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 km^2) 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 a blue-eyed cormorant (*Phalacrocorax atriceps*) colony. The colony of blue-eyed cormorants, 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 108 is contained within Environment Domain B (Antarctic Peninsula mid-northern latitudes geologic). Other protected areas containing Domain B include ASPAs 115, 134, 140 and 153 and ASMA 4. ASPA 108 sits within Antarctic Conservation Biogeographic Region (ACBR) 3 Northwest Antarctic Peninsula.

1. Description of values to be protected

Following management visits to the ASPA in February 2011 and January 2013, 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 blue-eyed cormorants (*Phalacrocorax atriceps*), 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^{o}, Standard parallel: -71^{o}.

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^{o}, Standard parallel: -71^{o}.

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 km^2; 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 blue-eyed cormorant 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). 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 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 blue-eyed cormorants (*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 blue-eyed cormorant 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. Brown skuas (*Catharacta loennbergi*) are numerous over much of the island, particularly on the extensive moss banks. South polar skuas (*C. 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 site visits in February 2011 and January 2013, 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 113, Lichfield Island, Arthur Harbour, Anvers Island, Palmer Archipelago, 64°46'S, 64°06'W, 62 km to the north.
- ASPA 139, Biscoe Point, Anvers Island, Palmer Archipelago, 64°48'S, 63°46'W, 60 km to the north
- ASPA 146, South Bay, Doumer Island, Palmer Archipelago, 64°51'S, 63°34'W, 60 km to the north west.

ASPAs 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).
- 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, 2011) 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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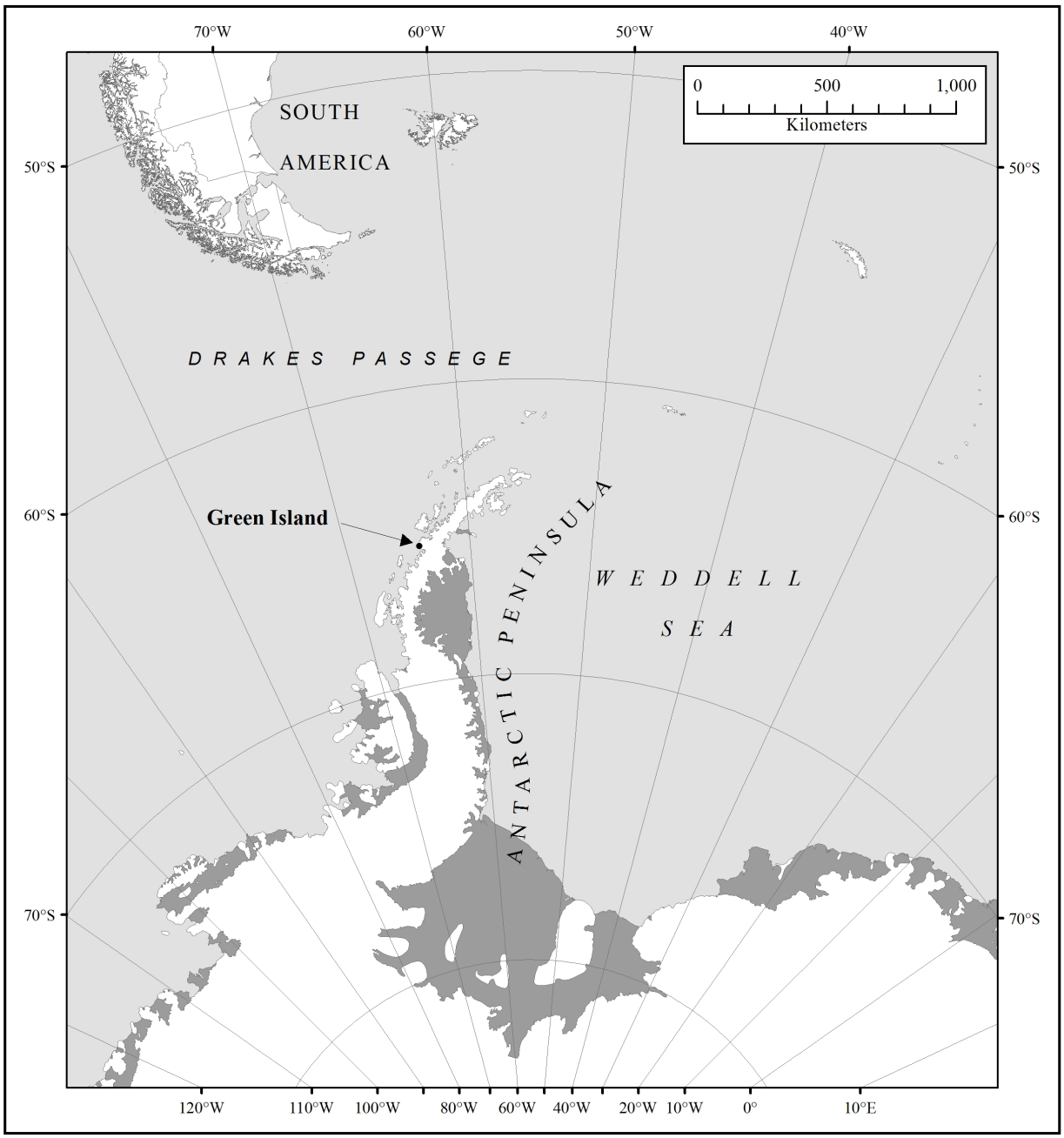
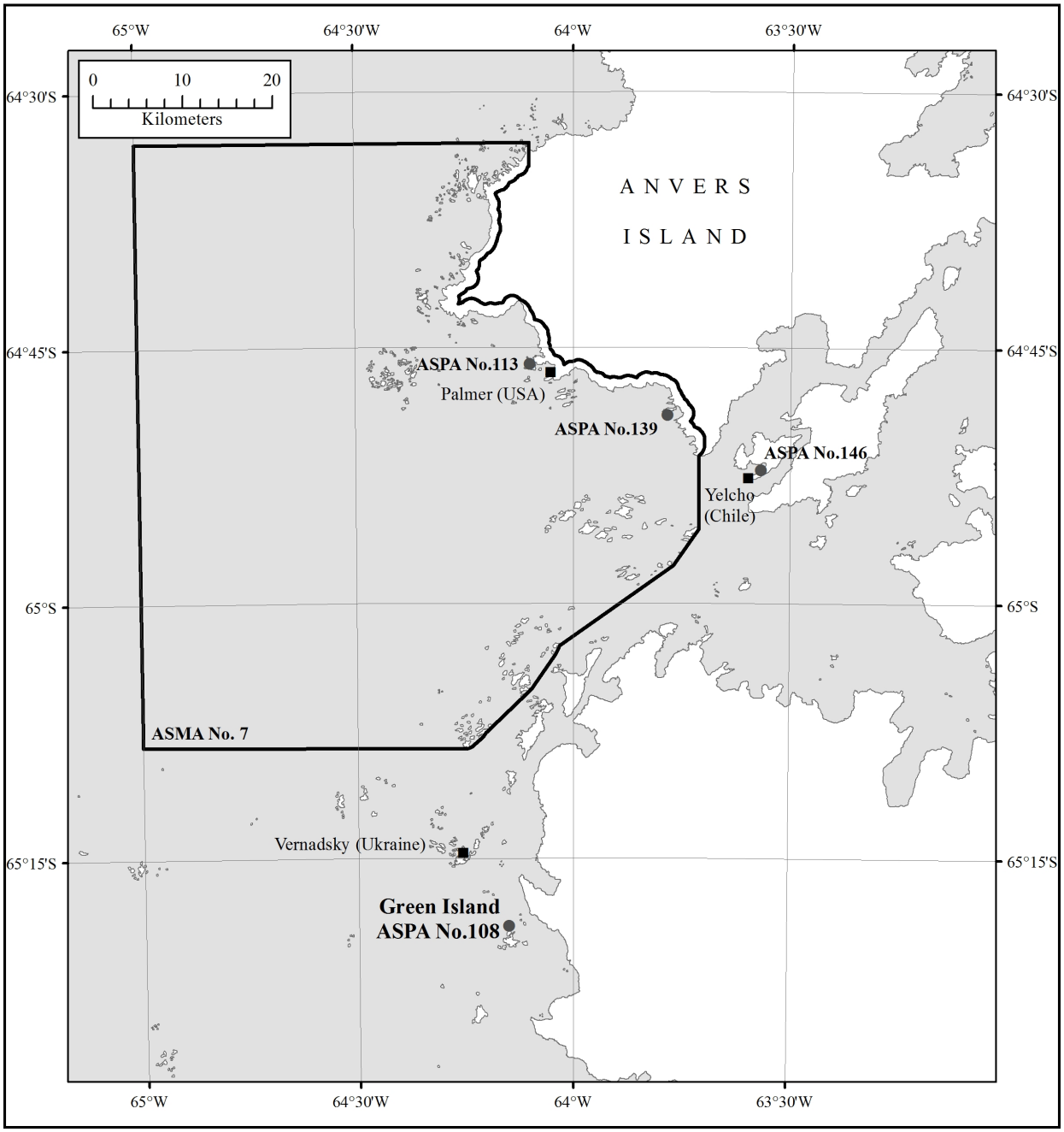
Map 1. Overview map, showing the location of Green Island on the Antarctic Peninsula. Map specifications: WGS84 Antarctic Polar Stereographic. Central meridian -55°, Standard parallel: -71°.



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°.



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