by interconnection with the ocean beneath the ice shelf and which subjects the lakes to tidal influence (Heywood, 1977). Surface meltwater pools, which in summer form particularly in hollows between lake-ice pressure ridges, flood to higher levels daily and encroach up alluvial fans in the lower valleys (Clapperton and Sugden, 1983).

Some recent observations suggested a decrease in the permanent ice cover of the lakes, for example with about 25% of Moutonnée Lake being free of ice cover in the 1994–95 and 1997–98 summers (Convey and Smith 1997, Convey pers.

comm., 1999). However, all three of the main lakes in the Area showed almost complete ice cover in early February 2001 (Harris 2001). Numerous ephemeral, commonly elongated, pools and ponds form laterally along the land/ice shelf margin, varying in length from 10 to 1500 m and up to 200 m wide, with depths ranging from 1 to 6 m (Heywood, 1977; Clapperton and Sugden, 1983). These pools/ponds often rise in level over the melt period, yet on occasion may drain suddenly via sub-ice fissures opening into the ice shelf, leaving former lake shorelines evident in surrounding moraines. The pools/ponds vary widely in their turbidity depending on the presence of suspended glacial sediment. The pools are typically ice-free in summer, while the larger ponds often retain a partial ice cover, and all but the deeper ponds probably freeze solid in winter (Heywood, 1977). Numerous ponds of up to 1 ha and 15 m in depth are present within the valleys, some with moss growth covering extensive areas down to 9 m in depth (Light and Heywood, 1975). The dominant species described were Campylium polygamum and Dicranella, stems of which reached 30 cm in length. Bryum pseudotriquetrum (and possibly a second Bryum species), Distichium capillaceum, and an unidentified species of Dicranella all grew on the benthic substratum at or below 1 m in depth (Smith, 1988). Moss cover was 40-80% in the 0.5-5.0 m depth zone (Light and Heywood, 1975). Much of the remaining area was covered by dense cyanobacterial felts (11 taxa) up to 10 cm thick, dominated by species of Calothrix, Nostoc and Phormidium together with 36 taxa of associated microalgae (Smith, 1988). The extensive growths of moss suggest that these ponds are probably relatively permanent, although their levels may fluctuate from year to year. The water temperature reaches up to c. 7°C in the deeper ponds and c. 15°C in the shallower pools in summer, offering a relatively favourable and stable environment for bryophytes. The shallower pools, in which several mosses have been found, may normally be occupied by terrestrial vegetation and flooded for short periods during summer (Smith, 1988). Algae are abundant in slow-moving streams and ephemeral melt runnels, although they do not colonise the unstable beds of fast-flowing streams. For example, large wet areas of level ground in Moutonnée Valley have a particularly rich flora, in places forming over 90% cover, with five species of desmid (which are rare in Antarctica) and the filamentous green Zygnema being abundant, and Nostoc spp. and Phormidium spp. colonising drier, less stable and silted areas (Heywood, 1977).

Protozoa, Rotifera, Tardigrada and Nematoda form a benthic fauna in the pools, ponds and streams (Heywood, 1977). Densities are generally highest in the slow-moving streams. The copepod Boeckella poppei was abundant in lakes, ponds and pools, but absent from streams. The marine fish Trematomus bernacchii was captured in traps laid in Ablation Lake at a depth of 70 m, within the saline water layer (Heywood and Light, 1975, Heywood, 1977). A seal (species unidentified, but probably crabeater (Lobodon carcinophagus) or Weddell (Leptonychotes weddellii)) was reported at the edge of Ablation Lake in mid-December 1996 (Rossaak, 1997), and isolated sightings of solitary seals have also been reported in earlier seasons (Clapperton and Sugden, 1982).

- *Vegetation*

Much of the Ablation Valley – Ganymede Heights area is arid, and overall vegetation abundance is low with a discontinuous distribution. However, complex plant communities exist in seepage areas and along stream margins, which are of particular interest because:

- they occur in an otherwise almost barren landscape;
- the mixed bryophyte and lichen communities are the best-developed and most diverse of any south of 70°S (Smith, 1988; Convey and Smith, 1997);
- some bryophyte taxa are profusely fertile and fruiting at their southern limit – an unusual phenomenon in most Antarctic bryophytes, especially so far south (Smith and Convey, 2002);
- the region represents the southernmost known locality for many taxa; and
- although some of these communities also occur at other sites on southeastern Alexander Island, the Area contains the best and most extensive examples known at this latitude.

The diversity of mosses is particularly high for this latitude, with at least 21 species recorded within the Area, which represents 73% of those known to occur on Alexander Island (Smith, 1997). The lichen flora is also diverse with more than 35 taxa known. Of the macrolichen flora, 12 of the 15 species known to occur on Alexander Island are represented within the Area (Smith, 1997). Ablation, Moutonnée and Striation valleys, and the SE coastal area, contain the most extensive stands of both terrestrial and freshwater vegetation (Smith, 1998; Harris, 2001). Smith (1988, 1997) reported the bryophyte vegetation is generally found in patches of about 10 to 50 m², with some stands up to 625 m², occurring from around 5 m to 40 m altitude on the north and east-facing gentle slopes of the main valleys. Harris (2001) recorded large stands of near-continuous bryophyte vegetation of up to approximately 8000 m² on gentle southeast-facing slopes on the south-eastern coast of the Area, at an elevation of approximately 10 m, close to where the Jupiter Glacier joins George VI Ice Shelf. A continuous stand of approximately 1600 m² was recorded on moist slopes in lower Striation Valley. Several large patches of continuous moss (of up to 1000 m²) were observed on SW/NW-facing eastern slopes of Flatiron Valley, at elevations of 300-400 m. Small discontinuous patches of moss were recorded in this vicinity up to an elevation of 540 m. Mosses were observed on peaks above Ablation Valley at elevations of up to approximately 700 m.

The dominant bryophyte in the wettest areas is frequently the liverwort Cephaloziella varians, which forms a blackish mat of densely interwoven shoots. Although the most southerly record of C. varians has been reported at 77°S from Botany Bay, Cape Geology (ASPA No. 154) in Victoria Land, the extensive mats it forms in the Ablation Valley – Ganymede Heights massif represent the most substantial stands of this species this far south and in the maritime Antarctic. Cyanobacteria, notably Nostoc and Phormidium spp., are usually associated either on the surface of the liverwort or soil, or with moss shoots. Beyond the wettest areas, undulating carpets of pleurocarpous mosses dominated by Campylium polygamum forms the greenest stands of vegetation, with associated Hypnum revolutum. These carpets overlie up to 10-15 cm of peat composed of largely undecomposed moribund moss shoots. Intermixed with these mosses, but often predominating on the drier margins, Bryum pseudotriquetrum grows as isolated cushions that may coalesce to develop a convoluted turf. In these drier, peripheral areas, several other turf-forming bryophytes are often associated with Bryum. Besides the more hydric species already cited, these include the calcicolous taxa Bryoerythrophyllum recurvirostrum, Didymodon brachyphyllus, Distichium capillaceum, Encalypta rhaptocarpa, E. procera, Pohlia cruda, Schistidium antarctici, Tortella fragilis, Syntrichia magellanica, Tortella alpicola, and several unidentified species of Bryum and Schistidium.

A significant characteristic of the vegetation in the Ablation Valley – Ganymede Heights massif is the unusual occurrence of a number of fertile bryophytes. Antarctic bryophytes seldom produce sporophytes, yet Bryum pseudotriquetrum, Distichium capillaceum, Encalypta rhaptocarpa, E. procera and Schistidium spp. have all been recorded in the Area as frequently fertile. Most unusually, small quantities of the moss Bryoerythrophyllum recurvirostre and the liverwort Cephaloziella varians have been observed fruiting in Ablation Valley, which was the first time this had been recorded anywhere in Antarctica (Smith pers comm., cited in Convey, 1995; Smith, 1997; Smith and Convey, 2002); in addition, D. capillaceum has never before been recorded with sporophytes throughout the maritime Antarctic (Smith, 1988). E. procera has only been reported as fertile in one other Antarctic location (on Signy Island, South Orkney Islands; Smith, 1988). Beyond the permanent seepage areas, bryophyte vegetation is extremely sparse and restricted to habitats where there is free water for at least a few weeks during the summer. Such sites occur sporadically on the valley floors, stone stripes on slopes, and also in crevices in north-facing rock faces. Most of the species occurring in the bryophyte patches have also been observed in these habitats, including lichens, most frequently in the shelter of, or even in crevices beneath, larger stones – especially at the margins of patterned ground features. At elevations of over 100 m aridity increases, and at higher altitudes only Schistidium antarctici (at 500 m in Moutonnée Valley) and Tortella fragilis (near the summit of the highest peak south-west of Ablation Valley (775 m) have been recorded. In these drier habitats lichens tend to become more frequent, especially where the substratum is stable. Lichens are widespread and locally abundant on the more stable screes, ridges, and plateaux above the valleys, the most predominant species being Usnea sphacelata, giving rock surfaces a black hue. This species is often associated with Pseudephebe minuscula, several crustose lichen species and, rarely, Umbilicaria decussata reaching the highest part of the massif; all but the latter species are also common in Moutonnée Valley. Epiphytic and terricolous lichens, predominantly the white encrusting species Leproloma cacuminum, are often frequent where the marginal bryophyte surface is driest. Other taxa such as Cladonia galindezii, C. pocillum and several crustose lichens are also sometimes present. Various lichens colonise the dry soil and pebbles in these localities, occasionally spreading onto cushions of moss. These include Candelariella vitellina, Physcia caesia, Physconia muscigena, occasional Rhizoplaca melanophthalma, Usnea antarctica, Xanthoria elegans, and several unidentified crustose taxa (especially species of Buellia and Lecidea). An abundance of Physcia and Xanthoria in isolated places suggests nitrogen enrichment deriving from south polar skuas (Stercorarius maccormicki) which nest in the Area (Bentley, 2004). A few ornithocoprophilous lichens occur on occasional boulders used as bird perches. Many of the bryophytes and lichens are at the southern limit of their known distributions and several species are very rare in the Antarctic. Rare moss species within the Area include Bryoerythrophyllum recurvirostrum, Campylium polygamum, Encalypta rhaptocarpa, Tortella alpicola, and Tortella fragilis. Several Bryum species, Encalypta rhaptocarpa, Schistidium occultum and Schistidium chrysoneurum are all at the southern limit recorded for these species. Of the lichen flora, Ablation Valley is the only known site where Eiglera flavida has been observed in the S. Hemisphere, and Mycobilimbia lobulata and Stereocaulon antarcticum are also rare. Lichen species with furthest-south records are Cladonia galindezii, Cladonia pocillum, Ochrolechia frigida, Phaeorrhiza nimbosa, Physconia muscigena, and Stereocaulon antarcticum.

- *Invertebrates, fungi, bacteria*

The microinvertebrate fauna thus far described is based on ten samples from Ablation Valley, and comprises seven confirmed taxa (Convey and Smith, 1997): two Collembola (Cryptopygus badasa, Friesea topo); one cryptostigmatid mite (Magellozetes antarcticus); and four prostigmatid mites (Eupodes parvus, Nanorchestes nivalis (= N. gressitti), Rhagidia gerlachei and Stereotydeus villosus). A number of specimens collected were earlier reported as Friesea grisea, a widespread maritime Antarctic species. However, specimens of Friesia collected subsequently from Alexander Island (i.e. from 1994 onwards) have been described as a distinct new species, F. topo (Greenslade, 1995), which is itself currently thought to be endemic to Alexander Island. The earlier specimens from Ablation Valley have been re-examined, with all those that remain identifiable being reassigned as F. topo. While the same number of species has been described at one other site on Alexander Island, the samples from Ablation Valley exhibited a mean total microarthropod population density about seven times greater than other sites in the region. Diversity at Ablation Valley was also greater than at several other documented sites on Alexander Island. Both diversity and abundance are considerably less than has been described at sites in Marguerite Bay and further north (Starý and Block, 1998; Convey et al., 1996; Convey and Smith, 1997; Smith, 1996). The most populous species recorded in Ablation Valley was Cryptopygus badasa (96.6% of all arthropods extracted), which was particularly common in moss habitats. Friesea topo was found on stones at low population densities and was virtually absent from the moss habitat, showing these species to have distinct habitat preferences. Ablation Valley is the only site on Alexander Island where the predatory mite R. gerlachei has been described. Very little research has been conducted on fungi in the Area; however, one study reported an unidentified nematode-trapping fungus present in a pond in Ablation Valley (Maslen, 1982). While further sampling is required to describe the terrestrial microfauna more fully, available data support the biological importance of the Area.

- *Breeding birds*

The avifauna of Ablation Valley – Ganymede Heights has not been described in detail. A few pairs of south polar skuas (Stercorarius maccormicki) have been reported as nesting close to some of the moist vegetated sites (Smith, 1988). Snow petrels have been noted as “probably breeding” in the vicinity of Ablation Point (Croxall et al., 1995, referring to Fuchs and Adie, 1949). Bentley (2004) reported direct aerial predation by south polar skuas on snow petrels within the Area. No other bird species has been recorded in the Ablation Valley – Ganymede Heights massif.

- *Human activities and impacts*

Human activity at Ablation Valley – Ganymede Heights has been exclusively related to science. The first visit to the Ablation Valley area was by members of the British Graham Land Expedition in 1936, who collected about 100 fossil specimens from near Ablation Point (Howlett, 1988). The next visits were about a decade later, when basic geological descriptions and further fossil collections were undertaken. More intensive palaeontological investigations were made by British geologists in the 1960s through to the 1980s, with detailed studies of the geomorphology (Clapperton and Sugden, 1983). Limnological investigations were undertaken in the 1970s, with a number of expeditions examining the terrestrial biology being initiated in the 1980s and 1990s. Scientific activities since the millennium have focussed on palaeoclimatological research. All known expeditions into the Area have been by British scientists. The impacts of these activities have not been fully described, but are believed to be minor and limited to footprints, aircraft tracks at the Moutonnée Valley terrestrial airstrip (see Section 6(ii)), removal of small quantities of geological and biological samples, markers, abandoned items such as supplies and scientific equipment, and the remains of human wastes.

An abandoned depot, consisting of two oil drums (one empty, one full), three 5 l cans of skidoo oil, one food box and ten glacier poles, was located on the moraine bench adjacent to George VI Ice Shelf, approximately 500 m north of Moutonnée Lake (70°51’19”S; 68°19’05”W). The depot was partially removed in November 2012 and two remaining full fuel drum were removed in November 2013. Various expeditions in the 1970s-80s placed empty fuel drums as route markers through pressure ice from George VI Sound into Ablation Valley, and a large onshore rock is painted yellow SE of Ablation Lake (McAra, 1984; Hodgson, 2001). Nearby is a large cross made from red painted rocks and cairns, with a wooden marker board in the centre. Evidence of campsites close to the shore of Ablation Lake remained in 2012. One site is on the SW shore near a rich area of vegetation, and another is approximately four kilometres east on the SE shore. At both sites circles of stones mark old tent sites, and circular structures have been built with low (0.8 m) stone walls. At the former site a number pieces of wood (including old markers), an old food box, string and human wastes were observed (Harris, 2001; Hodgson, 2001). Several red-painted rocks were found around the southern and western shores of Ablation Lake in February 2001, and paint fragments were sometimes observed in sediments. In 2000-01 some of the abandoned materials in Ablation Valley were removed: three fuel drums on lake ice, an old food box and some wood and string on the SW shore, and numerous fragments from broken perspex acryllic cloches on the SW shore (nine were deployed in January 1993 – Wynn-Williams, 1993; Rossaak, 1997 – all were destroyed by wind) (Harris, 2001; Hodgson, 2001). In November 2012, metal and rubbish near and old camp with a low stone wall (located at 70°49'58"S; 68°22'16"W) was removed. The painted rocks remain. Snowmobiles have been used on lake and glacier ice, and modified snowmobiles with front wheels were used over gravel terrain in a limited vicinity of the SW shore of Ablation Lake in 1983–84 (McAra, 1984). Some evidence of erosional paths forming on steep scree slopes, presumably a result of field work, was recorded in Moutonnée Valley (Howlett, 1988). Cairns have been built on a number of mountain summits and to mark a number of survey sites throughout the Area.

6(ii) Access to the Area

- Access to the Area shall be by aircraft, vehicle or on foot.
- There are no special restrictions on the points of access to the Area, nor on the overland or air routes used to move to and from the Area. Access overland from George VI Ice Shelf may be difficult because of pressure ice, but is considered to be the most reliable and safe access route for visitors arriving in the vicinity of the Area by fixed-wing aircraft, particularly as some routes into the Area from the glaciers to the west are steep, crevassed and arduous.
- Landing of fixed-wing aircraft within the Area is discouraged. If landings are essential for scientific or management objectives, they are restricted to the ice-covered lakes or to a single terrestrial site immediately west of Moutonnée Lake, provided landings are feasible. Pressure deformation of the ice surface of lakes, meltwater and thinning ice-cover may make landing on lake ice impractical later in the summer. Landings at Ablation Lake and the terrestrial site west of Moutonnée Lake were carried out in November 2000. The terrestrial landing site (Map 3) is oriented E–W and consists of approximately 350 m of gently sloping coarse gravel on ground raised approximately 2 m above the surrounding valley. Some red-painted stones mark the western (upper) end in the form of an arrow. Tyre-impressions are evident in the gravel. Due to the poor state of the surface and a risk of damage to the aircraft, use of the terrestrial site west of Moutonnée Lake is not recommended.
- Should helicopter access prove feasible, specific landing sites have not been designated but landings are prohibited within 200 m of lake shores, or within 100 m of any vegetated or moist ground, or in stream beds.
- Access is also possible by aircraft to upper Jupiter Glacier (550 m), immediately west of Ablation Valley and outside of the Area, from where access may be made into the Area overland on foot.
- Pilots, air crew, or other people arriving by aircraft, are prohibited from moving on foot beyond the immediate vicinity of any landing site within the Area unless specifically authorised by Permit.

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

There are no structures known to be present in the Area. A number of cairns have been installed as survey markers throughout the Area (Perkins, 1995; Harris, 2001) and some low walls have been erected at campsites. Nine plastic bright red reflector markers (30 cm high, held down by rocks) were put in place to mark the airstrip in Moutonnée Valley, but these were removed in November 2012. The nearest structure to the Area appears to be an abandoned caboose at Spartan Cwm, approximately 20 km south of the Area. A summer-only scientific camp facility exists at Fossil Bluff (UK), approximately 60 km to the south on the eastern coast of Alexander Island. The nearest permanently occupied scientific research stations are in Marguerite Bay (General San Martín (Argentina) and Rothera Research Station (UK)), approximately 350 km to the north (Map 2).

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

There are no other protected areas in the immediate vicinity of the Area. The nearest protected area to Ablation Valley – Ganymede Heights is ASPA No. 170 Marion Nunataks, Charcot Island, Antarctic Peninsula, approximately 270 km to the east of Alexander Island (Map 2).

6(v) Special zones within the Area

There are no special zones within the Area.

7. Permit conditions

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 for compelling scientific reasons which cannot be served elsewhere, or for reasons essential to the management of the Area;
- the actions permitted are in accordance with this Management Plan;
- any management activities are in support of the objectives of this Management Plan;
- the actions permitted will not jeopardise the natural ecological system in the Area;
- the activities permitted will give due consideration via the environmental impact assessment process to the continued protection of the environmental or scientific values of the Area;
- the Permit shall be issued for a finite period;
- the Permit, or an authorised copy, shall be carried when in the Area.

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

- Movement by vehicle within the Area shall be restricted to snow or ice surfaces.
- Movement over land within the Area shall be on foot.
- All movement should be undertaken carefully so as to minimise disturbance to the soil, vegetated surfaces and sensitive geomorphological features such as dunes, walking on snow or rocky terrain if practical. If practical, visitors should avoid walking in stream or dry lake beds, or on moist ground, to avoid disturbance to the hydrology and/or damage to sensitive plant communities. Care should be taken even when moisture is not obviously present, as inconspicuous plants may still colonise the ground.
- Pedestrian traffic should be kept to the minimum necessary to undertake permitted activities and every reasonable effort should be made to minimise trampling effects.
- The operation of aircraft over the Areas should be carried out, as a minimum requirement, in compliance with the 'Guidelines for the operations of aircraft near concentrations of birds' contained in Resolution 2 (2004).
- Overflight of bird colonies within the Area by Remotely Piloted Aircraft Systems (RPAS) shall not be permitted unless for scientific or operational purposes, and in accordance with a permit issued by an appropriate national authority.

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

Activities which may be conducted in the Area include:

- essential management activities, including monitoring;
- compelling scientific research that cannot be undertaken elsewhere and which will not jeopardize the ecosystem of the Area; and
- sampling, which should be the minimum required for approved research programmes.

Diving in lakes within the Area is normally prohibited unless it is necessary for compelling scientific purposes. If diving is undertaken, great care should be taken to avoid disturbance of the water column and of sensitive sediments and biological communities. The sensitivity of the water column, sediments and biological communities to disruption by diving activities shall be taken into account before Permits are granted for these purposes.

7(iv) Installation, modification or removal of structures

- Permanent structures or installations are prohibited.
- No 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.
- All markers, structures or scientific equipment installed in the Area must be

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, spores) and non-sterile soil (see section 7(vi)), and be made of materials that can withstand the environmental condition and pose minimal risk of contamination of the Area.
- Removal of specific structures or equipment for which the permit has expired shall be the responsibility of the authority which granted the original permit and shall be a condition of the Permit.

7(v) Location of field camps

When necessary for purposes specified in the Permit, temporary camping is allowed within the Area. One camp site has been designated within the Area: it is located on the north-western (upper) end of the airstrip in Moutonnée Valley (70°51’48"S, 68°21’39"W) (Map 3). The site is not marked, although tents should be erected as close as practicable to the marker on the north-western end of the airstrip. This site should be used by preference when working in this vicinity. Other specific camp site locations have not, as yet, been designated, although camping is prohibited on sites where significant vegetation is present. Camps should be located as far as practicable (preferably at least 200 m) from lakeshores, and avoid dry lake or stream beds (which may host an inconspicuous biota). By preference and where practical, camps should be located on snow or ice surfaces. Previously existing campsites should be re-used where possible, except where the above guidelines suggest these were inappropriately located.

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

No living animals, plant material or microorganisms shall be deliberately introduced into the Area. To ensure that ecological values of the Area are maintained, 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 sterilized. 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. Further guidance can be found in the CEP Non-native species manual (CEP, 2017) and the Environmental code of conduct for terrestrial scientific field research in Antarctica (SCAR, 2009). In view of the possible presence of breeding bird colonies within the Area, no poultry products, including wastes from such products and products containing uncooked dried eggs, shall be released into the Area.

No herbicides or pesticides shall be brought into the Area. Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the Permit, shall be removed from the Area at or before the conclusion of the activity for which the Permit was granted. 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 and fauna is prohibited, except in accordance with a 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 (2011). Any soil or vegetation sampling is to be kept to an absolute minimum required for scientific or management purposes, and carried out using techniques which minimise disturbance to surrounding soil, ice structures and biota.

7(viii) The 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, and 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 national authority must be notified and approval obtained.

7(ix) Disposal of waste

All wastes, except human liquid and domestic liquid wastes, shall be removed from the Area. Human liquid and domestic liquid wastes may be disposed of within the Area down ice cracks along the margin of George VI Ice Shelf or Jupiter Glacier, or by burying in moraine along the ice margin in these localities as close as practical to the ice. Disposal of human liquid and domestic liquid wastes in this manner shall be more than 200 m from, and avoiding the catchments of, the main lakes in Ablation, Moutonnée or Flatiron valleys, or shall otherwise be removed from the Area. Human solid waste shall be removed from the Area.

7(x) Measures that may be necessary to continue to met the aims of the Management Plan

- Permits may be granted to enter the Area to carry out scientific research, monitoring and site inspection activities, which may involve the collection of a small number of samples for analysis or to carry out protective measures.

- Any long-term monitoring sites shall be appropriately marked and the markers or signs maintained.
- Scientific activities shall be performed in accordance with the Environmental code of conduct for terrestrial scientific field research in Antarctica (SCAR, 2009).

7(xi) Requirements for reports

The principal Permit holder for each visit to the Area shall submit a report to the appropriate national authority as soon as practicable, and no later than six months after the visit has been completed. Such reports should include, as appropriate, the information identified in the Antarctic Specially Protected Area visit report form contained in the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas (Appendix 2). Wherever possible, 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, 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. Supporting documentation

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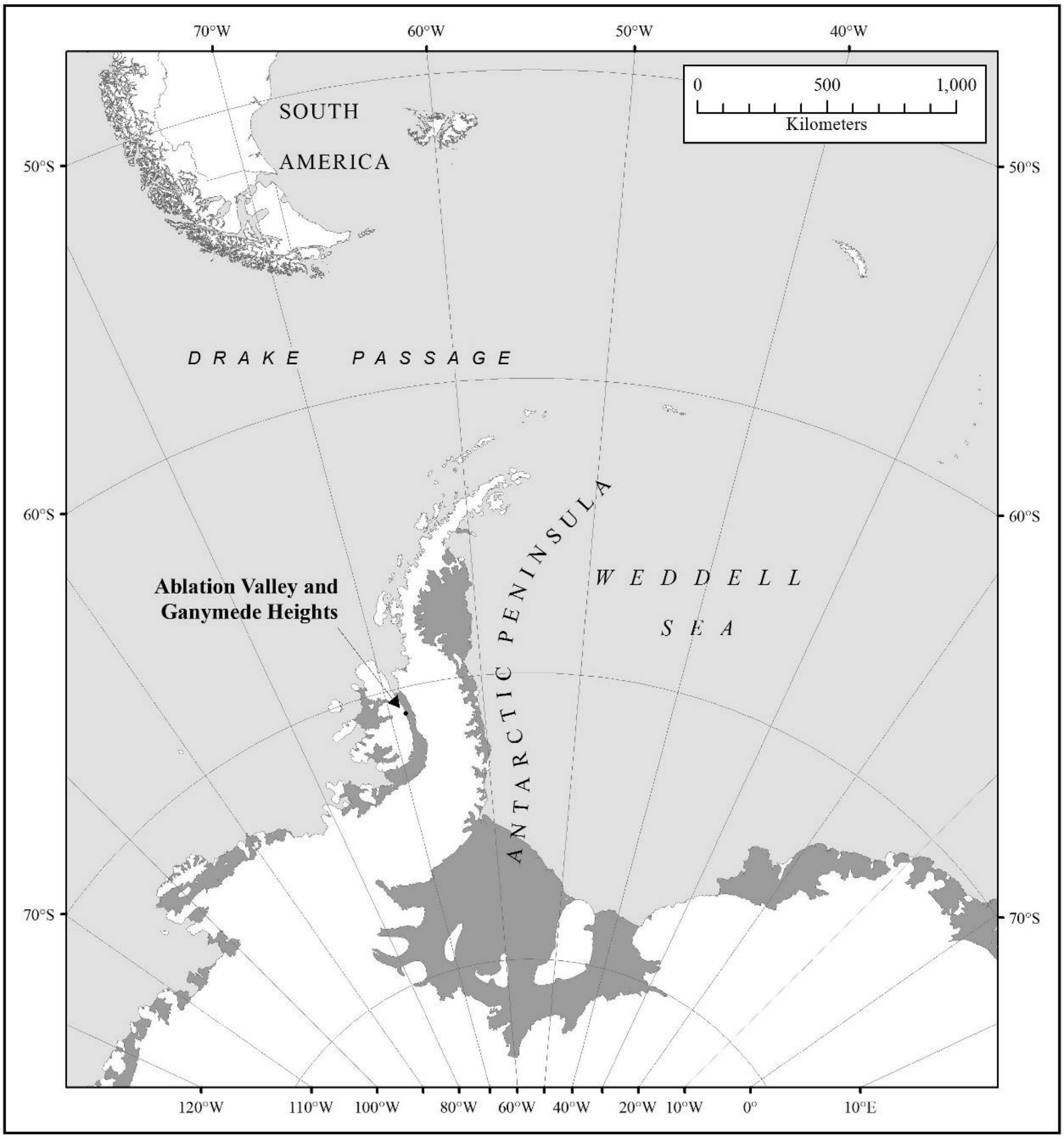
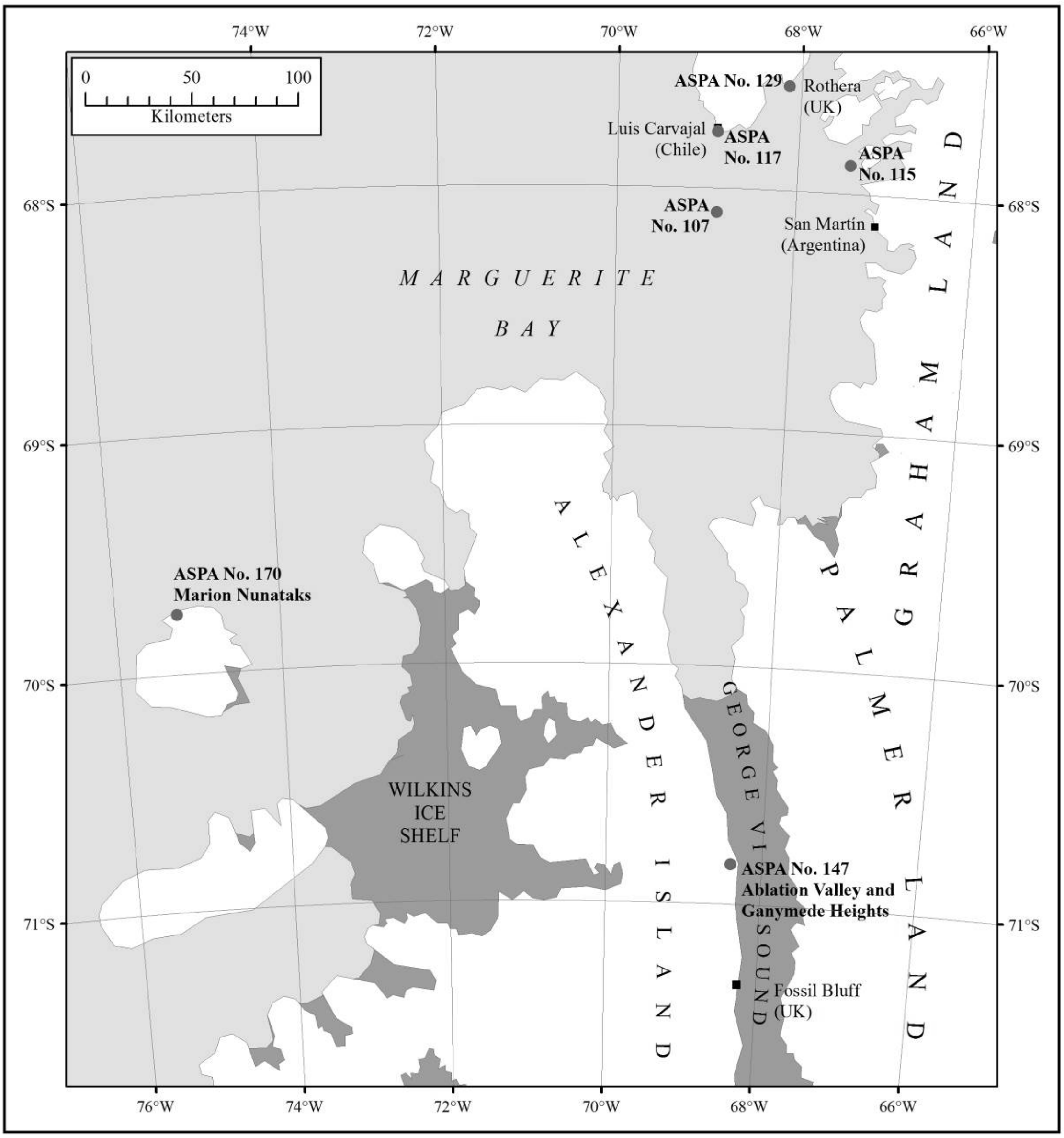
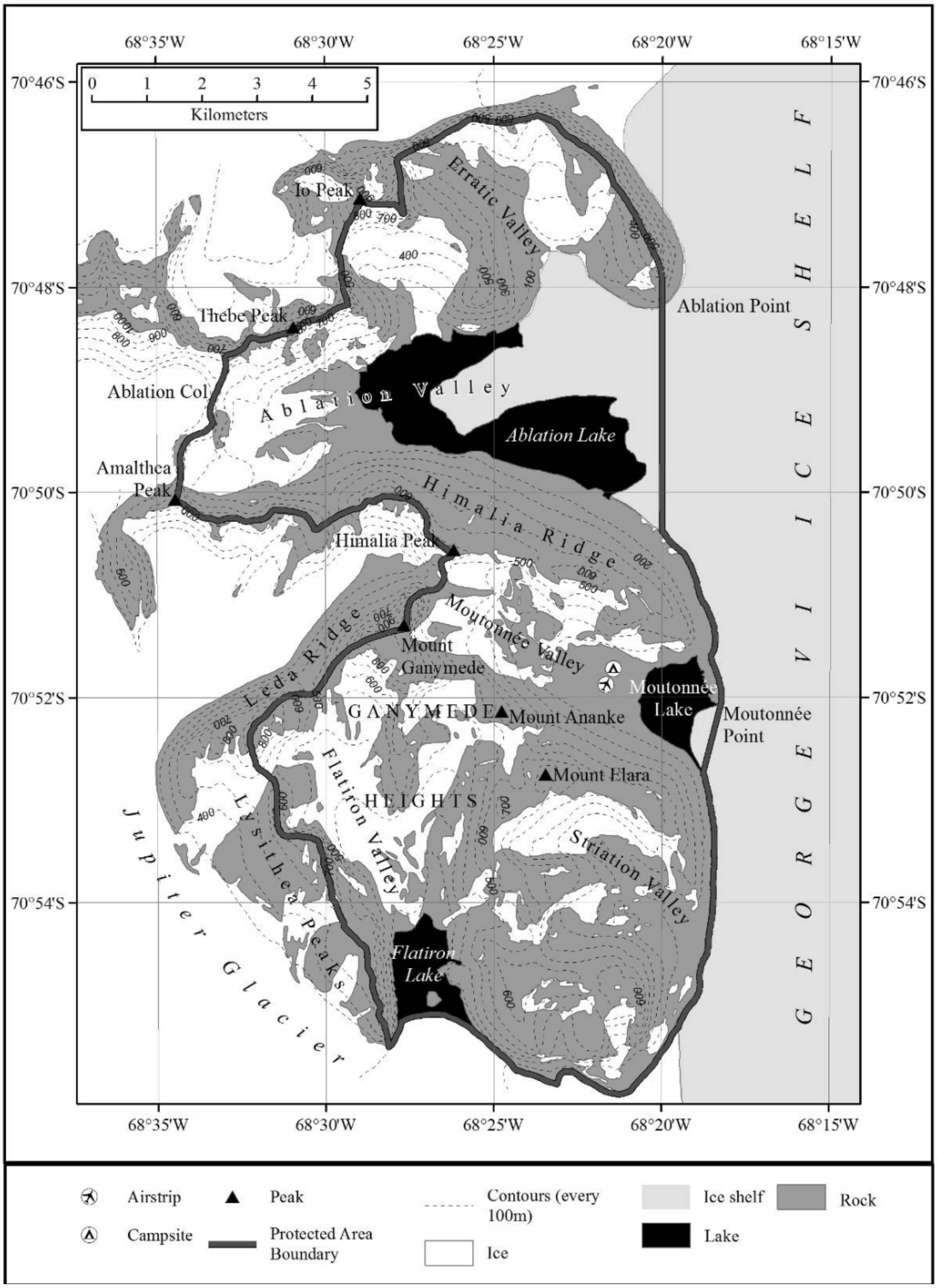
Map 1. Location of Ablation Valley and Ganymede Heights on the Antarctic Peninsula. Map specifications: WGS84 Antarctic Polar Stereographic. Central Meridian -55°, Standard Parallel: -71°.



Map 2. ASPA No. 147, Ablation Valley and Ganymede Heights, location map. Map specifications: WGS 1984 Antarctic Polar Stereographic. Central Meridian: -71°, Standard Parallel: -71°.



Map 3. ASPA No. 147, Ablation Valley and Ganymede Heights, topographic sketch map. Map specifications: WGS 1984 Antarctic Polar Stereographic. Central Meridian: -68.4°, Standard Parallel: -71.0°.



Annex 1.

Boundary coordinates for ASPA No. 147, Ablation Valley and Ganymede Heights, Alexander Island. In large part, the boundary follows natural features and a detailed description is found in Section 6(i). In the table below, the boundary coordinates are numbered, with number 1 the most northerly co-ordinate and further coordinates numbered sequentially in a clockwise direction around the Area boundary.

Number	Latitude	Longitude
1	70°46’26”S	68°24’01”W
2	70°46’28”S	68°25’48”W
3	70°46’55”S	68°28’27”W
4	70°47’13”S	68°28’15”W
5	70°47’12”S	68°29’33”W
6	70°48’02”S	68°29’58”W
7	70°48’23”S	68°32’55”W
8	70°49’44”S	68°34’38”W
9	70°50’06”S	68°31’13”W
10	70°49’56”S	68°28’52”W
11	70°50’19”S	68°26’51”W
12	70°51’17”S	68°28’19”W
13	70°52’09”S	68°31’59”W
14	70°53’02”S	68°31’06”W
15	70°53’03”S	68°29’59”W
16	70°55’03”S	68°27’58”W
17	70°54’53”S	68°27’40”W
18	70°55’36”S	68°23’26”W
19	70°55’41”S	68°21’30”W
20	70°54’43”S	68°19’11”W
21	70°52’44”S	68°19’03”W
22	70°52’04”S	68°18’25”W
23	70°51’17”S	68°18’41”W
24	70°50’18”S	68°20’27”W
25	70°48’08”S	68°20’44”W
26	70°7’38”S	68°21’23”W
27	70°46’55”S	68°22’16”W

Measure 5 (2018)

Antarctic Specially Protected Area No 170 (Marion Nunataks, Charcot Island, Antarctic Peninsula): 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 4 (2008) which designated Marion Nunataks, Charcot Island, Antarctic Peninsula as ASPA 170 and adopted a Management Plan for the Area;
- Measure 16 (2013), which adopted a revised Management Plan for ASPA 170;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 170;

Desiring to replace the existing Management Plan for ASPA 170 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 170 (Marion Nunataks, Charcot Island, Antarctic Peninsula), which is annexed to this Measure, be approved; and
2. the Management Plan for Antarctic Specially Protected Area No 170 annexed to Measure 16 (2013) be revoked.

Management Plan for Antarctic Specially Protected Area No. 170

MARION NUNATAKS, CHARCOT ISLAND, ANTARCTIC PENINSULA

Introduction

The primary reason for the designation of Marion Nunataks, Charcot Island, Antarctic Peninsula (69°45'S, 75°15'W) as an Antarctic Specially Protected Area (ASPA) is to protect primarily environmental values, and in particular the terrestrial flora and fauna within the Area.

Marion Nunataks lie on the northern edge of Charcot Island, a remote ice-covered island to the west of Alexander Island, Antarctic Peninsula, in the eastern Bellingshausen Sea. Marion Nunataks form a 12 km chain of rock outcrops on the mid-north coast of the island and stretch from Mount Monique on the western end to Mount Martine on the eastern end. The Area is 106.5 km² (maximum dimensions are 9.2 km north-south and 17.0 km east-west) and includes most, if not all, of the ice-free land on Charcot Island.

Past visits to the Area have been few, rarely more than a few days in duration and focussed initially on geological research. However, during visits between 1997 and 2000, British Antarctic Survey (BAS) scientists discovered a rich biological site, located on the Rils Nunatak at 69°44'56"S, 75°15'12"W.

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

ASPA No. 170, Marion Nunataks was originally designated as an ASPA through Measure 4 (2008) after a proposal by the United Kingdom.

The Area fits into the wider context of the Antarctic Protected Area system by protecting the unique species assemblage found on Marion Nunataks and being the first to protect a substantial area of ground that is representative of the permanent ice-cap and nunataks that exist commonly in the southern Antarctic Peninsula. 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 (see also Morgan et al., 2007). Using this model, ASPA No. 170 is contained within Environment Domain C (Antarctic Peninsula southern geologic) and Domain E (Antarctic Peninsula and Alexander Island main ice fields). Other protected areas containing Domain C include ASPA No. 147 (although not specifically stated in Morgan et al., 2007). Other protected areas containing Domain E include ASPA

Nos. 113, 114, 117, 126, 128, 129, 133, 134, 139, 147, 149, 152, and ASMA Nos. 1 and 4. The ASPA sits within Antarctic Conservation Biogeographic Region (ACBR) 4 Central South Antarctic Peninsula, and is one of only two ASPAs in ACBR 4, the other being ASPA No. 147 (Terauds et al., 2012).

1. Description of values to be protected

The outstanding environmental value of the Area, which is the primary reason for designation as an ASPA, is based on the following unique species assemblage found in the terrestrial environment:

- The terrestrial fauna is unique for the maritime Antarctic in that it appears to contain neither predatory arthropods nor Collembola (springtails), which are otherwise ubiquitous and important members of the terrestrial fauna of the zone. As such, the site provides unique opportunities for the scientific study of terrestrial biological communities from the maritime Antarctic where key ecological components are absent.
- The Marion Nunataks flora includes an exceptional development of three mosses that are encountered only rarely at latitudes south of 65°S (Brachythecium austrosalebrosum, Dicranoweisia crispula and Polytrichum piliferum).
- The Area includes two lichen species that are previously unrecorded from Antarctica (Psilolechia lucida and Umbilicaria aff. thamnodes) and represents the furthest south known occurrence for several lichen species (including Frutidella caesioatra, Massalongia spp., Ochrolechia frigida, Usnea aurantiaco-atra and Usnea trachycarpa).
- The values are vulnerable to human impacts including damage to habitat by, for example, trampling, or the introduction of non-indigenous species that may disrupt ecosystem structure and function.

2. Aims and Objectives

The aims and objectives of this Management Plan are to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- prevent or minimise the introduction to the Area of non-native plants, animals and microbes;
- minimise the possibility of the introduction of pathogens which may cause disease in fauna populations within the Area;
- allow scientific research in the Area provided it is for compelling reasons which cannot be served elsewhere and which will not jeopardize the natural ecological system in that Area; and
- preserve the natural ecosystem of the Area as a reference area for future studies.

3. Management Activities

Management activities that involve visits to the Area and erection of permanent structures may themselves significantly increase the risk of irreversible human impact, through introductions of locally non-native species. Therefore, the emphasis for management of the site should be to avoid unnecessary visits and importation of materials into the Area. The following management activities are to be undertaken to protect the values of the Area:

- Due to the sensitive nature of the Area and the severity of the consequences should non-native species be introduced, management visits shall be kept to an absolute minimum and erection of permanent structures, including notice boards and signs, on ice-free ground shall be avoided.
- Visiting field parties shall be briefed fully by the national authority on the values that are to be protected within the Area and the precautions and mitigation measures detailed in this Management Plan.
- Copies of this Management Plan shall be made available to vessels and aircraft planning to visit the vicinity of the Area.
- The Management Plan shall be reviewed at least every five years and updated as required.
- A copy of this Management Plan shall be made available at Rothera Research Station (UK; 67°34'S, 68°07'W) and General San Martín Station (Argentina; 68°08'S, 67°06'W).
- All scientific and management activities undertaken within the Area should be subject to an Environmental Impact Assessment, in accordance with the requirements of Annex I of the Protocol on Environmental Protection to the Antarctic Treaty.
- 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 1. Charcot Island in relation to Alexander Island and the Antarctic Peninsula. Map specifications: WGS84 Antarctic Polar Stereographic. Central meridian -55°, Standard parallel: -71°.

Map 2. Charcot Island, including ASPA No. 170 Marion Nunataks situated in the northwest of the island. Map specifications: WGS 1984 Antarctic Polar Stereographic. Central Meridian: -75°, Standard Parallel: -71.0°.

Map 3. ASPA No. 170, Marion Nunataks, Charcot Island, Antarctic Peninsula. Map specifications: WGS 1984 Antarctic Polar Stereographic. Central Meridian: -75°, Standard Parallel: -71.0°. Developed from USGS Landsat Image Mosaic of Antarctica, Scene ID: x-2250000y+0450000. Metadata available at http://lima.usgs.gov/.

6. Description of the Area

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

Charcot Island is roughly circular in shape, approximately 50 km across and is separated from northwest Alexander Island (~100 km away) by Wilkins Sound to the east and Attenborough Strait to the south (Maps 1 and 2). Until recently, Charcot Island was connected to Alexander Island by the Wilkins Ice Shelf, but substantial collapse occurred in 2008 and the ice bridge gave way in April 2009 (Vaughan et al., 1993; Braun et al., 2009). Charcot Island is ice-covered with the exception of Marion Nunataks (69°45'S, 75°15'W), which form a 12 km chain of rock outcrops that overlook the mid-north coast of Charcot Island, and consist predominantly of steep north–facing cliffs (Map 3). Mount Monique lies towards the western end of the Marion Nunataks chain and Mount Martine to the eastern end. The summits of both peaks are between 750 and 1000 metres above sea level.

The Area boundary is defined as follows:

The point on the northern coast of Charcot Island at 69°43'07"S, 75°00'00"W represents the most north-easterly point of the Area. From here, the Area boundary follows the coastline westwards to the point on the coast at 69°48'00"S, 75°19'19"W. The boundary then extends eastward inland to a point on the Charcot Island ice-cap at 69°48'00"S, 75°00'00"W. From there the boundary extends northwards to the coast at 69°43'07"S, 75°00'00"W. The Area also includes Cheeseman Island (located at 69°43'24"S, 75°11'00"W). There are no boundary markers delimiting the Area. The maximum dimensions of the Area are 9.2 km north-south and 17.0 km east-west (106.5 km²). The Area includes ice cap that extends at least 4 km to the south and east of Marion Nunataks, which is intended to act as a buffer zone to prevent accidental importation of species not native to the Area (see Map 3). The steep ice cliffs on the north coast of Charcot Island, make access from the sea difficult.

- *Climatic conditions*

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

- *Biogeography*

Research by Smith (1984) and Peat et al. (2007) describes the recognised biogeographical regions present within the Antarctic Peninsula. Antarctica can be divided into three major biological provinces: northern maritime, southern maritime and continental. Charcot Island lies within the southern maritime zone (Smith, 1984), approximately 600 km north of the major biogeographic discontinuity that separates the Antarctic Peninsula and continental Antarctica known at the Gressitt Line (Chown and Convey, 2007). It also lies within ACBR 4, Central South Antarctic Peninsula (Terauds et al., 2012; Terauds and Lee, 2016)

- *Geology*

The rocks of Marion Nunataks are turbiditic sandstones and mudstones, similar in appearance to those found on nearby Alexander Island. However, geochronology and isotopic analyses from detrital minerals (grains that survive erosion, transport and deposition and so preserve information on the source rock) suggest that Charcot Island rocks are different to those on Alexander Island, and possibly the whole of the Antarctic Peninsula (Michael Flowerdew, pers. comm.). Alexander Island rocks are thought to have formed from sediments eroded off rocks from the Antarctic Peninsula. However, Charcot Island sediments were originally deposited within a deep marine trench that formed as a result of the destruction of the Pacific plate beneath the edge of the ancient continent of Gondwana. The sedimentary rocks were scraped off the Pacific plate as it was destroyed and accreted to the Gondwana continent, causing them to be folded and methamorphosed under high pressure. Charcot Island sedimentary rocks are thought to be Cretaceous (deposited around 120 million years ago), and may have been transported over long distances in a relatively short time interval before becoming juxtaposed to Alexander Island around 107 million years ago.

- *Biology*

The known terrestrial biological site (located on the Rils Nunatak at 69°44’56”S, 75°15’12”W) extends approximately 200 m east-west, by a maximum of 50 m north-south and harbours an extensive biota (Convey et al., 2000). This vegetated bluff consists of rock gently sloping to the north-west, which rapidly steepens to broken cliffs that drop to the sea. Water has been observed to be freely available at the site during all summer visits between December 1997 and January 2000.

Biota in the known terrestrial biological site include:

- Bryophytes: 16 mosses (including Andreaea spp., Bartramia patens, Bryum pseudotriquetrum, Brachythecium austrosalebrosum, Ceratodon purpureus, Dicranoweisia crispula, Grimmia reflexidens, Hennediella heimii, Hypnum revolutum, Pohlia spp., Polytrichum piliferum, Schistidium antarctici, Syntrichia princeps) and one liverwort (Cephaloziella varians). The dominant species are Andreaea spp., Dicranoweisia crispula and Polytrichum piliferum, which are usually only common in the sub-Antarctic. The abundance of B. austrosalebrosum is remarkable as it is a hydric species requiring a continuous supply of water. The mosses generally occur on wet rock slabs irrigated by trickling melt water from late snow patches which has allowed the formation of cushions c. 15 cm deep. (Smith, 1998; Convey et al., 2000).

- Foliose alga: Prasiola crispa (Smith, 1998; Convey et al., 2000).
- Lichens: 34 species, plus two identified to genus level. The dominant lichen species are Pseudophebe minuscule, Umbilicaria decussata, Usnea sphacelata and various crustose taxa (Smith, 1998; Convey et al., 2000). Lichen communities occupy much of the dry, windswept stony ground and ridges. Melt channels on sloping rock slabs are lined with large thalli (up to ~15 cm across) of Umbilicaria antarctica. The Area includes two lichen species that are previously unrecorded from Antarctica (Psilolechia lucida and Umbilicaria aff. thamnodes) and represents the furthest south known occurrence for several lichen species (including Frutidella caesioatra, Massalongia spp., Ochrolechia frigida, Usnea aurantiaco-atra and Usnea trachycarpa). Unusually, the widespread Usnea antarctica was not recorded from the site.
- Invertebrates: Seven species of Acari, seven Nematoda and four Tardigrada were present in collections from Marion Nunataks. Uniquely, neither acarine predators nor Collembola were recorded (Convey, 1999; Convey et al., 2000).
- Vertebrates: A small colony of 60 Adelie penguins (Pygoscelis adeliae) containing many chicks was reported from the small islands just to the northwest of Mount Monique (Henderson, 1976; Croxall and Kirkwood, 1979). The colony was still present at the location in January 2011 with 70 breeding pairs and numerous chicks recorded. This is thought to be the most southerly colony of Adélie penguins on the Antarctic Peninsula. Other than the penguin colony, the Area has little vertebrate influence. South polar skuas (Stercorarius maccormicki) are observed in the Area and a single nest was found on moss turf. Other birds observed and considered likely to breed in the area were small numbers of Antarctic terns (Sterna vittata), snow petrels (Pagodroma nivea), Antarctic petrels (Thalassoica antarctica) and Wilson's storm petrels (Oceanites oceanicus Kühl) (Henderson, 1976; Smith, 1998; Convey et al., 2000).

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

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

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

- *Past human activity*

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

A temporary hut (30 m²) and airstrip were established by the Chilean Antarctic Expedition and Chilean Air Force (FACH) in November 1982. The camp was situated on ice a few kilometres east of Mount Martine (69°43'S, 75°00'W), on what is now the eastern boundary of the Area. The hut was buried by snow during the winter of 1983 and no evidence of the station remains on the surface (Comite Nacional de Investigaciones Antarcticas, 1983; Veronica Vallejos, pers comm.).

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

Brief boat landings were made at the Adélie penguin colony on the coast northwest of Mount Monique by scientists from the United States in early 2010 and 2011.

6 (ii) Access to the Area

No access points are specified, but landings are usually most safely made by aircraft on areas of permanent ice, as accessing inland locations from the sea is made difficult due to step ice cliffs around much of the coastline. Aircraft landing within the Area must comply with the condition described in section 7(ii). In early 2010 and 2011, brief landings were made from the sea by scientist from the United

States to visit the Adélie penguin colony situated on ice-free ground to the northwest of Mt. Monique (approximate location 69°45’40” S, 75°25’00” W). The landings were made despite difficult sea ice conditions, which are common in this area. Furthermore, sea ice conditions prevented further landings in 2012. Consequently, this route is not recommended for general access to the Area.

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

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

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

There are no other ASPAs or ASMAs in the vicinity, with the nearest protected area being ASPA No. 147 Ablation Valley and Ganymede Heights, which is situated 270 km away on the eastern coast of Alexander Island.

6 (v) Special zones within the Area

There are no special zones in 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 under Article 3, paragraph 4, and Article 7 of Annex V to the Protocol on Environmental Protection to the Antarctic Treaty.

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

- it is issued for a compelling scientific reason, which cannot be served elsewhere, or for reasons essential to the management of the Area;
- the activities permitted will give due consideration via the environmental impact assessment process to the continued protection of the environmental and scientific values of the Area;
- the activities permitted are in accordance with this Management Plan;
- the Permit, or an authorised copy, shall be carried when in the Area;
- the Permit shall be issued for a finite period;
- a report is supplied to the authority or authorities named in the Permit; 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

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

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

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

- *(a) Aircraft and Remotely Piloted Aircraft Systems (RPAS)*

Aircraft are only permitted to land in the Area if they have performed the measures as detailed in this Management Plan (section 7(x)). Otherwise aircraft must land outside the Area. Within the Area, fixed and rotory wing aircraft are prohibited from landing within 100 m of ice-free ground and the associated flora and fauna. The remaining 100 m of the approach to the ice-free ground must be made on foot.

An Adélie penguin colony is present within the Area on coastal ground to the northwest of Mount Monique (approximate location 69°44’40” S, 75°25’00” W). The operation of aircraft over the Area 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). Overflight of bird colonies within the Area by RPAS shall not be permitted unless for scientific or operational purposes, and in accordance with a permit issued by an appropriate national authority.

- *(b) Ships and small boats*

Little information is available on locations appropriate for ship and small boat landings (see section 6(ii)). Given the unpredictable nature of sea ice conditions in the region, landings by boat are not recommended for general access to the Area. However, boat lands may be appropriate for visiting coastal locations, such as the Adélie penguin colony northwest of Mt. Monique (approximate location 69°45’40” S, 75°25’00” W).

- *(c) Land vehicles and sledges*

Land vehicles shall not be taken into the Area unless essential for scientific, management or safety reasons. Land vehicles and sledges are only permitted within the Area if they are compliant with the measures as detailed in this Management Plan (section 7(x)). Once inside the Area, skidoos, sledges and other land vehicles are prohibited within 100 m of all ice-free ground and associated flora and fauna. The remaining 100 m of the approach to the ice-free ground must be made on foot.

- *(d) Human movement*

Pedestrian traffic shall be keep to an absolute minimum necessary to be consistent with the objectives of any permitted activities. Where no routes are identified, pedestrian traffic should be kept to the minimum necessary to undertake permitted activities and every reasonable effort should be made to minimise trampling effects. 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.

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

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

Activities which may be conducted in the Area include:

- Compelling scientific research that cannot be undertaken elsewhere and which will not jeopardize the ecosystem of the Area;
- sampling, which should be the minimum required for approved research programmes; and
- essential management activities, including monitoring.

7(iv) 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 and for a pre-established period, as specified in a permit.
- Permanent structures or installations are prohibited.
- All markers, structures or scientific equipment installed in the Area must be 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, spores) and non-sterile soil (see section 7(x)), and be made of materials that can withstand the environmental condition and pose minimal risk of contamination of the Area.
- Removal of specific structures or equipment for which the permit has expired shall be the responsibility of the authority which granted the

original permit and shall be a condition of the Permit.

- Existing structures must not be removed, except in accordance with a permit.

7(v) Location of field camps

Camping within the Area is only permitted if scientific and management objectives cannot be achieved during a day trip to the Area. Camping may also occur within the Area during an emergency. Unless unavoidable for safety reason, tents should be erected on permanent snow or ice, at least 500 m from the nearest ice-free area. Field camp equipment must be cleaned and transported as described in section 7(x) of this Management Plan.

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

In addition to the requirements of the Protocol on Environmental Protection to the Antarctic Treaty, restrictions on materials and organisms which may be brought into the area are as follows:

- 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 unintentional introduction of animals, plant material, microorganisms 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). Additional site-specific biosecurity measures are listed in section 7(x).
- No poultry products, including food products containing uncooked dried eggs, shall be taken into the Area.
- No herbicides or pesticides shall be brought into the Area. Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for a compelling scientific purpose specified in the Permit, shall be removed from the Area at or before the conclusion of the activity for which the Permit was granted. Release of radio-nuclides or stable isotopes directly into the environment in a way that renders them unrecoverable should be avoided.
- Fuel, food and other materials are not to be deposited in the Area, unless required for essential purposes connected with the activity for which the Permit has been granted. They shall be stored and handled in a way that minimises the risk of their accidental introduction into the environment. Fuel, food and other materials must only be stored on snow or ice that is at least 500 m from the nearest ice-free ground. Permanent depots are not permitted.
- Materials introduced into the Area shall be for a stated period only and shall be removed by the end of that stated period.

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

Taking of, or harmful interference with, native flora and fauna is prohibited, except in accordance with a permit 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 (2011). Any soil or vegetation sampling is to be kept to an absolute minimum required for scientific or management purposes, and carried out using techniques which minimise disturbance to surrounding soil, ice structures and biota.

7(viii) The 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, and 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 national authority must be notified and approval obtained.

7(ix) Disposal of waste

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

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

To help protect the ecological and scientific values derived from the isolation and low level of human impact at the Areas, visitors shall take special precautions against the introduction of non-native species. Further guidance can be found in the CEP non-native species manual (CEP, 2017) and the Environmental code of conduct for terrestrial scientific field research in Antarctica (SCAR, 2009). Of particular concern are animal or plant introductions sourced from:

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

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

- *(a) Aircraft*

The interior and exterior of aircraft shall have been carefully inspected and cleaned as near as possible to the time of departure of the aircraft from the originating

Antarctic station or ship. It is recommended that this include thorough sweeping and vacuuming of the inside of the aircraft and steam-cleaning or brushing of the exterior of the aircraft. Any aircraft that has landed at other rock airstrips or near biologically rich sites since being cleaned at the Antarctic station or ship is not permitted to enter the Area.

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

- *(b) Small boats*

Small boats used to transport visitors from a support vessel to the Area boundary shall be cleaned (with particular attention paid to the inside of the boats) to ensure they are free of soil, dirt and propagules.

- *(c) Land vehicles and sledges*

Before land vehicles and sledges enter the Area, all mud, soil, vegetation and excessive dirt and grease must be removed. Ideally, this should have been completed on the originating Antarctic station or ship before transfer of the vehicles into the field. Land vehicles shall not enter the Area if after cleaning they have been driven over areas of rock or soil outside the Area.

- *(d) Field camp equipment*

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

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

To the greatest extent possible, all sampling equipment, scientific apparatus and markers brought into the Area shall have been sterilized, and maintained in a sterile condition, before being used within the Area. Sterilization should be by an accepted method, including UV radiation, autoclaving or by surface sterilisation using 70% ethanol or a commercially available biocide (e.g. Virkon®) (see the Environmental code of conduct for terrestrial scientific field research in Antarctica (SCAR, 2009)).

- *(f) General field equipment*

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

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

- *(g) Outer clothing*

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

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

- Direct aircraft landing in the Area. Sterile protective over-clothing shall be worn. The protective clothing shall be put on immediately prior to leaving the aircraft. Spare boots, previously cleaned using a biocide then sealed in plastic bags, shall be unwrapped and put on just before entering the Area.
- Overland movement into the Area from outside its boundaries. Sterile protective over-clothing is not recommended as, once within the Area, significant amounts of travel over crevassed ground may be required and use of sterile protective over-clothing may interfere with safety equipment such as ropes and harnesses. For overland movement into the Area, alternative measures must be used. Each visitor is required to bring at least two sets of outer clothing. The first set shall be worn for the journey to the Area boundary. The second set of outer clothing, which has previously been cleaned and sealed in plastic bags, shall only be worn inside the Area. Immediately before entering the Area, visitors shall change into their clean set of outer clothing. Spare boots, previously cleaned using a biocide then sealed in plastic bags, shall be unwrapped and put on just before entering the Area. The removed unclean outer clothing shall be stored in sealed, labelled plastic bags, preferably outside the Area. On leaving the Area by overland travel, the clothing worn in the Area should be removed and stored in a clean, labelled plastic bag until needed for any further trips into the Area, or returned to the originating Antarctic station or ship for cleaning.
- Movement to the Area boundary by small boat. When aboard the support vessel, and immediately prior to entering the small boat to travel to the Area, each visitor, including the boat crew, shall put on clean clothing

(including boating suits, life jackets and footwear) which is free of soil, seeds and other propagules. Alternatively, on arrival at the Area boundary, and before exiting the small boat, visitors shall cover all clothing in clean protective oversuits. Additional clothing or footwear required by visitors when within the Area, shall be cleaned before leaving the support vessel, and stored in a sealed container (e.g. plastic bag) until needed.

7(xi) Requirements for reports

The principal permit holder for each visit to the Area shall submit a report to the appropriate national authority as soon as practicable, and no later than six months after the visit has been completed. Such reports should include, as appropriate, the information identified in the Antarctic Specially Protected Area visit report form contained in the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas (Appendix 2). In this report, particular note should be made of the specific ice-free locations visited within the Area (including, if possible, GPS coordinates), the length of time spent at each location and the activities undertaken. Wherever possible, 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, 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. Supporting documentation

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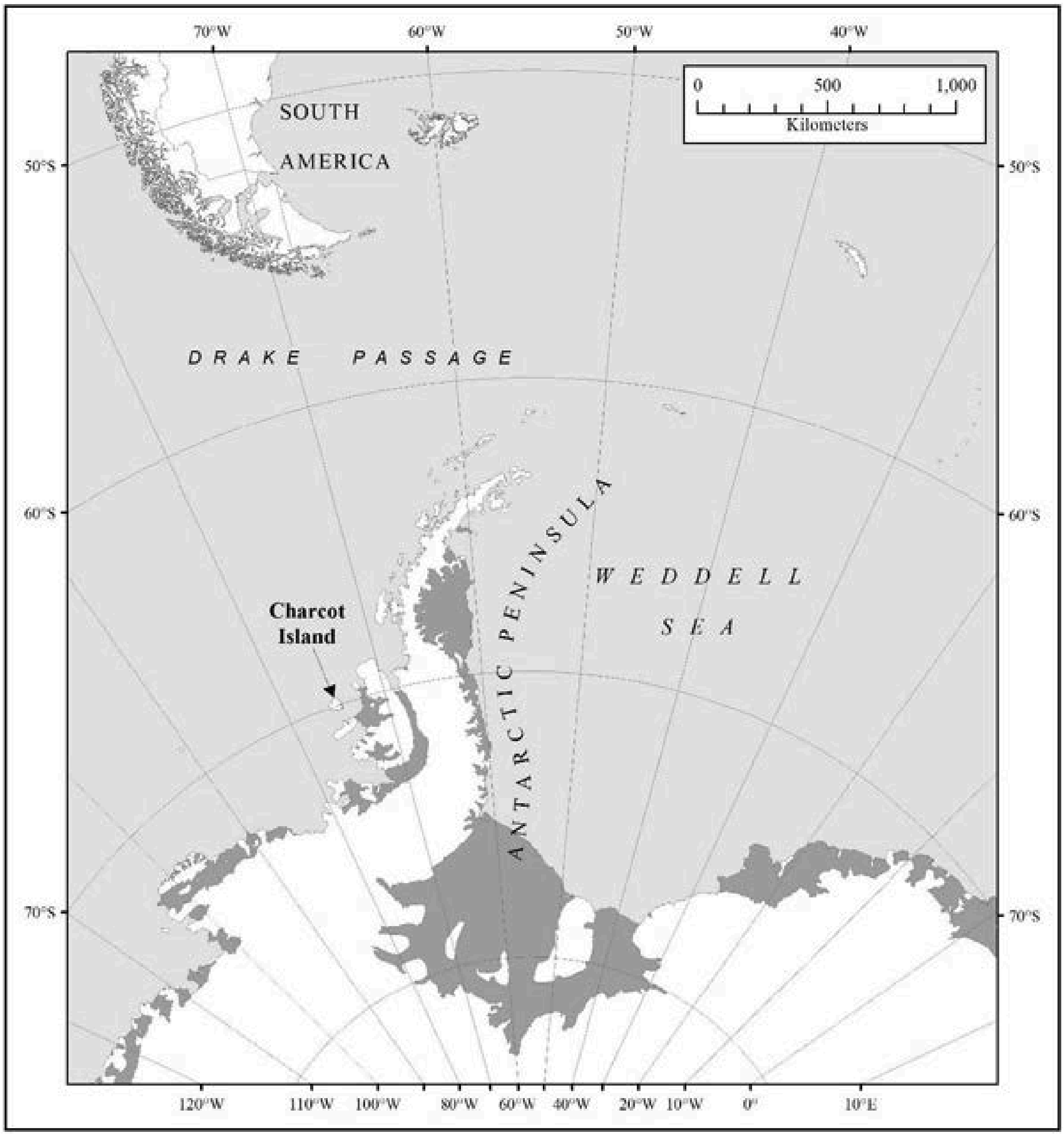
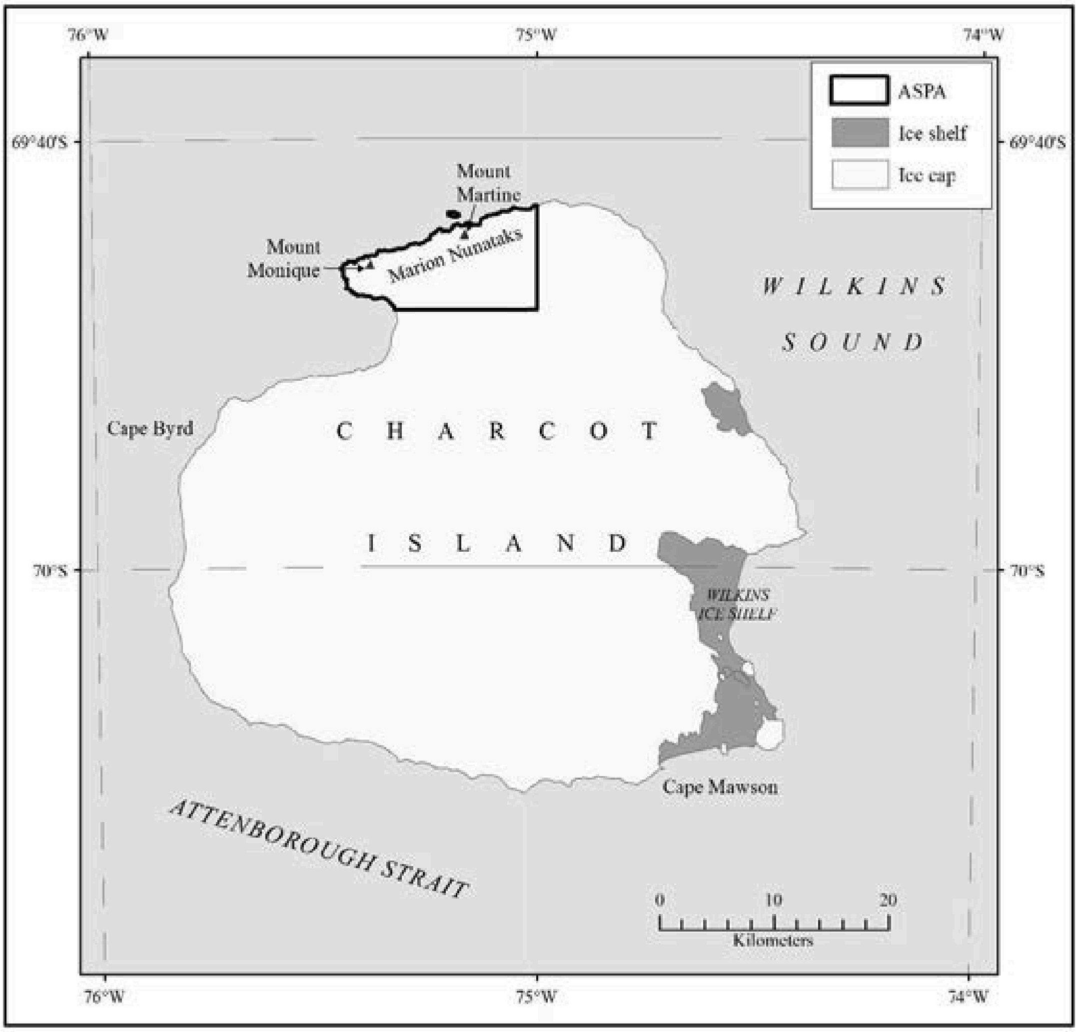
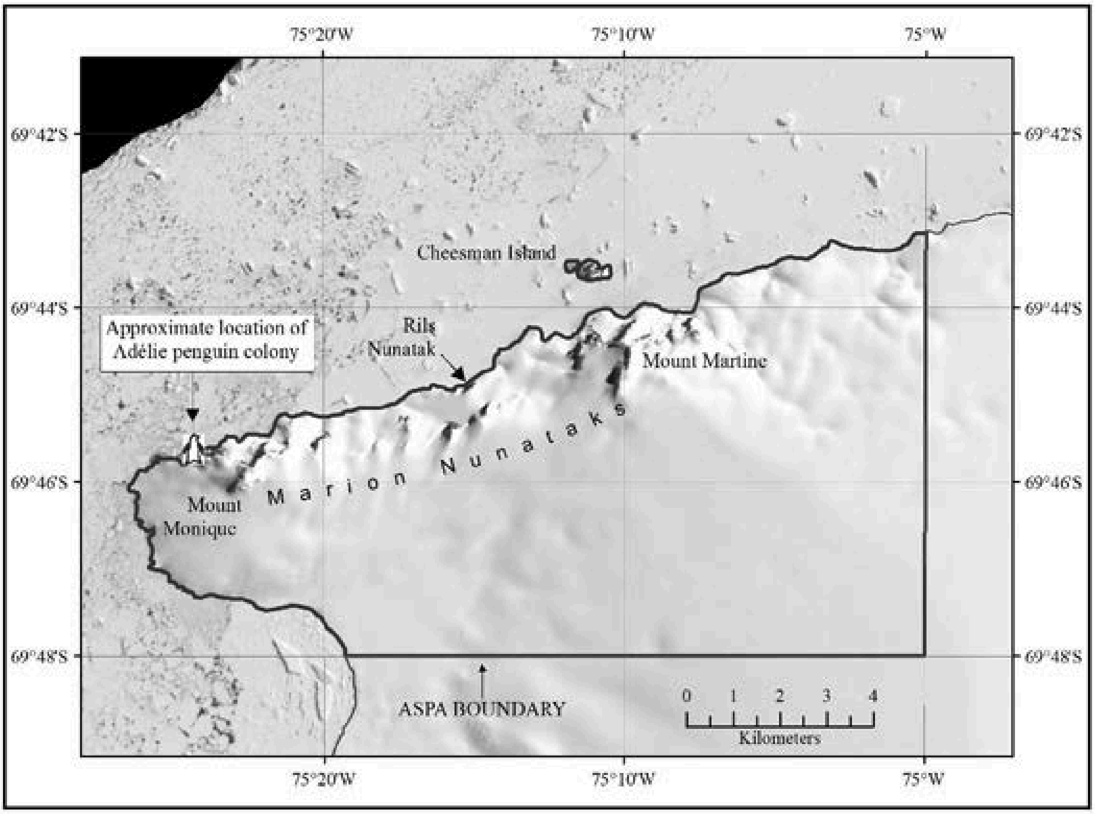
Map 1. Charcot Island in relation to Alexander Island and the Antarctic Peninsula. Map specifications: WGS84 Antarctic Polar Stereographic. Central meridian -55°, Standard parallel: -71°.



Map 2. Charcot Island, including ASPA No. 170, Marion Nunataks situated in the northwest of the island. Map specifications: WGS 1984 Antarctic Polar Stereographic. Central Meridian: -75°, Standard Parallel 1: -71.0°.



Map 3. ASPA No. 170, Marion Nunataks, Charcot Island, Antarctic Peninsula. Map specifications: WGS 1984 Antarctic Polar Stereographic. Central Meridian: -75°, Standard Parallel 1: -71.0°. Developed from USGS Landsat Image Mosaic of Antarctica, Scene ID: x-2250000y+0450000. Metadata available at http://lima.usgs.gov/.



Measure 6 (2018)

Antarctic Specially Protected Area No 172 (Lower Taylor Glacier and Blood Falls, McMurdo Dry Valleys, Victoria Land): Revised Management Plan

The Representatives,

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

Recalling Measure 9 (2012) which designated Lower Taylor Glacier and Blood Falls, McMurdo Dry Valleys, Victoria Land as ASPA 172 and adopted a Management Plan for the Area;

Noting that the Committee for Environmental Protection has endorsed a revised Management Plan for ASPA 172;

Desiring to replace the existing Management Plan for ASPA 172 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 172 (Lower Taylor Glacier and Blood Falls, McMurdo Dry Valleys, Victoria Land), which is annexed to this Measure, be approved; and
2. the Management Plan for Antarctic Specially Protected Area No 172 annexed to Measure 9 (2012) be revoked.

Management Plan for Antarctic Specially Protected Area No 172

LOWER TAYLOR GLACIER AND BLOOD FALLS, MCMURDO DRY VALLEYS, VICTORIA LAND

Introduction

Blood Falls is an iron-rich saline discharge located at the terminus of the Taylor Glacier, Taylor Valley, McMurdo Dry Valleys. The source of the discharge is believed to be a subglacial extensive brine aquifer located beneath the measureable length (~5 km) of the ablation zone of the Taylor Glacier, estimated to be located between one to six kilometres above Blood Falls. Approximate area and coordinates: sub-surface area 436km² (centered at 161°40.230'E, 77°50.220'S); sub-aerial area 0.11km² (centered at the Blood Falls discharge at 162°15.809'E, 77°43.365'). The primary reasons for designation of the Area are its unique physical properties, and the unusual microbial ecology and geochemistry. The Area is an important site for exobiological studies and provides a unique opportunity to sample the subglacial environment without direct contact. The influence of Blood Falls on adjacent Lake Bonney is also of significant scientific interest. Furthermore, the ablation zone of the Taylor Glacier is an important site for paleoclimatic and glaciological research. The lower Taylor Glacier subglacial brine reservoir and Blood Falls are globally unique and a site of outstanding scientific importance. Designation of the Area allows for scientific access to ice deep within Taylor Glacier, provided measures are in place to ensure this does not compromise the Blood Falls reservoir and hydrological system. Under the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)) the Area lies within Environment S – McMurdo – South Victoria Land geologic. Under the Antarctic Conservation Biogeographic Regions (v2) (Resolution 3 (2017)) the Area lies within ACBR 9 – South Victoria Land.

1. Description of values to be protected

Blood Falls is a distinctive glacial feature located at 162°16.288'E, 77°43.329'S, at the terminus of the Taylor Glacier in the Taylor Valley, McMurdo Dry Valleys, southern Victoria Land (Map 1). The feature forms where an iron-rich, saline liquid discharge of subglacial origin emerges at the surface and then rapidly oxidizes to give it a distinctive red coloration (Figure 1). Available evidence suggests the source of the discharge is a subglacial marine salt deposit and brine reservoir located beneath the Taylor Glacier (Keys 1980; Hubbard et al. 2004; Mikucki et al. 2015) (Map 1). The feature is unique in its physical configuration, microbial biology and geochemistry and has an important influence on the local ecosystem of Lake Bonney. Furthermore, the episodic discharge events at Blood Falls provide a unique opportunity to sample the properties of the subglacial reservoir and its ecosystem.

Blood Falls was first observed by Griffith Taylor, Robert F. Scott’s Senior Geologist, in 1911. However, scientific research into its unusual morphological and geochemical characteristics did not commence until the late 1950s (Hamilton et al. 1962; Angino et al. 1964; Black et al. 1965). The feature named as Blood Falls is the primary discharge site at the terminus of the Taylor Glacier (Map 2). A secondary lateral saline discharge has been observed to emerge at the surface from under sediments ~40 m north from the Taylor Glacier at the margin of the Santa Fe Stream delta (162°16.042'E, 77°43.297'S, Map 2). The exact location and form of the subglacial reservoir source feeding Blood Falls is currently uncertain, although geological, glacio-chemical and geophysical mapping results suggest that the reservoir extends from beneath Lake Bonney and below the glacier terminus to at least 5 km up-valley (Keys 1980; Hubbard et al. 2004; Mikucki et al. 2015, Foley et al. 2015). It has been estimated that the brine reservoir became encased by ice approximately 3 to 5 Ma BP (Marchant et al. 1993) and may represent the oldest liquid feature in the Taylor Valley (Lyons et al. 2005).

The Blood Falls outflow contains a unique microbial community of apparently marine origin. The microbes may survive in the subglacial environment for millions of years without external carbon input. On account of its high iron and salt content, and its physical location below glacier ice, the microbial ecosystem at Blood Falls is an important site for exobiological studies and may provide an analogue for the conditions found beneath the polar ice caps on Mars or ocean worlds such as Enceladus and Europa. It is therefore important to ensure that the Blood Falls microbial community, the brine reservoir and associated subglacial hydrological system are protected.

The discharge episodically released from Blood Falls into adjacent Lake Bonney alters the geochemical composition of the lake and provides nutrients that are otherwise limited, making the site valuable for investigation of the impacts of subglacial outflow on lake ecosystems. There is growing evidence that brine from the subglacial aquifer also has a direct, subglacial connection with Lake Bonney bottom waters (Mikucki et al. 2015; Spigel et al. in press 2018).

The Taylor Glacier is an important site for Antarctic glaciological and paleoclimatic studies. It provides a unique opportunity to study Antarctic outlet glacier behaviour in relation to environmental change, using ice core paleoclimatic data from Taylor Dome, geologic evidence from the Taylor Valley and climatic data from nearby US Long Term Ecological Research (LTER) sites (Kavanaugh et al. 2009a; Bliss et al. 2011). The lower ablation zone of the Taylor Glacier has been identified as a potentially valuable site for paleoclimatic studies, as it exposes ice from the last glacial period and allows past concentrations of trace gases to be measured at a high temporal resolution (Aciego et al. 2007). In addition, the Taylor Glacier is of scientific value for glaciological studies, in particular glacier dynamics and the relationships between stresses and glacier flow, and for other glaciological research (Kavanaugh & Cuffey 2009).

The Blood Falls system is a valuable site for study of microbiology, water chemistry, glaciology, and paleoclimatology. The most unusual aspects of the Blood Falls system are its physical configuration, brine chemistry and microbial ecosystem. Blood Falls also exerts considerable influence over the geochemistry and microbiology of Lake Bonney. The Area possesses outstanding aesthetic values and significant educational value, as the site has been the subject of a range of scientific and media articles in recent years. Blood Falls and the Taylor Glacier brine reservoir merit special protection due to their outstanding scientific values, unique configuration, ancient origin, importance to ecosystems in the local area, and their vulnerability to disturbance by human activities.

On the basis of presently available knowledge, the input of contaminants directly into the subglacial reservoir or into areas of the bed from which subglacial fluids could flow towards the reservoir has been identified as the most likely potential mechanism for contamination of the Taylor Glacier brine reservoir. However, the uncertainties surrounding the location of the subglacial reservoir and its connectivity with the subglacial hydrological system make it difficult to assess the likelihood of this occurring and for this reason a precautionary approach has been adopted when defining the boundaries of the sub-surface component of the Area.

2. Aims and objectives

Management at the lower Taylor Glacier and Blood Falls aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance and sampling in the Area;
- allow scientific research, in particular on the microbial community, water chemistry and physical configuration of the lower Taylor Glacier and Blood Falls;
- allow other scientific research and visits for education / outreach provided they will not jeopardize the values of the Area;
- minimize the possibility of introduction of alien plants, animals and microbes into 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:

- Markers or signs illustrating the location and boundaries, with clear statements of entry restrictions, should as appropriate be placed at locations on the boundary of the sub-aerial component of the Area 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 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;

- A copy of this Management Plan shall be kept available in the principal research hut facilities proximal to the Area, in particular the Lake Bonney, Lake Hoare, Lake Fryxell, F6, and New Harbor camps, and at McMurdo Station and Scott Base;
- National Antarctic programs operating in the region shall consult together for the purpose of ensuring that the above provisions are implemented.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

Map 1: ASPA 172: Lower Taylor Glacier and Blood Falls sub-surface protected area boundary. Projection: Lambert Conformal Conic; Standard parallels: 1st 77°35'S; 2nd 77°50'S; Central Meridian: 161°30'E; Latitude of Origin: 78°00’S; Spheroid and horizontal datum: WGS84; Contour interval 200m.

Inset 1: Location of ASMA 2 McMurdo Dry Valleys in the Ross Sea region.

Inset 2: Location of the Taylor Glacier in ASMA 2 McMurdo Dry Valleys.

Map 2: ASPA 172: Blood Falls sub-surface and sub-aerial protected area boundary and designated camp site. Projection: Lambert Conformal Conic; Standard parallels: 1st 77°43'S; 2nd 77°44'S; Central Meridian: 162°16'E; Latitude of Origin: 78°00'S; Spheroid and horizontal datum: WGS84; Contour interval 20m.

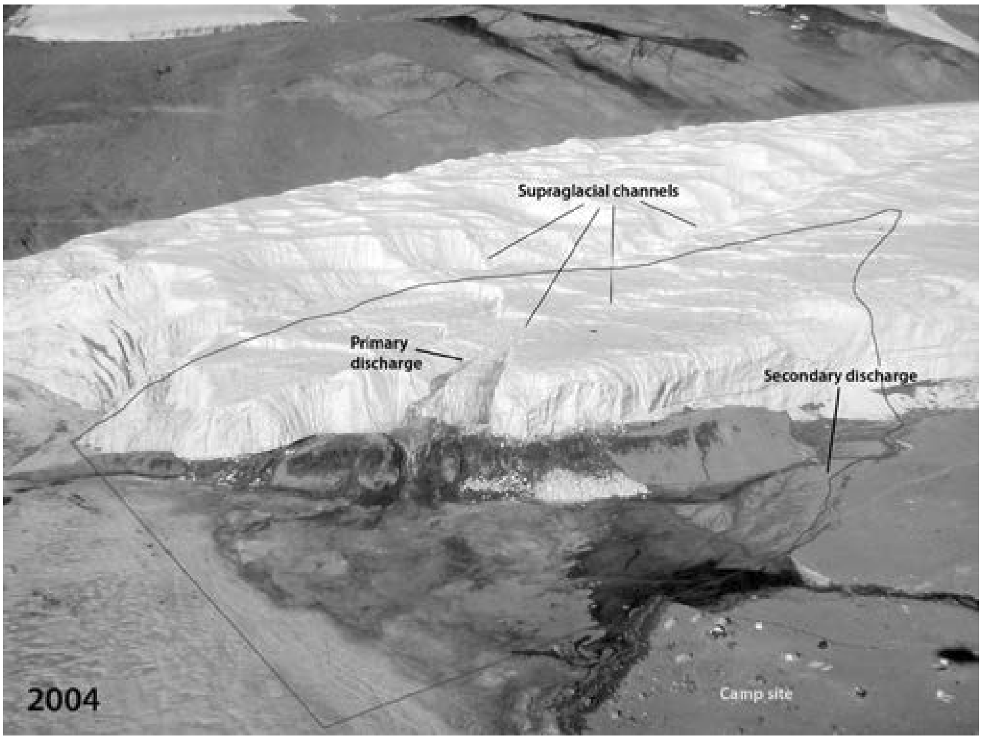


Figure 1. Aerial view of the terminus of the Taylor Glacier in 2004, with Blood Falls at center and Lake Bonney at lower left (Photographer unknown: 18 Nov 2004). Note that the camp site shown is now largely submerged by Lake Bonney (January 2018).

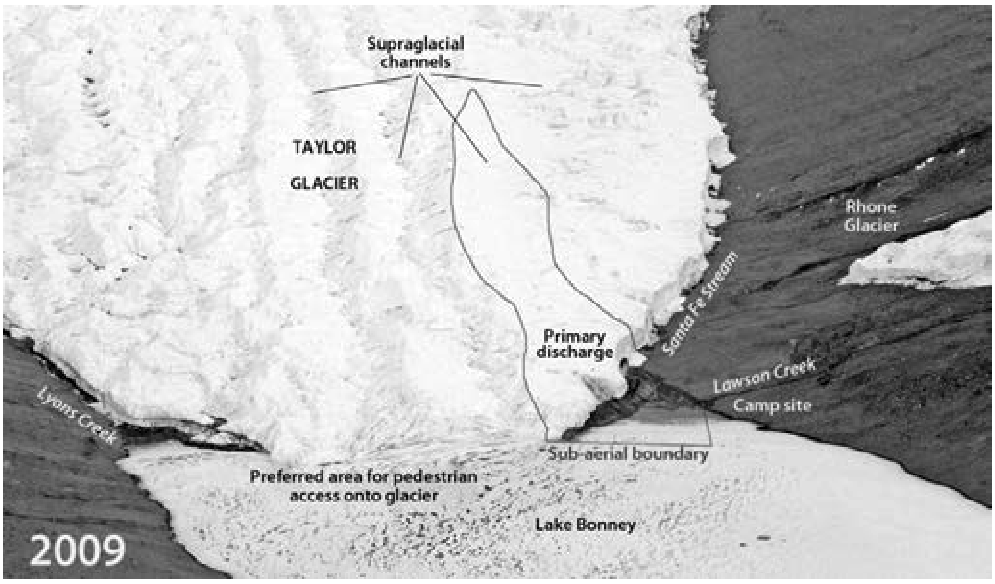


Figure 2. Aerial view of the terminus of the Taylor Glacier in 2009, showing the extent of the sub-aerial component of the Area. A comparison with Figure 1 highlights the extent to which the size of the discharge varies over time (C. Harris, ERA / USAP: 10 Dec 2009).

6. Description of the Area

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

- *Overview*

Blood Falls (located at 162°16.288'E, 77°43.329'S) is an iron-rich, hypersaline discharge that emerges from a crevasse near the terminus of Taylor Glacier, in the McMurdo Dry Valleys, southern Victoria Land. The brine initially lacks color, but freezes to a bubbly white icing as it flows off the glacier and then oxidises to produce its distinctive red-orange colour. Many traces of iron coloured material remain encapsulated in former crevasses and cracks in the glacier especially near the primary discharge point. A secondary, much smaller and less distinct, surface discharge has been observed twice (1958, 1976) ~40m north of Taylor Glacier at the margin of the Santa Fe stream delta (162°16.042'E, 77°43.297'S, Map 2). The secondary discharge has a similar physical and chemical composition to the primary outlet at Blood Falls (Keys 1980).

The volume and physical extent of the primary Blood Falls surface outflow and icing accumulation varies over time, ranging from a few hundred to several thousand cubic metres of saline icing, and the discharge events occur at intervals of one to three years or more (Keys 1980). An unknown proportion of brine sometimes drains, before it freezes (e.g. 1972, 1978) into Lake Bonney. At its minimum extent, the discharge appears as a small area of discoloration at the Taylor Glacier terminus, but can extend tens of metres across Lake Bonney at its maximum (see e.g., Figures 1 & 2).

The source of the brine discharges is subglacial, and the water in the discharge brine is melted glacial ice (Mikucki et al. 2009) but the original source and formation age and evolution for the subsurface brine remains unclear. Chemical and isotopic analyses indicate that a marine salt deposit or deposits are melting and / or have melted ice of Taylor Glacier (Keys 1980). Deepened subglacial topography beneath the Taylor Glacier between one to six kilometres from the terminus suggests the salt body is likely to be located there but there could be other locations further up glacier. The thickness and extent of the resulting subglacial brine, or the exact location and nature of the resulting reservoir(s) and brine drainage paths have yet to be firmly established (Keys 1980; Hubbard et al. 2004).

- *Boundaries and coordinates*

The boundaries of the Area are designed to protect the values of the subglacial brine reservoir and the Blood Falls surface discharge, taking into account the size of the catchment, likely hydrological connections and practicality. Because there is evidence that hydrological connections and interactions between the surface and bed of the Taylor Glacier are likely to be minimal, restricting access on and / or over the majority of the surface of the catchment is not considered necessary. However, a small area encompassing the confirmed primary and secondary Blood Falls discharges, including a part of the Taylor Glacier surface that drains directly into the primary discharge, is included within the boundary at the surface to provide adequate protection for the confirmed outflow areas (Map 2). The ‘possible discharge’ location examples shown on Map 1 are not currently included within the Area because they remain unconfirmed. They may represent exposures that indicate basal processes that may at one time have involved the reservoir or related features rather than be points of contemporary discharge. Moreover these features do not feed into the reservoir or primary outflow site at Blood Falls.

Subglacial interconnections, on the other hand, could be extensive, so a relatively large sub-surface component extending ~50km up-glacier aims to protect the main part of the subglacial catchment of the lower Taylor Glacier that could be interconnected with the brine reservoir (Map 1). This extent is currently considered sufficient to protect the values of the reservoir, although it is recognized that some interconnections may extend further since technically the catchment extends far onto the polar plateau; the western boundary was therefore selected in part as a practical limit beyond which the risks to the Area are considered minimal.

In summary, the vertical and lateral extents of the Area were defined on the grounds that the boundary:

- protects the integrity of the subglacial reservoir and the confirmed primary and secondary Blood Falls discharge areas;
- allows for uncertainties in the location of the reservoir and in the connectivity within the subglacial hydrological system;
- provides a practical boundary based on catchments that is straightforward to map and identify in the field; and
- does not unnecessarily restrict activities on and / or over the surface of the Taylor Glacier.

Key boundary coordinates are summarized in Table 1.

Table 1: Summary list of key protected area boundary coordinates (see Maps 1 & 2)

Location	Label	Longitude (E)	Latitude (S)
Sub-surface boundary			
Blood Falls primary discharge	A	162° 16.305'	77° 43.325'
Taylor / Ferrar glaciers ice divide, southern margin of Kukri Hills	B	161° 57.300'	77° 49.100'
Knobhead, foot of NE ridge	C	161° 44.383'	77° 52.257'
Kennar Valley, center at Taylor Glacier margin	D	160° 25.998'	77° 44.547'
Beehive Mountain, foot of SW ridge	E	160° 33.328'	77° 39.670'
Mudrey Cirque SW extent	F	160° 42.988'	77° 39.205'
Mudrey Cirque SE extent	G	160° 48.710'	77° 39.525'
Sub-aerial boundary			
Taylor Glacier terminus, ice / moraine outcrop	*a*	162° 16.639'	77° 43.356'

Supraglacial catchment feeding Blood Falls, western extent	*b*	162° 14.508'	77° 43.482'
Taylor Glacier, northern margin	*c*	162° 15.758'	77° 43.320'
Santa Fe Stream delta, western margin	*d*	162° 15.792'	77° 43.315'
Lawson Creek, boulder on west bank	*e*	162° 16.178'	77° 43.268'
Lake Bonney, ~180m east from shore at Santa Fe Stream delta	*f*	162° 16.639'	77° 43.268'

- *Sub-surface*

The sub-surface boundary encompasses the entire ablation zone of the Taylor Glacier, from a depth of 100m below the surface to the glacier bed. In order to aid identification of the boundary at the surface, and because of practical constraints over the availability of data on the configuration of the 100m depth within the glacier, the surface margin of the Taylor Glacier is used as a surrogate for the 100m depth line and thus is used to define the lateral extent of the sub-surface component of the Area. The following description first defines the lateral extent of the sub-surface component of the Area and subsequently defines the vertical extent.

The sub-surface component of the protected area boundary extends from the primary Blood Falls discharge site (162°16.288'E 77°43.329'S) (labelled 'A' in Table 1 and on Maps 1 & 2) and follows the Taylor Glacier terminus southward 0.8km to the southern margin of the glacier at Lyons Creek. The boundary of the Area thence extends 19.3km SW (Map 1), following the southern margin of the Taylor Glacier to the western extremity of the Kukri Hills. The boundary thence extends 7.8km east to an approximate position where the ice divides between the Taylor and Ferrar glaciers along the southern margin of the Kukri Hills, located at 161°57.30'E, 77°49.10'S ('B', Table 1, Map 1). The boundary thence extends 7.9km SW, following the approximate divide between the Taylor and Ferrar glaciers to the eastern extremity of Knobhead at 161°44.383'E, 77°52.257'S ('C', Table 1, Map 1). The boundary thence follows the southern margin of the Taylor Glacier westward 11.8km to Windy Gully, crosses Windy Gully and thence extends 45.2km NW, following the margins of the Taylor, Beacon and Turnabout glaciers to the Kennar Valley, located at 160°25.998'E, 77°44.547'S ('D', Table 1, Map 1). The boundary thence extends NE across the Taylor Glacier 9.5km to the foot of Beehive Mountain at 160°33.328'E, 77°39.670'S ('E', Table 1, Map 1). As a visual reference, the protected area boundary runs parallel to a distinct ridge evident in the surface of the Taylor Glacier immediately downstream from an area of heavy crevassing.

From Beehive Mountain, the boundary extends 5km east to the boundary between Mudrey Cirque and the Taylor Glacier at 160°42.988'E, 77°39.205'S ('F', Table 1, Map 1). The boundary thence follows the margin of Mudrey Cirque for 9.6km to rejoin the Taylor Glacier at 160°48.710'E, 77°39.525'S ('G', Table 1, Map 1) and thence extends 59.6km SE to the foot of the Cavendish Icefalls, following the northern margin of the Taylor Glacier. The boundary thence extends north and east along the Taylor Glacier margin for 16.9km, excluding Simmons Lake and Lake

Joyce, and extends a further 15.4km east to the primary Blood Falls discharge site ('A', Table 1, Map 2).

The vertical extent of the sub-surface component of the Area is defined in terms of depth below the surface of the Taylor Glacier (Figure 3). The sub-surface boundary extends from a depth of 100m below the Taylor Glacier surface to the glacier bed, which is defined as the underlying bedrock surface below the glacier. The subglacial hydrological system, the Blood Falls brine reservoir, and any layers of mixed ice / sediment and / or unconsolidated sediments are included within the boundary. The sub-surface component of the Area does not impose additional constraints on activities conducted at the surface or within the upper 100m depth within the body of the Taylor Glacier.

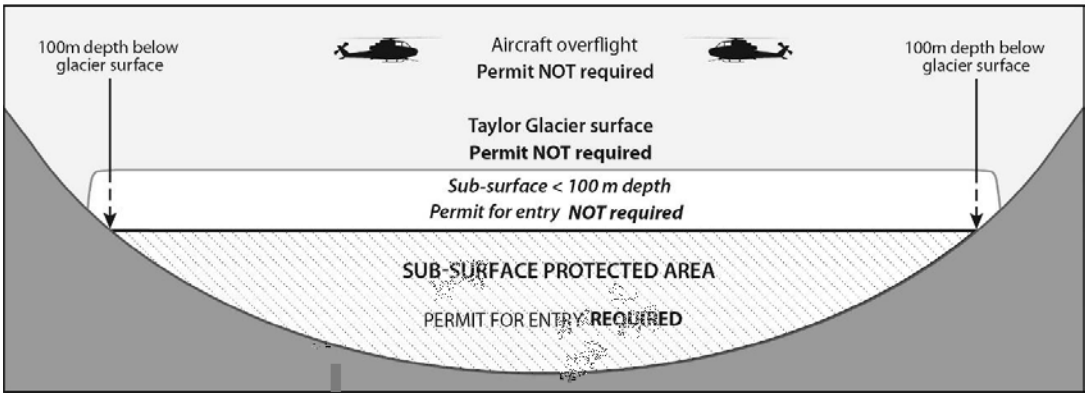


Figure 3: Depth-based definition of the vertical extent of the sub-surface component of the lower Taylor Glacier and Blood Falls protected area

- *Sub-aerial*

This sub-aerial component of the Area comprises the delta of Santa Fe Stream, part of the western extremity of Lake Bonney, and a small supraglacial catchment surrounding Blood Falls that is defined by a system of ice ridges that persist in the local glacier morphology over at least decadal time-scales. The SE boundary of the sub-aerial component of the Area is indicated by a prominent ice and moraine outcrop extending from the Taylor Glacier terminus at 162°16.639'E, 77°43.356'S (labelled 'a' in Table 1 and on Map 2). The boundary thence extends SW and up-glacier for 900.8m, following the southern margin of the supraglacial catchment surrounding Blood Falls to the most westerly extent of the supraglacial catchment, located at 162°14.508'E, 77°43.482'S ('b', Table 1, Map 2). The boundary thence extends NE by 594.5m to the Taylor Glacier margin at 162°15.758'E, 77°43.320'S ('c', Table 1, Map 2), following the northern margin of the supraglacial catchment. The boundary of the Area thence extends 16.8m NE in a straight line, to the top of the river bank above the Santa Fe Stream delta at 162°15.792'E, 77°43.315'S ('d', Table 1, Map 2). The boundary thence extends NE for 198.7m, following the top of the bank to the point at which it meets Lawson Creek, at 162°16.178'E, 77°43.268'S ('e', Table 1, Map 2). The boundary thence extends due east in a straight line for 180.5m to a point on Lake Bonney at 162°16.639'E e.g., 77°43.268'S (‘f’, Table 1, Map 2) and thence due south in a straight line for 166.5m to the prominent ice and moraine outcrop.

- *Climate*

Two meteorological stations operated by the McMurdo Dry Valleys Long Term Ecological Research (LTER) program are located close to Blood Falls (http://www.mcmlter.org/): ‘Lake Bonney’ (Point ‘a’, 162°27.881'E, 77°42.881'S) located ~4.5 km to the east, and ‘Taylor Glacier’ (162°07.881'E, 77°44.401'S), located ~4 km up-glacier. The mean annual air temperature at both stations was approximately –17ºC during the period 1993 – 2015. The lowest temperature at these stations during this period was –48.26ºC, recorded at Lake Bonney in August 2008, whilst the maximum of 10.64ºC was recorded at Lake Bonney in December 2001. August was the coolest month at both stations, with January and December the warmest at Lake Bonney and Taylor Glacier respectively.

Mean annual wind speeds over the same period (1995 – 2009) ranged from 3.89 m/s at Lake Bonney to 5.16 m/s at the Taylor Glacier. A maximum wind speed of 44.12 m/s was recorded at Taylor Glacier on 11 May 2014. Taylor Valley topography, in particular Nussbaum Riegel, encourages formation of isolated weather systems within the Lake Bonney basin and limits the flow of coastal winds into the area (Fountain et al. 1999).

Average mean annual precipitation at Lake Bonney between 1995 and 2009 was 340mm water equivalent. Ablation rates on the Taylor Glacier are highest in the area surrounding the Cavendish Ice Falls, reaching a maximum at the base of Windy Gully (~ 0.4m a-1), and are lowest up-glacier of Beacon Valley (~0 to 0.125m a-1). Ablation rates on the lower Taylor Glacier generally range from 0.15 to 0.3m a-1 (Bliss et al. 2011).

- *Geology and geomorphology*

The Taylor Valley is comprised of a mosaic of tills of varying ages and rock types, including: Precambrian metamorphic basement rocks (Ross Supergroup), early Paleozoic intrusives (Granite Harbor formation), a series of sedimentary rocks of Devonian to Jurassic age (Beacon Supergroup) and the Jurassic age Ferrar Dolerite sills (Pugh et al. 2003).

The Blood Falls subglacial reservoir is thought to be a marine brine originating from a marine incursion into the McMurdo Dry Valleys during the Pliocene (3 to 5 Ma BP) and may represent the oldest liquid water feature in the Dry Valleys (Lyons et al. 2005). It has been proposed that during the subsequent retreat of seawater from the Taylor Valley, the brine was trapped close to the modern-day terminus of the Taylor Glacier and was then ‘sealed’ beneath the glacier as ice advanced during the late Pliocene or Pleistocene (Marchant et al. 1993). The brine deposit is now thought to form a subglacial reservoir, which episodically emerges at the surface at the primary outflow and the secondary lateral discharge site. It has been suggested the brine has been modified since entrapment, partly due to inputs from chemical weathering (Keys 1980; Lyons et al. 2005; Mikucki et al. 2009).

- *Soils and sediment*

Taylor Valley soils are generally poorly developed and largely composed of sand (95- 99% by weight) (Burkins et al. 2000; Barrett et al. 2004). Taylor Valley soils have some of the lowest organic matter concentrations on Earth (Campbell & Claridge 1987; Burkins et al. 2000) and soils within the Lake Bonney basin are particularly low in organic carbon content (Barrett et al. 2004). In the Taylor Valley, soils generally extend to a depth of 10 to 30cm, below which is permafrost (Campbell & Claridge 1987). In addition to glacial till, the Taylor Valley floor is covered by lacustrine sediments, deposited by the formerly extensive glacial Lake Washburn, which extend to a depth of approximately 300m (Hendy et al. 1979; Stuiver et al. 1981; Hall & Denton 2000).

Moraines at the snout of the Taylor Glacier are composed of reworked lacustrine sediment, which dates from approximately 300 ka BP (Higgins et al. 2000). Sediments at the Taylor Glacier margin are also composed of silty and sandy tills, formed by melt-out from debris-rich basal glacier ice and from erosion by ice marginal streams (Higgins et al. 2000). A thick basal ice sequence characterised by fine-grained sediments and thought to contain salts originating from the Blood Falls subglacial reservoir was documented in a tunnel excavated on the northern margin of the Taylor Glacier (Samyn et al. 2005, 2008; Mager 2006; Mager et al. 2007). These observations suggest that the base of the Taylor Glacier is interacting with the underlying sediment and that localised melting and refreezing may be occurring (Souchez et al. 2004; Samyn et al. 2005; Mager et al. 2007).

- *Glaciology and glacial hydrology*

The Taylor Glacier is an outlet glacier of the East Antarctic Ice Sheet and terminates in the western lobe of Lake Bonney. A comprehensive study has recently been undertaken to investigate the dynamics of the Taylor Glacier ablation zone, including its geometry and surface velocity field (Kavanaugh et al. 2009a), its force balance (Kavanaugh & Cuffey 2009) and its contemporary mass balance (Fountain et al. 2006; Kavanaugh et al. 2009b). Results suggest that the glacier primarily flows through deformation of cold ice and that the Taylor Glacier is approximately in mass balance. Ice samples from the lower Taylor Glacier ablation zone have been used in paleoclimatic studies and the ice has been dated to the last glacial period (Aciego et al. 2007). Recent investigations on the lower Taylor Glacier identified a complete sequence of ice well-preserved in age and structure spanning from 8 to 55 ka BP (Baggenstos et al. 2017), with some ice aged at least 150 ka BP (Severinghaus pers. comm. 2018). Ice cores extracted from this area have been used to analyse changes in atmospheric gas constituents (Bauska et al. 2016; Petrenko et al. 2017). Other recent glaciological studies conducted on the Taylor Glacier have investigated the evolution of the dry ice cliffs at the terminus (Pettit et al. 2006; Carmichael et al. 2007), carried out textural and gas measurements on basal ice within a subglacial tunnel proximal to the primary

Blood Falls outlet (Samyn et al. 2005, 2008; Mager et al. 2007) and assessed the surface energy budget of the glacier (Bliss et al. 2011). Studies of the supraglacial hydrology of the Taylor Glacier suggest that meltwater channels cover approximately 40% of the lower ablation zone of the Taylor Glacier and melting within the channels contributes significantly to total runoff into Lake Bonney (Johnston et al. 2005). Two large channels drain across the primary Blood Falls outlet, but it is considered highly unlikely that direct connections exist between surface meltwater channels and the Blood Falls subglacial reservoir due to the cold temperatures of the near-surface ice and the lack of crevasse penetration beyond 100m depth (Cuffey, Fountain, Pettit and Severinghaus, pers. comms. 2010).

The extent of subglacial meltwater beneath the Taylor Glacier and its connectivity with the Blood Falls system is currently uncertain. Inferred basal temperatures suggest that the majority of the Taylor Glacier base is substantially below the pressure melting point (Samyn et al. 2005, 2008) and a radar survey conducted by Holt et al. (2006) found no evidence of widespread liquid water beneath the Taylor Glacier. Measurements made by Samyn et al. (2005) recorded a basal temperature of -17°C at the side of the glacier near Blood Falls. However, ice thickness and plausible gradients of englacial temperature are consistent with temperatures around -5 to -7°C at the base of the glacier within 1–3km of Blood Falls, similar to the measured temperatures of brine discharging at the primary and secondary sites (Keys 1980). Ice-penetrating radar surveys suggest that water, probably hypersaline, may exist within an 80 m bedrock depression, located between 4 and 6km from the Taylor Glacier terminus (Hubbard et al. 2004).

Saline water is released episodically from the subglacial reservoir of Blood Falls, usually via the primary outlet and on occasions via the secondary lateral discharge site. However, detailed underwater surveys of the Taylor Glacier terminus conducted by the ENDURANCE (Environmentally Non-Disturbing Under-Ice Robotic Antarctic Explorer) AUV (autonomous underwater vehicle) suggest that the subglacial brine may enter Lake Bonney across the majority of the Taylor Glacier terminus (Stone et al. 2010; Priscu, pers. comm. 2011). In addition, a number of sites have been identified on both the northern and southern margins of the Taylor Glacier where salts and orange discolouration exist in layers (examples of which are identified on Map 1 as ‘Possible discharge’), but the nature of these features has yet to be confirmed (Keys 1980; Nylen, pers. comm. 2010). The trigger for subglacial release events is uncertain, although it has been suggested that after accumulating under pressure beneath the glacier, the brine must travel through a discrete subglacial conduit which controls the location of the primary discharge: this behavior is similar to some aperiodic glacier bursts (jökulhlaups) where basal melting processes and changing stress patterns (such as physical shifts of the Taylor Glacier) may create a passage for the brine through impounding basal ice or force the subglacial liquid out from its bedrock depression (Keys 1980; Higgins et al. 2000; Mikucki 2005). Badgeley et al. (2017) suggest Blood Falls acts as a ‘pressure-release valve’ for the hydrologic system, where pressurized subglacial brine pools upstream from Blood Falls are injected englacially by basal crevassing where it can remain liquid due to cryoconcentration and latent heat release. Ultimately brine is released as an episodic artesian well through connection with surface crevassing events at Blood Falls after it has been advected towards the terminus by ice flow.

The primary Blood Falls discharge is cold (– 6ºC), high in dissolved organic carbon, iron and sodium chloride, and has a conductivity approximately 2.5 times seawater (Mikucki et al. 2004; Mickuki 2005). A number of lines of geochemical evidence support a marine origin for the Blood Falls outflow, which generally shows very similar characteristics to seawater. Studies have demonstrated that the volume, spatial extent and geochemistry of the Blood Falls discharge varies over time (Black et al. 1965; Keys 1979; Lyons et al. 2005) and differs between normal flow and rapid discharge events (Mikucki 2005).

- *Ecology and microbiology*

The Blood Falls outflow contains a microbial community, apparently of marine origin (Mikucki & Priscu 2007; Mikucki et al. 2009). The bacteria may be capable of metabolising iron and sulphur compounds, allowing the population to survive in the subglacial environment for extended periods of time, possibly millions of years (Mikucki et al. 2009). The microbes are also thought to play an important role in carbon cycling, allowing the ecosystem to survive without external carbon input (Mikucki & Priscu 2007). The primary controls on the characteristics of the microbial ecosystem at Blood Falls may provide an analogue for the conditions found beneath the polar ice caps on Mars (Mikucki et al. 2004). A living bacterial assemblage has been identified within the basal ice and sediments sampled within the tunnel excavated on the northern margin of Taylor Glacier (Christner et al. 2010).

Microbial studies have provided further support for a marine origin of the brine reservoir, as the microbial assemblages recorded at Blood Falls are similar to those found in other marine systems (Mikucki et al. 2004; Mikucki & Priscu 2007). The ecosystem has been highlighted as an important site for exobiological studies, particularly as an analogue for Martian ice masses (Mikucki et al. 2004; Mikucki 2005). The primary controls on the Blood Falls microbial assemblage are thought to be the pre-glacial history of the ecosystem and the surrounding terrain, the bed lithology and the glacier hydrology, although the extent of contact between the microbial ecosystem and the glacial hydrological system is currently uncertain (Mikucki 2005; Mikucki & Priscu 2007).

The saline subglacial waters of Blood Falls meet the comparatively fresh surface water of western Lake Bonney in the lake perimeter area (often referred to as a 'moat', as this zone is prone to melt in summer). The moat area acts as a transition zone and its geochemical composition becomes less similar to Blood Falls with distance from the primary discharge site (Mikucki 2005). The Blood Falls discharge is also diluted in the moat area by input from Santa Fe Stream, which is primarily fed by surface melt from the Taylor Glacier and flows along its northern margin (Mikucki 2005). Lawson Creek also flows into the Area and drains into Lake Bonney approximately 100m north of the primary Blood Falls outflow.

Saline discharge, organic carbon and viable microbes from Blood Falls are episodically released into the western lobe of Lake Bonney, altering the geochemistry and biology of the lake and providing nutrients that are otherwise limited (Lyons et al. 1998, 2002, 2005; Mikucki et al. 2004). Discharges into Lake Bonney have been observed at a depth of 20 to 25m, and below this depth Lake Bonney exhibits a very similar geochemistry to Blood Falls, including high iron levels and a similar ion chemistry to seawater (Black & Bowser 1967; Lyons et al. 1998, 2005; Mikucki et al. 2004). Studies have shown that bacteria in the deep areas of western Lake Bonney are similar in size to those from Blood Falls, but much smaller than other those found in the deep waters of other lakes in the Dry Valleys (Takacs 1999).

- *Terrestrial ecology*

Invertebrate communities in the Blood Falls area have not been extensively studied. However, soil samples from the shore of western Lake Bonney identified Scottnema lindsayae as the most abundant nematode in the Lake Bonney basin and also recorded Eudorylaimus antarcticus and Plectus antarcticus (Barrett et al. 2004).

- *Human activities and impact*

Local field camps historically have been located in two main areas on the north-western shore of Lake Bonney, close to the moat area and the primary Blood Falls outflow (Map 2). The camp site contains a number of tent sites marked by stone circles. This has resulted in localized soil disturbance, although activities at the camp site are considered unlikely to have had an impact on Blood Falls (Keys, Skidmore, pers. comms. 2010). Until recently, a helicopter landing site was located approximately 160 m north of the primary Blood Falls outflow, although usage is also unlikely to have adverse effects on Blood Falls (Hawes, Skidmore, pers. comms. 2010). A pedestrian trail has formed to the west of Lawson Creek, which extends parallel to and above Santa Fe Stream around 50 – 100 m from the northern margin of the Taylor Glacier. The trail has become prominent due to foot traffic and shows signs of minor erosion.

Stream monitoring equipment, including a weir, was installed by the LTER in the Santa Fe Stream delta area (Map 2), which was largely removed in January 2010. Parts of the weir embedded into stream sediments proved difficult to extract and have been left in situ because the impact of removal was considered greater than leaving the material in place. A number of items of disused glaciological equipment have been collected from the northern margin of the Taylor Glacier in the Santa Fe Stream delta area, and it is possible some of these items remain either on inaccessible locations on the glacier surface and / or embedded in sediments at the foot of the ice cliffs. Two tunnels cut into the basal ice remain from previous scientific studies, on the northern margin of Taylor Glacier ~ 600m and 1000m from Blood Falls respectively, although in time these will collapse and melt out.

6(ii) Access to the Area

- Access to, movement on, and / or over the surface of the Taylor Glacier within the region covered by the sub-surface component of the Area is not subject to any special restrictions (Figure 3).
- Access to the sub-aerial component of the Area is normally made first by helicopter to the designated landing site on the north-western shore of Lake Bonney (162°16.47'E, 77°43.17'S, Map 2), and from there on foot. Access may also be made on foot from the direction of Lake Bonney or from higher up the Taylor Glacier.
- The preferred route for pedestrian access to the sub-aerial component of the Area from the designated helicopter landing site and camp site is from Lake Bonney, avoiding the coloured saline icing of the discharge and Santa Fe Stream delta when possible, ascending the terminus of the Taylor Glacier from slopes to the south of the sub-aerial component boundary (Map 2). Steep ice cliffs impede foot access to the sub-aerial component of the Area along the northern margins of the Taylor Glacier. Moats and pools forming around the margin of Lake Bonney may impede access later in the season.
- A pedestrian walking route has formed parallel to and ~50 – 100 m from the northern margin of the Taylor Glacier, providing access several kilometres up-valley from the designated helicopter landing site and camp site. Steep ice cliffs on the northern margin of the Taylor Glacier impede access onto the surface of the glacier from this route.

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

No permanent structures exist within the Area. Two permanent survey markers are set in a boulder located approximately 175m north of the Area: NZAP Benchmark TP01 is a tube with female thread (162°16.466'E, 77°43.175'S, elevation 72.7m); UNAVCO benchmark TP02 is a 5/8" threaded bolt (162°16.465'E, 77°43.175'S, elevation 72.8m). The boulder is located on an area of sloping ground on the northern shore of Lake Bonney situated ~15 m S of the helicopter landing site. A stream weir and a stream gauge are located ~80 m NW of the Area at Lawson Creek. Lake Bonney Camp is located ~4.3 km east of the Area.

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

The Area lies within ASMA No.2 McMurdo Dry Valleys. The closest Antarctica Specially Protected Areas (ASPAs) are: Canada Glacier (ASPA No.131) which is located 22 km NE of Blood Falls in the Taylor Valley; Linneaus Terrace (ASPA No.138), which lies 31 km NW of Blood Falls in the Wright Valley; and Barwick Valley (ASPA No.123) situated approximately 43 km NW of Blood Falls.

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 permit conditions

Entry into the sub-aerial or sub-surface component of 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, educational or outreach reasons that cannot be served elsewhere, or for reasons essential to the management of the Area;
- the actions permitted are in accordance with this Management Plan;
- the activities permitted will give due consideration via the environmental impact assessment process to continued protection of the environmental, ecological, scientific, or educational values of the Area;
- the Permit shall be issued for a finite period;
- the Permit, or a copy, shall be carried within the Area.

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

- *a) Sub-surface component (lower Taylor Glacier)*

- Access to, and movement over, the sub-surface component of the Area by aircraft, vehicle or on foot are not subject to any special restrictions (Figure 3).

- *b) Sub-aerial component (near Blood Falls)*

- *Aircraft access and overflight*

- Overflight below 100 m (328 ft) AGL of, or landings within, the sub-aerial component of the Area by aircraft, including Remotely Piloted Aircraft Systems (RPAS), are prohibited unless authorized by Permit;
- Helicopters facilitating access to Blood Falls should normally avoid landings within the sub-aerial component of the Area, and instead land at the designated landing site on the NW shore of Lake Bonney (162°16.47'E, 77°43.17'S, Map 2);
- Helicopters or other aircraft may be used for the acquisition of data within, or delivery of essential equipment into, the sub-aerial component of the Area when necessary for scientific or management purposes for which a Permit has been granted, taking care that to the maximum extent practicable any surface access avoids supraglacial channels.

- *Vehicle access and use*

- Vehicles are prohibited within the sub-aerial component of the Area.

- *Pedestrian access and movement within the Area*

- Access to and movement within the sub-aerial component of the Area shall normally be on foot;

- Visitors accessing the sub-aerial component of the Area should avoid the primary and secondary Blood Falls discharge areas unless permitted activities specifically require access to these sites;
- The preferred route for pedestrian access to the sub-aerial component of the Area from the designated helicopter landing site and camp site is from Lake Bonney, ascending the terminus of the Taylor Glacier from slopes to the south of the sub-aerial component boundary (Map 2).
- Movement within the sub-aerial component of the Area should be limited to that which is necessary for the performance of permitted activities.

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

- Scientific research that will not jeopardize the ecosystem or scientific values of the Area or compromise the integrity of the Blood Falls system;
- Essential management activities, including monitoring and inspection;
- 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;
- Specific conditions apply to activities that are or may be conducted in the sub-surface and sub-aerial components of the Area, which are as follows:

\- *a) Sub-surface component*

- All projects proposing to access the sub-surface component of the Area shall consider in advance the uncertainties that exist in the properties of the sub-surface hydrological system, and the risk that such activities could have more than a minor or transitory impact on the values of the Area. As such, prior environmental impact assessment of such activities should include a detailed and robust scientific review with the opportunity for input by relevant experts.
- Such proposals shall take into account the SCAR Code of Conduct for Subglacial Aquatic Environments, and as appropriate other best-practice protocols and procedures which have been developed for safe and environmentally sound access to the subglacial environment (see e.g., Committee on Principles of Environmental Stewardship for the Exploration and Study of Subglacial Environments 2007; Arctic and Antarctic Research Institute 2010; Lake Ellsworth Consortium 2011).
- Any activities involving entry into the sub-surface component of the Area shall monitor the effectiveness of control measures to minimize / prevent releases to the environment.

\- *b) Sub-aerial component*

- Meltwater sampling from supraglacial channels draining into the primary Blood Falls outflow is permitted, provided the appropriate measures specified in Section 7(vi) are taken to minimize potential contamination.

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

- No structures are to be erected within the Area except as specified in a permit and, with the exception of permanent survey markers and signs, permanent structures or installations are prohibited;
- All structures, scientific equipment or markers installed in the Area shall be authorized by permit and clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area;
- Installation (including site selection), maintenance, modification or removal of structures or equipment shall be undertaken in a manner that minimizes disturbance to the environment and to flora and fauna;
- Removal of specific structures / equipment for which the permit has expired shall be the responsibility of the authority which granted the original Permit, and shall be a condition of the Permit;
- If equipment is left in situ in the sub-surface component of the Area for extended periods, provisions shall be made to minimize the risk of contamination and / or loss of the equipment;
- Certain equipment and materials may need to be installed into subglacial aquatic environments for scientific and / or monitoring purposes (e.g., to measure geophysical or biogeochemical processes, or to monitor impacts of human activities on the subglacial environment). Any such installations shall be specifically covered in the environmental impact assessment for the activity, and include consideration of procedures for removal and the risks and benefits should removal not be practical.

7(v) Location of field camps

- Camping on the surface of the Taylor Glacier within the region covered by the sub-surface component of the Area is not restricted.
- Camping within the sub-aerial component of the Area is prohibited.
- A designated field camp is located on the northwestern shore of Lake Bonney approximately 150 m north of the primary Blood Falls outlet. It covers an area of gently sloping rocky terrain in the vicinity of 162°16.34'E, 77°43.20'S, extending ~100 m from the shore of Lake Bonney and ~200 m northeast from Lawson Creek to a permanent survey benchmark (TP02), which is located ~20 m from the lake shore. Individual tent sites are marked by stone circles. Where practicable, use tent sites located furthest from the shore of Lake Bonney.

7(vi) Restrictions on materials and organisms that 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 Blood Falls and to minimize the risk of microbial introductions to the Blood Falls system 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. Precautions shall be taken within the sub-surface and sub-aerial components of the Area as follows:

- *a) Sub-surface component*

All equipment that is proposed to enter the sub-surface component of the Area shall be sterilized prior to deployment into the sub-surface component of the Area to prevent microbial introductions to the maximum extent practicable. Sterilization shall be by acceptable methods and specified in the environmental impact assessment for the activity;

- *b) Sub-aerial component*

Visitors shall ensure that sampling equipment or markers are clean. To the maximum extent practicable, footwear and other equipment (including crampons, stabilizers, backpacks and carry-bags) shall be thoroughly cleaned prior to entry. Changing into clean footwear (including crampons, etc.) to be worn only inside the Area is also an appropriate option. To reduce the risk of microbial contamination, the exposed surfaces of footwear, sampling equipment and markers should be sterilized before use within the Area. Sterilization should be by an acceptable method, such as by washing in 70% ethanol solution in water or in a commercially available solution such as ‘Virkon’. Sterile protective overclothing shall be worn when undertaking sampling within the sub-aerial component of the Area. The overclothing shall be suitable for working at temperatures of -20°C or below and comprise at a minimum sterile overalls to cover arms, legs and body and sterile gloves suitable for placing over the top of cold-weather gloves. Disposable sterile / protective foot coverings are not suitable for glacier travel and should not be used;

- 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;
- Chemical tracers shall not be introduced into the sub-surface component of the Area, and use of tracers in the sub-aerial component of the Area shall follow the guidelines for ‘Streams’ in the Environmental Guidelines for Scientific Research contained in Appendix B of the Management Plan for ASMA No.2 McMurdo Dry Valleys;
- Fuel, food, and other materials shall not be stored in the Area, unless required for essential purposes connected with the activity for which the permit has been granted;
- In general, all materials introduced shall be for a stated period only and shall be removed at or before the conclusion of that stated period, unless installed into subglacial aquatic environments for scientific and / or monitoring purposes on a permanent basis in which case the conditions for

their deployment shall be justified and specified in the environmental impact assessment for the activity;
- All materials 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 should be undertaken 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 and fauna

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

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, and which was not brought into the Area by the permit holder or otherwise authorized, may be removed from the Area, unless the impact of removal is likely to be greater than leaving the material in situ: if this is the case the appropriate authority should be notified.

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

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. 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, 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, for the purpose of any review of the Management Plan and in organising the scientific use of the Area.
- Where access to the sub-surface component of the Area is undertaken, reports shall additionally document the location of drilling sites to an accuracy of ±1m, details of the drilling method and type of drilling fluid used. Any contamination of the sub-surface environment shall be reported. Reports shall include the results of monitoring carried out to assess the effectiveness of contamination control measures, particularly those relating to microbial control.
- 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

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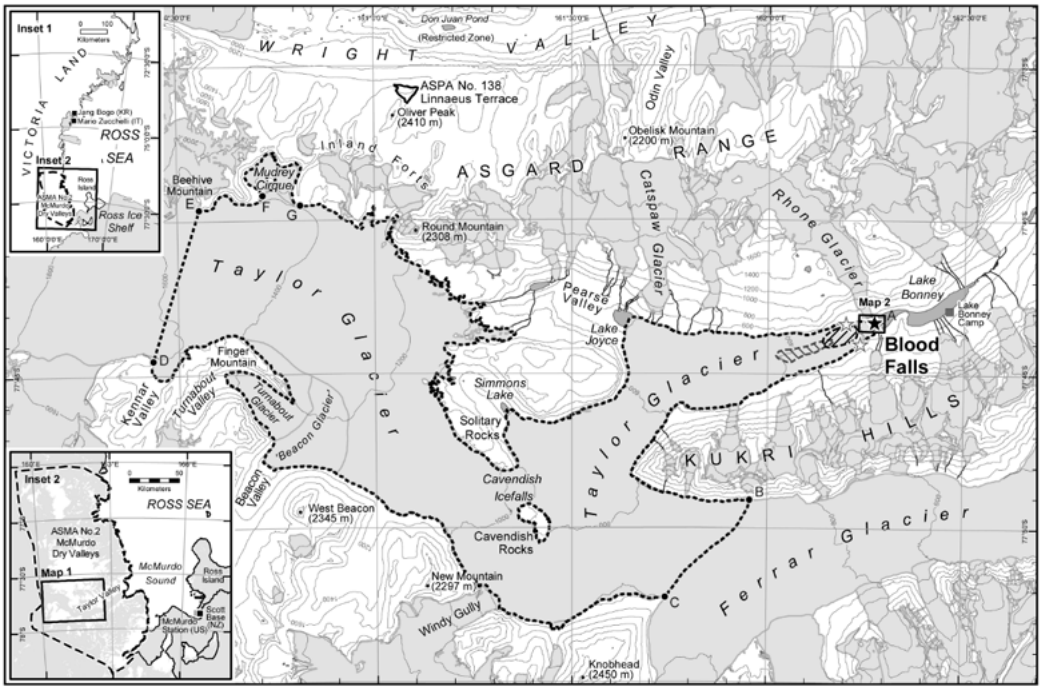


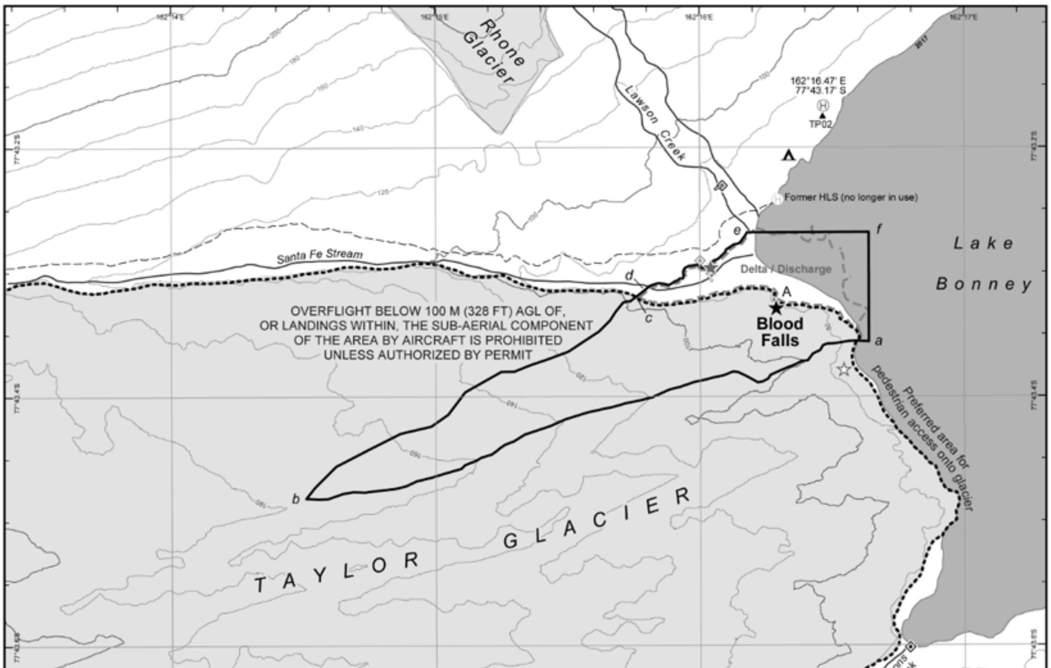
Map 1: ASPA No.172 Lower Taylor Glacier and Blood Falls sub-surface protected area boundary

v3 Issued 15 Mar 2018 (Map ID: 06.03.06-LN13.07)
Environmental Research & Assessment

Ice free ground · Permanent ice · Lake / pond · Stream · Contour (200m) · Mountain peak · Antarctic Specially Managed Area (ASMA) boundary · Antarctic Specially Protected Area (ASPA) boundary (existing) · Sub-surface protected area boundary (Extends vertically from bed to 100 m below glacier surface) · Boundary point · Facilities Zone

Blood Falls subglacial brine reservoir (estimated): Derived from Hubbard et al. 2004 · Derived from Keys 1980 · Blood Falls primary discharge · Blood Falls possible discharge

Projection: Lambert Conformal Conic
Spheroid & horizontal datum: WGS84
Data source: Glacier & topography: USGS 1:50K map series
Subglacial brine reservoir: Hubbard et al. (2004), Keys (1980)
Discharge sites: GPS survey T.Nylen (Dec 2006)



Map 2: ASPA No.172 Blood Falls sub-surface and sub-aerial protected area boundary

v4 Issued 15 Mar 2018 (Map ID: 06.03.06-LN14.10)
Environmental Research & Assessment

Ice free ground · Glacier · Lake (shoreline year) · Index contour (100 m) · Contour (20 m) · Stream · Stream delta / discharge area · Sub-surface protected area boundary · Sub-aerial protected area boundary · Boundary point · Blood Falls primary discharge · Blood Falls secondary discharge · Blood Falls possible discharge · Survey mark · Designated campsite · Helicopter landing site · Existing walking track · Stream gauge · Stream gauge (removed Jan 10) · Stream weir · Stream weir (removed Jan 10)

Projection: Lambert Conformal Conic
Spheroid & horizontal datum: WGS84
Data source: Contours: derived from USGS 2m LiDAR DEM
Glacier & stream digitised from aerial imagery (1993)
Lake: digitised from orthorectified WorldView 2 imagery (Nov 2017)
Campsite, stream gauges & weirs: ERA field survey (Dec 2009)
HLS: ASC field survey (Jan 2018)
Discharge sites: GPS survey T.Nylen (Dec 2006)

978-1-5286-1301-9

CCS0519238318