



Management Plan

for Antarctic Specially Protected Area No. 177 LÉONIE ISLANDS AND SOUTH-EAST ADELAIDE ISLAND, ANTARCTIC PENINSULA

Introduction

The primary reason for the designation of the six sites located on the Léonie Islands, Ryder Bay, and south-east Adelaide Island, Antarctic Peninsula (Lat. -67.60°; Long. -68.23°), as an Antarctic Specially Protected Area (ASP) is to protect a combination of outstanding scientific, environmental, wilderness and aesthetic values and, in particular, relating to the avifauna and terrestrial biological communities within the Area.

The Area consists of sites located on the Léonie Islands, within Ryder Bay, and the south-east of Adelaide Island, Antarctic Peninsula (see Table 1). The six sites identified as

components of the ASPA include: Anchorage Island (Lat. -67.593°; Long. -68.189°), Donnelly Island (Lat. -67.606°; Long. -68.189°), East Lagoon Island (Lat. -67.590°; Long. -68.239°), Walton Terraces, Léonie Island (Lat. -67.596°; Long. -68.350°), Mucklescarf Island (Lat. -67.594°; Long. -68.261°) and the Horton, Hurley and Turner Glaciers (Lat. -67.58°; Long. -68.49°). The total area of all six sites is 102.1 km², with ice-free ground accounting for 2.7 km². The area is considered to be of sufficient size as it encompasses many of the bird nesting sites and important concentrations of terrestrial vegetation in the locality, as well as areas of outstanding scientific, wilderness and aesthetic value.

Table 1. List of the six sites that comprise ASPA No. 177 Léonie Islands and south-east Adelaide Island, Antarctic Peninsula.

Site name	General coordinates	Primary value	Area (ha)
Anchorage Island	Lat. -67.593°; Long. -68.189°	Scientific and Environmental	60
Donnelly Island	Lat. -67.606°; Long. -68.189°	Scientific	12
East Lagoon Island	Lat. -67.590°; Long. -68.239°	Environmental	20
Walton Terraces, Léonie Island	Lat. -67.596°; Long. -68.350°	Environmental, Wilderness and Aesthetic	15
Mucklescarf Island	Lat. -67.594°; Long. -68.261°	Environmental	0.2
Horton, Hurley and Turner Glaciers	Lat. -67.584°; Long. -68.490°	Wilderness and Aesthetic	10100

East Lagoon Island, Walton Terraces on Léonie Island and Mucklescarf Island are included within ASPA No. 177 to ensure conservation of the environmental values contained therein and therefore should be subject to as little human visitation and impact as possible (although essential science should be permitted). The designation of Anchorage Island is to protect scientific values and, as far as possible, if the scientific activity cannot be undertaken outside the ASPA, then it should be undertaken here in preference to the other sites in ASPA No. 177. Donnelly Island has been designated as a control site for monitoring the impact of Rothera Research Station on the surrounding fellfield ecosystem; it is important, therefore, that visits are undertaken only for associated environmental monitoring purposes. Horton, Hurley and Turner Glaciers and Walton Terraces on Léonie Island have been designated to protected outstanding wilderness and aesthetic values.

The sites comprising the Area are located between 3.5 and 11 km from Rothera Research Station. Historically, the island sites were subject to visitation by tourists (including

those from cruise ships and smaller yachts) and National Antarctic Programme personnel and were, therefore, susceptible to disturbance from field research and logistical and recreational activities. ASPA designation assists in ensuring that these locations are protected in light of the scientific, logistical and recreational activities in the local vicinity, and that permitted activities are suitably managed to minimise impacts upon the values within the Area.

Using the Environmental Domains classification, the Léonie Islands and south-east Adelaide Island are predominantly Environmental Domain B (Antarctic Peninsula mid-northern latitudes geologic). Other protected areas containing Environment Domain B include ASPA Nos. 108, 115, 134, 140 and 153 and ASMA 4. The Area is within Antarctic Conservation Biogeographic Region (ACBR) 3 North-west Antarctic Peninsula. The ASPA islands are contained within Antarctic Important Bird Area (IBA) No. 47236 (AQ205), which was designated in 2018.



Four other ASPAs are present within the Marguerite Bay area (ASPAs No. 107 Emperor Island, Dion Islands, ASPA No. 115 Lagotellerie Island, ASPA No. 117 Avian Island and ASPA No. 129 Rothera Point). ASPA No. 107 Emperor Island and ASPA No. 117 Avian Island were designated predominantly to protect the avifauna of the area, ASPA No. 115 Lagotellerie Island to protect terrestrial communities and avifauna, while ASPA No. 129 Rothera Point was designated to monitor the impact of the nearby station on an Antarctic fellfield ecosystem. Therefore, ASPA No. 177, Léonie Islands and south-east Adelaide Island, complements the local network of ASPAs primarily by protecting exceptionally rich terrestrial biological communities and high densities of breeding avifauna. In particular, although Rothera Point and Léonie Island both have a high plant biodiversity, the number of shared plant species is not high, indicating the need to protect different vegetated sites within the Ryder Bay area (Cannone *et al.*, 2018). ASPA No. 177 Léonie Islands and south-east Adelaide Island includes over 8.1% of the known world population of south polar skuas and would therefore constitute one of the largest protected populations globally for this species. Furthermore, the ASPA protects 2.2% of the known global population of Antarctic shags, with the protected colony within ASPA No. 177 of roughly equivalent size to colonies within ASPA No. 117 Avian Island and ASPA No. 115 Lagotellerie Island. A larger population is found in ASPA 107 Emperor Island. The ASPA also protects an area of aesthetically outstanding and largely unvisited wilderness juxtaposed against areas of on-going and often intense human activity associated with the nearby research stations.

1. Description of values to be protected

The primary reason for the designation as an ASPA is to protect a combination of outstanding scientific, wilderness and environmental values and, in particular, the avifauna and terrestrial biological communities within the Area (see Table 2). Specific values in the Area as a whole include:

- Scientific values relating to terrestrial ecosystems found in an area used for on-going international scientific research.
- Scientific values associated with a control area against which to compare human impacts at Rothera Research Station. Since ASPA No. 129 Rothera Point, Adelaide Island was designated in 1985 as a control area against which to monitor the impact of Rothera Research Station, the footprint of the station has expanded, including through the construction of a rock airstrip within 300 m of the ASPA. ASPA No. 129 may therefore be subject to greater levels of local impact than envisioned when the area was first designated. Therefore, part of the Area (Donnelly Island, c. 5 km from the station and rarely visited), has been designated as a further control site for environmental monitoring purposes.
- Environmental values associated with avian fauna:
 - South polar skuas (*Stercorarius maccormicki*) - over 8.1% of the global population, based on the revised global population estimate (Phillips *et al.* 2019).
 - Antarctic shags (*Phalacrocorax [atricaps] bransfieldensis*) – 2.2% of the revised global population estimate (Schrimpf *et al.* 2018, Phillips *et al.* 2019).

The ASPA island sites are contained within Antarctic Important Bird Area (IBA) No. 47236 (AQ205) that was designated in 2018; this is the first IBA to be identified in Antarctica since the wider review of candidate sites by Harris *et al.* (2015) (see Resolution 5 (2015)). The IBA qualifies on the basis of the large breeding populations of south polar skua and Antarctic shag. The IBA includes Rothera Point and the islands in Ryder Bay, which in January 2018 held 978 occupied territories of south polar skuas, 259 south polar skuas at club sites and 405 pairs of Antarctic shags (Phillips *et al.* 2019). Based on these counts, the islands in the wider Ryder Bay area contain an estimated c. 3.5% of all breeding Antarctic shags, and c. 10.3% of all breeding south polar skuas (see Phillips *et al.*, 2019, for updated global population estimates for both of these species). ASPA No. 177, includes c. 80% of the skuas and 62% of the shags breeding in the IBA.

- Environmental values associated with unusually rich areas of terrestrial vegetation. Rich lichen-dominated communities are found on Anchorage Island and East Lagoon Island. Walton Terraces, Léonie Island, support large and diverse vegetation stands (including the flowering plants, *Deschampsia antarctica* and *Colobanthus pratensis*), as well as boulder areas which support a typical lichen fellfield community.
- Wilderness values that are outstanding for the geographical region due to the very limited visitation of some of the ASPA sites, when compared to areas where local scientific infrastructure and Rothera Research Station are located. In accordance with a common understanding of the concept of wilderness (Dudley 2008; Bastmeijer 2016), the relevant parts of the ASPA are characterised by a very high degree of naturalness (unmodified native ecosystems) and undevelopedness (absence of and distance from any permanent or semi-permanent infrastructure, artefacts, transport routes or any other evidence of present or past visible human presence).
- Aesthetic values due to the spectacular scenery when looking at the sites from the Ryder Bay area. The aesthetic values are strengthened by an outstanding combination of mountains, cascading glaciers, streams, vegetation and wildlife present within the Area.

The specific values found in each of the Area's sites are detailed in Table 2, and described below:

Anchorage Island: The island contains a combination of outstanding scientific and environmental values. It is a site of on-going international scientific research on terrestrial ecology, undertaken by researchers from several nations including the United Kingdom, the Netherlands, Germany, Italy and Malaysia (see section 8. *Supporting documentation*).

Research on Anchorage Island has focused on the potential impact of climate warming on the functioning of Antarctic terrestrial ecosystems, including how vegetation, soil communities and ecosystem processes respond to warmer temperatures. One warming study using open topped chambers is ongoing and has now run for 17 years. Other studies focus on the role of marine vertebrates and invasive species on ecosystem functioning. Both factors are likely to respond to climate change and may have a larger impact on Antarctic terrestrial ecosystems than warming alone. Anchorage Island is also of ecological importance as the breeding site of c. 460 pairs of south polar skuas, and through the presence of localised areas of moss-dominated vegetation and more widespread lichen-dominated vegetation.



Donnelly Island: This site protects scientific values, primarily that the area serves as a control area, against which the effects of human impact associated with the nearby Rothera Research Station (UK; 5 km away) can be monitored. The island is also the breeding site of c. 25 pairs of south polar skuas.

East Lagoon Island: The island contains environmental values including c. 150 pairs of breeding south polar skuas and an unusually rich area of lichen-dominated fellfield habitat.

Walton Terraces, Léonie Island: Walton Terraces, located on the western side of Léonie Island, contain environmental values including c. 160 pairs of south polar skuas and an unusually large area of rich and biodiverse terrestrial vegetation. Walton Terraces are located c. 10 km from Rothera Research Station, have received little visitation relative to many of the other locations in Ryder Bay and there is no direct line of sight to the research station on Rothera Point. The site is one of the most verdant in the area, with rich vegetation, streams and high numbers of birds. It also has considerable wilderness and aesthetic value due to the absence of evidence of human presence or activities.

Mucklescarf Island: This small island, only 55 m across, contains outstanding environmental values due to the presence of a colony of 251 pairs of Antarctic shags.

Horton, Hurley and Turner Glaciers: This area of south-east Adelaide Island provides outstanding wilderness values, as it has remained almost entirely unvisited, compared with the other locations in the vicinity that have been subject to sometimes intense levels of human activity during the past 112 years. Regarding aesthetic values, the site also presents stunning scenery when viewed from Ryder Bay, and has been the subject of paintings by artists including Philip Hughes (b. 1936: works include 'Hurley and Horton Glaciers from Lagoon Island' and 'Notebook Antarctic Volume 4. Léonie Island'), Keith Grant (b. 1930) and Sandra Chapman (NESTA Dreamtime Fellowship). Sir Peter Maxwell Davies, composer of the Antarctic Symphony (Symphony No. 8), described the snow-covered mountains as 'heart-rendingly beautiful', and wrote 'the view across the sea to distant mountains is stupendous'.

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 or inadvertent human disturbance through uncontrolled access and inappropriate collections of biological material;
- avoid major changes to the structure and composition of the terrestrial ecosystems, in particular to the fellfield ecosystem and breeding birds, by (i) preventing physical development within the site, (ii) limiting human access to the Area and (iii) prohibit inappropriate collection of biological material;
- prevent installation or development of any permanent or semi-permanent infrastructure, artefacts, transport routes or any other evidence of present or past visible human presence in or near the sites designated to protect wilderness values (see Table 2).
- prevent the introduction of non-native species to the Area;

- 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 the Area;
- preserve the natural ecosystem of the Area as a reference area for future studies, including comparative studies within ecosystems in the vicinity of Rothera Research Station.
- allow visits for management purposes in support of the aims of the management plan.

3. Management Activities

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

- Visiting field parties shall be briefed fully by the National Antarctic Programmes operating in the area on the values that are to be protected within the Area and the precautions and mitigation measures detailed in this Management Plan.
- Personnel in the vicinity of, accessing or flying over the Area shall be specifically instructed, by their national programme or appropriate national authority, as to the provisions and contents of the Management Plan.
- Visits to the Horton, Hurley and Turner Glaciers site and Walton Terraces, Léonie Island, shall be kept to an absolute minimum.
- A map showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently at Rothera Research Station (UK; Lat. -67.56944°; Long -68.12222°), Teniente Luis Carvajal Station (Chile; Lat. -67.76056°; Long. -68.91472°) and General San Martin Station (Argentina; Lat. -68.12972°; Long. -67.10278°), where copies of this management plan shall be made available.
- 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.
- Markers, signs or other structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition.
- Abandoned equipment or materials shall be removed to the maximum extent possible provided that doing so does not adversely impact on the values of the Area
- The Area shall be visited, as necessary, to assess whether it continues to serve the purposes for which it was designated and to ensure that management and maintenance activities are adequate.
- Visits shall be permitted as necessary in order to facilitate the study and monitoring of anthropogenic changes that could affect the protected values in the Area. Impact studies and monitoring should be conducted, to the maximum extent possible, by non-invasive methods and, if appropriate, through the use of remote sensing techniques.



- 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. Location of ASPA No. 177 Léonie Islands and south-east Adelaide Island, within the wider Marguerite Bay area. Map specifications: WGS84 UTM Zone 19S. Central Meridian 68°W. (Inset map: WGS84 Antarctic Polar Stereographic. Central Meridian 55°W, Standard Parallel: 71°S)

Map 2. Overview map of the multi-site ASPA No. 177 Léonie Islands and south-east Adelaide Island, Antarctic Peninsula. The Horton, Hurley and Turner Glaciers site is detailed in the map below. The Walton Terraces site on Léonie Island is detailed in Map 3. The Anchorage Island, East Lagoon Island, Donnelly Island and Mucklescarf Island sites are detailed in Map 4. Map specifications: WGS84 UTM Zone 19S. Central Meridian 68°W. Boundary coordinate details can be found in Table 3.

Map 3. Map of the Walton Terraces site, which is part of the multi-site ASPA No. 177 Léonie Islands and south-east Adelaide Island, Antarctic Peninsula. Map specifications: WGS84 UTM Zone 19S. Central Meridian 68°W. Boundary coordinate details can be found in Table 3.

Map 4. Map of the Anchorage Island, East Lagoon Island, Donnelly Island and Mucklescarf Island sites, which are part of the multi-site ASPA No. 177 Léonie Islands and south-east Adelaide Island, Antarctic Peninsula. Map specifications: WGS84 UTM Zone 19S. Central Meridian 68°W. Boundary coordinate details can be found in Table 3.

6. Description of the Area

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

General description

Ryder Bay, located in northern Marguerite Bay, is 11 km wide at its mouth and indents 7 km into the south-east side of Adelaide Island, south-west Antarctic Peninsula (see Map 1). The peaks to the east of Ryder Bay rise up to 2315 m above sea level, and three glaciers (Horton, Hurley and Turner Glaciers) drop over 1 km in altitude from the base of the peaks to flow into the bay. All of the Léonie Islands are situated in Ryder Bay. A minimum deglaciation date for Marguerite Bay has been estimated at c. 9000 years ago. Most of the islands in the bay have patches of persistent snow, and Léonie Island, the largest and highest of the Léonie Islands, has a large permanent ice cap. The islands are rocky, with irregular coastlines including beaches, steep cliffs, scattered rocks and boulders, providing extensive ice-free ground and crevices for nesting birds and the development of terrestrial communities. Several ephemeral freshwater ponds, meltwater channels and small streams are present, particularly on Léonie Island. Small ponds and melt pools are present on East Lagoon and Anchorage Islands. Vegetation is sparse and dominated by lichens and mosses, but with Antarctica's two native flowering plants, *Deschampsia antarctica* and *Colobanthus quitensis*, also present.

Boundaries

Boundary coordinates for the Area are provided in Table 3, but for more detail, please see Maps, 2, 3 and 4. There are no boundary markers delimiting the Area as, in general, the coast itself is a clearly defined and visually obvious boundary, or the presence of markers would detract from the wilderness values of the Area.

Boundary descriptions for each of the six sites that comprise the Area are as follows:

Anchorage Island: The site encompasses all of the ice-free ground, permanent ice and semi-permanent ice found within Anchorage Island. However, it excludes the marine environment extending greater than 10 m offshore from the low tide water line, all unnamed adjacent islands and islets and an area on the north-west of the island where a hut is located to support field parties working on the island.

Donnelly Island: The site encompasses all of Donnelly Island but excludes all unnamed adjacent islands and islets. The site encompasses all of the ice-free ground, permanent ice and semi-permanent ice found within Donnelly Island, but excludes the marine environment extending greater than 10 m offshore from the low tide water line.

East Lagoon Island: The site encompasses most of East Lagoon Island, but excludes all unnamed adjacent islets, the marine environment extending greater than 10 m offshore from the low tide water line and the area of the island west of longitude -68.23888° (Boundary Coordinates 1 to 2 on Map 4). A sign detailing the extent of the site boundary will be installed on the island on ice-free ground outside the Area.

Walton Terraces, Léonie Island: The site encompasses predominantly ice-free ground to the west of Léonie Island to a maximum altitude of 100 m, but excludes the marine environment extending greater than 10 m offshore from the low tide water line. From the northernmost point of the site, located on the north-west coast of Léonie Island (Boundary Coordinate (BC) 1), the boundary follows the coast south-west (BC 2) and then south, until a large snow slope, c. 225 m wide, is crossed (BC3). The boundary follows the snow slope inland for c. 250 m to an altitude of 100 m above sea level. (BC 4). The boundary follows the 100 m contour line in a north-north-westerly direction until a large snow slope is crossed (BC 6). The boundary then traverses downward across the slope in a northerly direction to join the coast at the northernmost point of the site (BC 1). A sign detailing the extent of the site boundary will be installed on coastal ice-free ground at the northernmost point of the island outside the Area boundary.

Mucklescarf Island: The site encompasses all of the ice-free ground and semi-permanent ice found within Mucklescarf Island, but excludes the marine environment extending greater than 10 m offshore from the low tide water line.

Horton, Hurley and Turner Glaciers: The site encompasses all ice-free ground and permanent and semi-permanent ice found predominantly within the catchment areas of the Horton, Hurley and Turner Glaciers. Much of the boundary follows the rock ridges that limit the catchment area and are described in an anti-clockwise direction starting with the northernmost point, which is located at the summit of Mount Barré (Boundary Coordinate (BC) 1; Map 2). The boundary extends along the south-west ridge of Mount Barré to the col between Mount Barré and Mount Gaudry (BC 2). It then continues along the north-east ridge of



Mount Gaudry to the summit (BC 4). From here, the boundary passes south and then south-east along the southern ridge of Mount Gaudry to Hurley Glacier (BCs 5 and 6). The boundary then follows a line west (towards BC 7), then north-west (BC 9) to join the north-western ridge of Mount Liotard. The boundary follows this ridge south, then east-south-east to the summit of Mount Liotard (BC 11) and then onward down Mount Liotard's south-easterly ridge to the coast of Ryder Bay (BC 13). Following the coastline north, the boundary then crosses the ocean at the snouts of the Turner Glacier (BCs 14 to 15) and then the Hurley and Horton Glaciers (BC 15 to 16) to then re-join the coastline (BC 16). The boundary follows the coastline north-east for c. 1 km, after which it passes inland (BC 17) along the bottom of the north-eastern face of the south-east ridge of Mount Barré. At a point a little under half way along the south-east ridge of Mount Barré (BC 19) the boundary ascends to join the ridgeline and continues east-north-east to the summit of Mount Barré (BC 1). At the glacier fronts (which have fluctuated in position by up to 100 m over the past 60 years) the boundary is marked using permanent ice-free rock outcrops (marked by BCs 14, 15 and 16); however, this means a small marine area (c. 3.3 km²) is included within the Area (see Map 2). Where the boundary follows the coastline, it excludes the marine environment extending greater than 10 m offshore from the low tide water line.

Access to the Area site boundaries shall be by overland vehicle, by small boat or by snowmobile over sea ice. Access points for small boats to the Léonie Island sites are described in section 6(ii) *Access to the Area*. Use of overland vehicles within the Area is not permitted. Winged aircraft and helicopters are not permitted to land within the Area. Movement within the Area shall be by foot only. Pedestrian traffic shall be kept to the minimum necessary to be consistent with the objectives of any permitted activities.

Climatic conditions

Summer temperatures in the Ryder Bay area are typically between 0 and +5 °C, and in winter generally range from –5 to –20 °C; however, because of the Area's coastal location and the Southern Ocean low-pressure weather systems, temperatures can vary widely at any time of year. Sea ice can form in Ryder Bay from late May to late November, although it takes prolonged periods of calm conditions for ice to form and become fast. Prevailing winds are northerly, reaching gale force on around 70 days per year. While it can snow at any time of year, in recent years the main snowfall has come at the end of winter. Rain occasionally falls during the summer months and overall, annual precipitation is around 700 mm. Because the Area is just south of the Antarctic Circle, it is light for 24 h per day during summer, and for a few weeks in winter the sun does not rise above the horizon.

Geology

No areas of outstanding geological value are located within the Area; however, a description of the general geology of each ASPA site is provided below:

Anchorage and Donnelly islands: The geology of Anchorage and Donnelly islands is part of the Adelaide Island intrusive suite, which is dominated by granodiorites, tonalities and gabbroic rocks. On Anchorage Island, granodiorite is predominant, with minor amounts of quartz diorite and diorite. The geology of Anchorage and Donnelly islands is interpreted to be consistent with the rest of the Adelaide Island intrusive suite and is therefore thought to be approximately 48 Ma (Eocene age). Dioritic/andesitic, feldspar-phyric xenoliths are common, and can account for 30–40% of the rock. The mineralogy of the Anchorage Island granodiorite consists of plagioclase, quartz, amphibole, biotite and variable amounts of chlorite and epidote, which has formed along cracks and joints in the rock, as a result of hydrothermal alteration. Malachite (copper) mineralisation is also a characteristic of the granodiorites of Anchorage and Donnelly Islands. At the northern extremity of Anchorage Island, a 20 m² megacrystic granitic block is hosted within the granodiorite.

East Lagoon Island and Mucklescarf Island: Basaltic and andesitic lavas and breccias crop out on the eastern and western parts of Lagoon Island; these generally weather grey/green although some exposures display intense red/yellow hematite mineralised weathering. The basalt rocks identified on Lagoon Island are associated with the lava successions observed at other more northerly locations on Adelaide Island, including Bond Nunatak and Mount Vélain. Basaltic rocks from East Lagoon Island are generally massive, fine grained lavas, which are typically feldspar porphyritic. Breccias and autoclastic breccias are associated with the lavas, along with thinner vulcanoclastic units. The geology of Mucklescarf Island has not been investigated, but is assumed to be similar to the geology of the Lagoon Islands.

Walton Terraces, Léonie Island: Western Léonie Island is distinct to the main massif of the island, which is gabbroic in composition. The western coastal area is part of the Buchia Buttress formation, also observed in the Turner Glacier region on Adelaide Island. This section is characterised by vulcanoclastic sandstone beds with associated cobble/boulder conglomerates, typical of deposition in a shallow water setting. The rocks are Late Jurassic in age.

Horton, Hurley and Turner Glaciers: This region is dominated by three distinct rock types. The Mount Liotard Formation is exposed on Mount Liotard and the area to the north and west. At least 1800 m of basaltic andesite and andesite multiple lava flows are exposed across the region. Individual, complete lava units are difficult to distinguish, but where possible, individual lavas of 30–40 m thickness have been identified within the succession. The units are typically feldspar porphyritic, are cut by rare basaltic sills and are interpreted to be approximately 70 million years old. Mount Gaudry and the region to the east of Mount Liotard is dominated by Eocene age granodiorite and hybrid gabbro-granodiorite plutons. Many of the plutons are heterogeneous and are characterized by concentrations of well-rounded xenoliths, which are typically more mafic than the host rock. The coastal margin of this area is characterised by volcanic breccias, crystal tuffs, vulcaniclastic rocks and coarse-grained vulcanoclastic sandstone units with interbedded cobble/boulder conglomerates of the Late Jurassic age Buchia Buttress Formation.



Soils

On rock terraces, particularly on Léonie Island, closed stands of moss and grass have developed a relatively rich loamy soil up to 25 cm in depth, which is also present on Anchorage Island, but only in isolated patches. Within the Area the sparse soils occasionally contain egg shell and bone fragments indicative of the earlier existence of penguin colonies, as also recorded on nearby Rothera Point.

Terrestrial habitats and vegetation

A list of plant and lichen species found on the sites that comprise the Area and within other ASPAs in the Marguerite Bay area is given in Table 4. Distinct arrays of plant and lichen species exist within different locations. In particular, despite Léonie Island and ASPA No. 129 Rothera Point both having a high plant biodiversity, the number of shared plant species between locations is not high, demonstrating the need to protect different vegetated sites within the Ryder Bay area. Significant input of nutrients from vertebrate sources occurs on all islands in Ryder Bay and may play a part in determining the relative biological richness of the Area.

Anchorage Island: This irregularly shaped island is around 3 km in length, includes several rocky ridges and reaches a maximum height of 57 m above sea level. On the slopes of these ridges, there are patches of the moss *Sanionia uncinata* and the grass *Deschampsia antarctica*. However, the dominant vegetation consists of lichens. Lichen-dominated areas typically have high coverage of the lichens *Buellia latemarginata*, *Usnea antarctica*, *Rhizoplaca aspidophora*, *Acarospora macrocyclos* and *Buellia* spp., with bryophytes scarce or absent altogether. In contrast, the much scarcer moss-dominated habitats typically have high coverage of the mosses *Sanionia uncinata*, *Brachythecium austro-salebrosum*, *Pohlia nutans* and the algae *Prasiola crispa*, with smaller quantities of the liverwort *Cephaloziella varians* and the lichens, *Buellia* spp., *Usnea antarctica* and *Acarospora macrocyclos*.

Donnelly Island: Comprehensive surveys of the vegetation of Donnelly Island have not been undertaken, but much of the rocky areas are dominated by *Usnea antarctica*. *Deschampsia antarctica* and *Colobanthus quitensis* are present on the island and small areas of lush moss are found in some gullies. Plants and lichens on Donnelly Island are likely to be a subset of those present on the immediately adjacent Anchorage Island.

East Lagoon Island: Much of the island, down to rocks just above high water, is covered by a dense, well-developed lichen fellfield of similar species composition to that found on Anchorage Island. However, raised beach terraces on the island's eastern slopes are locally dominated by the grass *Deschampsia antarctica* and the moss *Polytrichastrum alpinum*, whilst west-facing damp gullies and slopes are covered by a moss carpet dominated by *Sanionia uncinatus*, *Brachythecium austro-salebrosum* and *Andreaea* spp. Moist rock faces are festooned with large thalli of macro-lichens (notably *Umbilicaria* spp. and *Usnea* spp.).

Walton Terraces, Léonie Island: Walton Terraces, on the western part of Léonie Island, are sheltered and receive much reflected radiation from the nearby Hurley and Turner glaciers on Adelaide Island. Additionally, water is continuously available during the summer from late and permanent snow beds, including a number of small, defined streams. Stable terraces, crags and gullies from sea level to c. 100 m support large and diverse vegetation

stands, while more consolidated boulder screes at the same altitude harbour a typical lichen fellfield community. Several coastal terraces support stands of vegetation of 400-500 m², including many closed stands of higher plants (*Deschampsia antarctica*, *Colobanthus quitensis*) of up to 10 m². Dominant bryophytes include *Andreaea* spp., *Brachilophozia hatcheri*, *Cephaloziella* spp., *Brachythecium austro-salebrosum*, *Bryum* spp., *Sanionia uncinatus*, *Pohlia nutans* and *Polytrichastrum alpinum* and there is also a very diverse lichen flora (see Table 4).

Mucklescarf Island: Little is known about the terrestrial biology of the island; however, due to the small size of the island, high density of birds and large quantities of surface guano, terrestrial vegetation is minimal.

Horton, Hurley and Turner Glaciers: Little is known about the biology of the ice-free ground within the site. However, the predominance of permanent ice and glaciers, combined with the high altitude and generally steep angle of the ice-free ground means that terrestrial biological communities are likely not to be extensive and may be largely limited to small patches of lichen-dominated communities on available lower altitude rock surfaces.

Invertebrates

The islands of Ryder Bay have unusually diverse invertebrate communities. Nevertheless, differences in invertebrate species richness between sites have been recorded, this being greatest on Léonie Island, intermediate on Anchorage Island, and most limited on the Lagoon Islands (Table 5). On Léonie Island, the most widely distributed species are *Globoppia loxolineata*, *Gamasellus racovitzi*, *Eupodes minutus*, *Nanorchestes berryi*, *Stereotydeus villosus*, *Cryptopygus antarcticus*, *Cryptopygus badasa* and *Friesia grisea*. On Anchorage Island and East Lagoon Island, *Gamasellus racovitzi*, *Cryptopygus antarcticus* and *Friesia grisea* are widely distributed, with *Halozetes belgicae* being widespread on East Lagoon Island and *Alaskozetes antarcticus* on Anchorage Island. The presence of the latter two species indicates the coastal marine influence on these low-lying islands. The two predatory mites, *Gamasellus racovitzi* and *Rhagidia gerlachei*, are found in most substrates sampled, and the herbivore/detritivore *Stereotydeus villosus* (Prostigmata) is also often found in great numbers on the surface of stone substrates. The springtails *C. antarcticus* and *C. badasa* show little overlap in distribution at Ryder Bay sites, the latter being more abundant in material taken from small growths of moss found on ledges and crevices at higher altitude (on Léonie Island in particular) and the former dominating more extensive coastal (and possibly more consistently damp) habitats. *F. grisea* is generally encountered infrequently in coastal substrates, with the exception of drier *Polytrichastrum alpinum* turfs where it is dominant. Invertebrate records are not available for Mucklescarf Island, Donnelly Island, or the Horton, Hurley and Turner Glaciers, although they are likely to be a subset of those listed in Table 5.

The non-native Collembolon, *Hypogastrura viatica*, was recorded from Léonie Island and presumably introduced before 1993. In 2015 an attempt was made to assess the continued presence and distribution of this species in the local area, including the islands of Ryder Bay and Rothera Point. *Hypogastrura viatica* was not identified amongst the Collembola specimens extracted from samples taken from the islands and Rothera Point. With no evidence of the continued



presence of this non-native *Collembolon* in the local area, either *H. viatica* has become extinct or has such a restricted spatial distribution that the monitoring programme failed to detect it. In light of these results, biosecurity measures are described as a precautionary measure to reduce the risk of further anthropogenic dispersal of this potentially invasive species (see 7(i) *General permit conditions*).

Vertebrate fauna

Numbers of skua territories counted in January 2018 within the ASPA sites on each of the islands, were as follows: Léonie Island (west) (159, and 58 skuas at a club site), East Lagoon Island (144), Anchorage Island (439 and 136 skuas at two club sites) and Donnelly Island (25). Skua territories were widely distributed across snow-free ground except on the scree above 100 m on Léonie Island.

Antarctic shags breed on Mucklescarf Island (251 pairs), with the colony unusually large for this species; only 11 other colonies (<10% of those recorded) hold ≥200 pairs (Schrimpp *et al.* 2018). No skua territories were found on the island.

Other breeding species are kelp gulls (*Larus dominicanus*), which are found on East Lagoon Island (15-25 pairs), Anchorage Island (10-20 pairs), Léonie Island (20-30 pairs) and Donnelly Island (10-20 pairs) (all counts in 2018; British Antarctic Survey unpublished data). Antarctic terns (*Sterna vittata*) do not breed within the Area, but around 10 pairs breed elsewhere on Léonie Island. However, Antarctic terns were recorded breeding in small numbers on Lagoon and Anchorage Islands in the 1990s (Milius 2000). Wilson's storm-petrels (*Oceanites oceanicus*) breed at Anchorage Island, confirmed in 2018 by records of adults calling from crevices in daylight or a bird seen incubating - and are highly likely to breed on East Lagoon Island given the large extent of suitable habitat. Moulting Adélie penguins (*Pygoscelis adeliae*) are present in considerable numbers (10s to 100s of birds) on Anchorage Island, and in smaller numbers elsewhere in the Area in the late summer. However, no penguin or giant petrel colonies are present within the Area.

Weddell seals (*Leptonychotes weddellii*) haul out on the shore of raised beaches at all sites. Large numbers (>100) of moulting southern elephant seals (*Mirounga leonina*) haul out on Anchorage Island, and East Lagoon Island in the summer, and 100s of non-breeding Antarctic fur seals (*Arctocephalus gazella*) may be present on the islands in the late summer. The numbers of fur seals are currently small and may be rising, which may ultimately cause a similar threat to the terrestrial environment as experienced at sites in the South Orkney Islands.

Human activities and impact

The Léonie Islands have been subject to human activity for over 112 years. The islands were charted originally in January 1909 by Jean-Baptiste-Etienne-Auguste Charcot during the French Antarctic Expedition (1908-10) and further charted by the British Graham Land Expedition in February 1936, when the name of the largest island was also applied to the whole group. The islands were further surveyed by British expeditions from "Stonington Island" (1948-50) and charted by an RN Hydrographic Survey Unit from HMS Endurance (1976-77). The islands were visited occasionally following the establishment of Adelaide Station (1961-77) and more regularly following the establishment of Rothera Research Station (Lat. -67.56944°; Long -68.12222°) in 1975, which is located only 3.5 km

from the nearest island within the Area. The Léonie Islands became a focus for substantial terrestrial biology research following the construction of the Bonner Laboratory at Rothera Research Station in 1997. Overall, activities have been confined to scientific research visits and recreation visits by station personnel and occasional visits by tourists aboard yachts and, more rarely, cruise vessels.

Anchorage Island: Anchorage Island has been subject to intensive research since the mid-1990s. The Anchorage field hut (located just outside the Area) has supported field researchers for several years. A wooden mast was erected for survey purposes in the 1960s on the highest point of the island (Lat. -67.59778°; Long. -68.20417°), but this has subsequently collapsed and the mast, anchor cables and stakes were removed in Jan 2018.

Donnelly Island: Donnelly Island was visited by two people for one hour on 31 Jan 2018 for environmental management purposes. To our knowledge it had not been visited previously for at least 20 years. However, a brief visit to the island was made in the mid-1990s to install a small memorial plaque for John P. Donnelly, ship Chief Engineer with the British Antarctic Survey, after whom the island is named.

East Lagoon Island: East Lagoon Island has been subject to research, particularly on its lichen communities, since the 1990s. The close proximity of East Lagoon Island to the field hut on West Lagoon Island means that the site has been subject to some recreational visits. The two islands are separated by a shallow channel, 50 m wide, which can be crossed using waders at low tide.

Walton Terraces, Léonie Island: Located on the side of Léonie Island that is furthest from Rothera Research Station, the area has received occasional visits by researchers and infrequent recreational visits by research station staff.

Mucklescarf Island: Due to its small size and high density of breeding birds, the island has been of interest to bird biologists but has only been visited irregularly (every few years) to undertake bird population counts.

Horton, Hurley and Turner Glaciers: In contrast to the high levels of visitation to some of the other sites within the Area over the past century or more, visitation of the Horton, Hurley and Turner Glaciers has been almost non-existent. Ascents of the peaks located at the northern and western boundary of the Area site have been made by geological parties, but they did not enter the Area. One landing was made by a small geological party during the 2006/7 for c. 1 hour at the eastern boundary of the site at the rock bluff south of the Turner Glacier front (Lat. -67.57778°; Long. -68.38750°). No other access to the site is known. No permanent or semi-permanent infrastructure, artefacts, transport routes or any other evidence of visible human presence are known.

Other nearby research stations

Two year-round scientific research stations operate in the vicinity: General San Martín (Argentina; Lat. -68.12972°; Long. -67.10278°) which is 75 km south-east, and Rothera Research Station (UK; Lat. -67.56944°; Long -68.12222°) which is c. 3.5 km to the north-east. A summer-only station, Teniente Luis Carvajal (Chile; Lat. -67.76056°; Long. -68.91472°), located 35 km to the south-west at the southern end of Adelaide Island, has been operated by Chile since 1985. The temporary Turkish Antarctic Research Station (TARS; Lat. -67.829676°; Long -67.237757°) is located on Horseshoe Island, c. 45 km east-south-east from the Area.



6 (ii) Access to the Area

Due to the presence of submerged rocks, access to each of the Area sites is best made by small shallow-bottomed boats. Alternatively, if reliable sea ice has formed, it may be possible to access the Area by snowmobile. Access points for small boats are shown in Maps 3 and 4 and are described below.

Anchorage Island: Access to the island is best made at rocks located near the research hut on the north-west shore of the island at coordinates Lat. -67.60278°; Long -68.21319°. An alternative access point is to the east of the island at Lat. -67.60167°; Long. -68.20056°, but landings at other locations around the island may be possible.

Donnelly Island: The recommended landing site is located at Lat. -67.61000°; Long. -68.20222°, but landings at other locations around the island may be possible.

East Lagoon Island: Landing may be possible at many locations on the beach to the east of the 'lagoon' that separates West Lagoon Island and East Lagoon Island, for example, at Lat. -67.59344°; Long. -68.24003°.

Walton Terraces, Léonie Island: Given that the site is included in the Area to protect its wilderness values, entry is only allowed for compelling scientific reason, which cannot be served elsewhere in the ASPA, or for reasons essential to the management of the Area. Léonie Island is best accessed on the northern tip of the island outside the Area (Lat. -67.59250°; Long. -68.34139°). Other landing sites may be possible, but submerged rocks present a significant risk to vessels.

Mucklescarf Island: Access to the island is best made at a small inlet to the south of the island at coordinates Lat. -67.59411°; Long. -68.26119°. Landing at other locations may be difficult due to the rocks and the large density of birds on the island.

Horton, Hurley and Turner Glaciers: Given that the site is included in the Area to protect its wilderness values, entry is only allowed for compelling scientific reasons, which cannot be served elsewhere in the ASPA, or for reasons essential to the management of the Area. If access is required for such reasons, then this may be achieved by small boat from Ryder Bay, or overland via various snow covered mountain passes to the north and west of the site.

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

There are no permanent structures present within the Area. The nearest scientific research station is Rothera Research Station, located 3.5 km north-east of Anchorage Island (see Map 2). A refuge, which is currently being replaced, is located on Anchorage Island just outside the Area, c. 200 m from the western-most recommended boat landing site. Scientific equipment has been installed at several locations on Anchorage Island including clothes (Lat. -67.60611°; Long -68.21806°), an Automatic Weather Station (Lat. -67.60253°; Long. -68.20292°) and artificial plant experiments (Lat. -67.60556°; Long. -68.20556° and Lat. -67.64583°; Long. -68.20417°). On Donnelly Island a memorial plaque has been installed with the words 'This island named in memory of John P. Donnelly (1948-1993) Chief Engineer RRS James Clarke Ross' (Lat. -67.60806°; Long. -68.19667°). No structures are located within East Lagoon Island, Walton Terraces on Léonie Island, Mucklescarf Island or the Horton, Hurley and Turner Glaciers.

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

ASPA No. 129 Rothera Point, Marguerite Bay lies 4 km north-east of Anchorage Island. ASPA No. 107, Emperor Island, Dion Islands, Marguerite Bay, lies about 15 km south of Adelaide Island. ASPA No. 115, Lagotellerie Island, Marguerite Bay, lies about 11 km south of Pourquoi Pas Island. ASPA No. 117, Avian Island, Marguerite Bay, lies about 0.25 km south of the south-west tip of Adelaide Island. HSM No. 63 'Base Y' is located on Horseshoe Island, c. 45 km east-south-east from the Area. The locations of these protected areas are shown on Map 1.

6(v) Special zones within the Area

None

7. Terms and conditions for entry permits

7(i) General permit conditions

Entry into the Area is prohibited except in accordance with a permit issued by an appropriate national authority 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;
- for sites that are included in the Area to protect wilderness values, i.e., Horton, Hurley and Turner Glaciers and Walton Terraces on Léonie Island (see Table 2), activities shall only be undertaken for compelling scientific reasons, which cannot be served elsewhere in the ASPA, 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, scientific, wilderness and aesthetic 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 that might have exceptionally been undertaken, and/or of any materials released and not removed, that were not included in the authorized permit.



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

To protect the values of the Area, the following restrictions apply within the Area:

- To protect the wilderness values of the Area, in accordance with the aims and objective of this management plan, visits to the Horton, Hurley and Turner Glaciers site and Walton Terraces on Léonie Island shall be kept to the absolute minimum.
- Access to the Area site boundaries shall be by small boat (e.g., Rigid Inflatable Boat (RIB)) or by snowmobile or other overland vehicle. Access points for small boats to the Léonie Island sites are described in section 6(ii) *Access to the Area* and below:
 - Anchorage Island: Lat. -67.60278°; Long. -68.21306° or Lat. -67.60167°; Long. -68.20056°
 - Donnelly Island: Lat. -67.61000°; Long. -68.20222°
 - East Lagoon Island: Lat. -67.59344°; Long. -68.24003°
 - Walton Terraces, Léonie Island: Lat. -67.59250°; Long. -68.34139°
 - Mucklescarf Island: Lat. -67.59411°; Long. -68.26119°
 - Horton, Hurley and Turner Glaciers: Access by boat not recommended
- Use of overland vehicles within the Area is not permitted.
- Movement across land and ice within the Area shall be by foot only. Pedestrian traffic shall be kept to the minimum necessary to be consistent with the objectives of any permitted activities and every reasonable effort should be made to minimise trampling effects. No trails exist within the Area. Visitors should avoid areas of visible vegetation. Care should be exercised when walking in areas of moist ground, particularly stream course beds, where foot traffic can easily damage sensitive soils, plant and algal communities, and degrade water quality.
- Winged aircraft and helicopters are not permitted to land within the Area.
- The Rothera Research Station runway commenced operation in 1991 and is located within 3.5 km of some sites within the Area. Given the proximity of the runway, on occasions overflight of the Area may be necessary for operational or scientific reasons. To the maximum extent possible, the operation of aircraft over the Area should be carried out, in compliance with the *Guidelines for the Operation of Aircraft near Concentrations of Birds* contained in Resolution 2 (2004) (available at: http://www.ats.aq/documents/recatt/Att224_e.pdf).
- Overflight of bird colonies within the Area by Remotely Piloted Aircraft Systems (RPAS) shall not be permitted unless for compelling scientific or operational purposes, and in accordance with a permit issued by an appropriate national authority. Furthermore, operation of RPAS within or over the Area shall be in accordance with the 'Environmental guidelines for operation of Remotely Piloted Aircraft Systems (RPAS) in Antarctica' (Resolution 4 (2018)) (available at: https://www.ats.aq/devAS/ats_meetings_meeting_measure.aspx?lang=e).

- Strict personal quarantine precautions shall be undertaken to avoid the introduction of non-native species. Precautions shall also be applied when moving between the different sites that comprise the Area. Specifically, footwear shall be scrubbed to remove any adhered soil or mud and outer clothing, bags and experimental equipment must be free of soil, mud, guano and plant propagules.

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

Activities which may be conducted within the Area include:

- Compelling scientific research which cannot be undertaken elsewhere.
- Scientific research that will not jeopardise the environmental, scientific or wilderness values of the Area.
- Essential management activities, including monitoring.

For sites that are included in the Area to protect wilderness values, i.e. Horton, Hurley and Turner Glaciers and Walton Terraces on Léonie Island (see Table 2), activities shall only be undertaken for compelling scientific reasons, which cannot be served elsewhere in the ASPA, or for reasons essential to the management of the Area.

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.
- For sites that are included in the Area to protect wilderness values, i.e., Horton, Hurley and Turner Glaciers and Walton Terraces, Léonie Island (see Table 2), the installation of structures shall only be undertaken for compelling scientific reason, which cannot be served elsewhere in the ASPA, or for reasons essential to the management of the Area.
- 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, and be made of materials that can withstand the environmental conditions and pose minimal risk of contamination of the Area.
- Removal of specific structures or equipment for which the permit has expired shall be the responsibility of the authority which granted the original permit and shall be a condition of the Permit.
- Existing structures within the Area must not be removed, except in accordance with a permit (see section 6 (iii) *Location of structures within and adjacent to the Area*).



7(v) Location of field camps

- Camping within the Area is prohibited.
- Accommodation may be available at Rothera Research Station.
- Alternatively, field huts/facilities operated by the British Antarctic Survey are located on West Lagoon Island (Lat. -67.59393°; Long. -68.24311°) and on Anchorage Island just outside the Area (Lat. -67.60222°; Long. -68.20893°) (see Map 4).
- Camping outside the Area on Léonie Island may be possible on the beach at location Lat. 67.59361°; Long. -68.34389° (see Map 3).

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 that 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). Furthermore, substantial differences in biodiversity have been recorded between the different sites that comprise the ASPA, therefore, precautions shall be taken to prevent the transfer of species between sites within the ASPA. Visitors should also consult and follow, as appropriate, recommendations contained in the *CEP non-native species manual*, and in the *Environmental code of conduct for terrestrial scientific field research in Antarctica*. Additional 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. 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*.
- Any water, sediment, soil or vegetation sampling is to be kept to the minimum required for scientific or management purposes, and carried out using techniques that 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 (see sections 7(iii) *Activities which may be conducted in the Area*, 7(x) *Measures that may be necessary to continue to meet the aims of the management plan* and 7(vii) *Taking of, or harmful interference with, native flora and fauna*). With regard to geological sampling, permits shall not be granted if there is a reasonable concern that any proposed sampling would take, remove or damage such quantities of rocks (including fossiliferous rocks) that their abundance within the Area would be significantly affected. Other 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

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;
- maintenance of scientific equipment; and
- carry out protective measures.
- carry out research or management in a manner that avoids interference with long-term research and monitoring activities or possible duplication of effort. Persons planning new projects within the Area should consult with established programmes working within the Area, such as those of the United Kingdom or the Netherlands, before initiating the work.



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

To help maintain the ecological and scientific values of the Area, visitors shall take special precautions against biological introductions both into *and* between each of the six sites that comprise the ASPA. Of particular concern are microbial, animal or vegetation introductions sourced from soils from other Antarctic sites, including stations, or from regions outside Antarctica. To the maximum extent practicable, visitors shall ensure that footwear, clothing and equipment – particularly any sampling equipment – is thoroughly cleaned before entering the Area or moved between the six sites that comprise the Area.

The Area has not been designated specifically to protect geological values; however, in view of the fact that geological sampling is both permanent and results in cumulative impact the following measures shall be taken to safeguard the values of the Area:

- Visitors removing geological samples from the Area shall complete a record describing the geological type, quantity and location of samples taken, which should, at a minimum, be deposited with their National Antarctic Data Centre or with the Antarctic Master Directory.
- Visitors planning to sample within the Area shall demonstrate that they have familiarised themselves with earlier collections to minimise duplication.

7(xi) Requirements for reports

- The principal permit holder for each visit to the Area shall submit a report to the appropriate national authority as soon as practicable, and no later than six months after the visit has been completed.
- Such reports should include, as appropriate, the information identified in the Visit Report form contained in Appendix 2 of the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas (Resolution 2 (2011)).
- 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

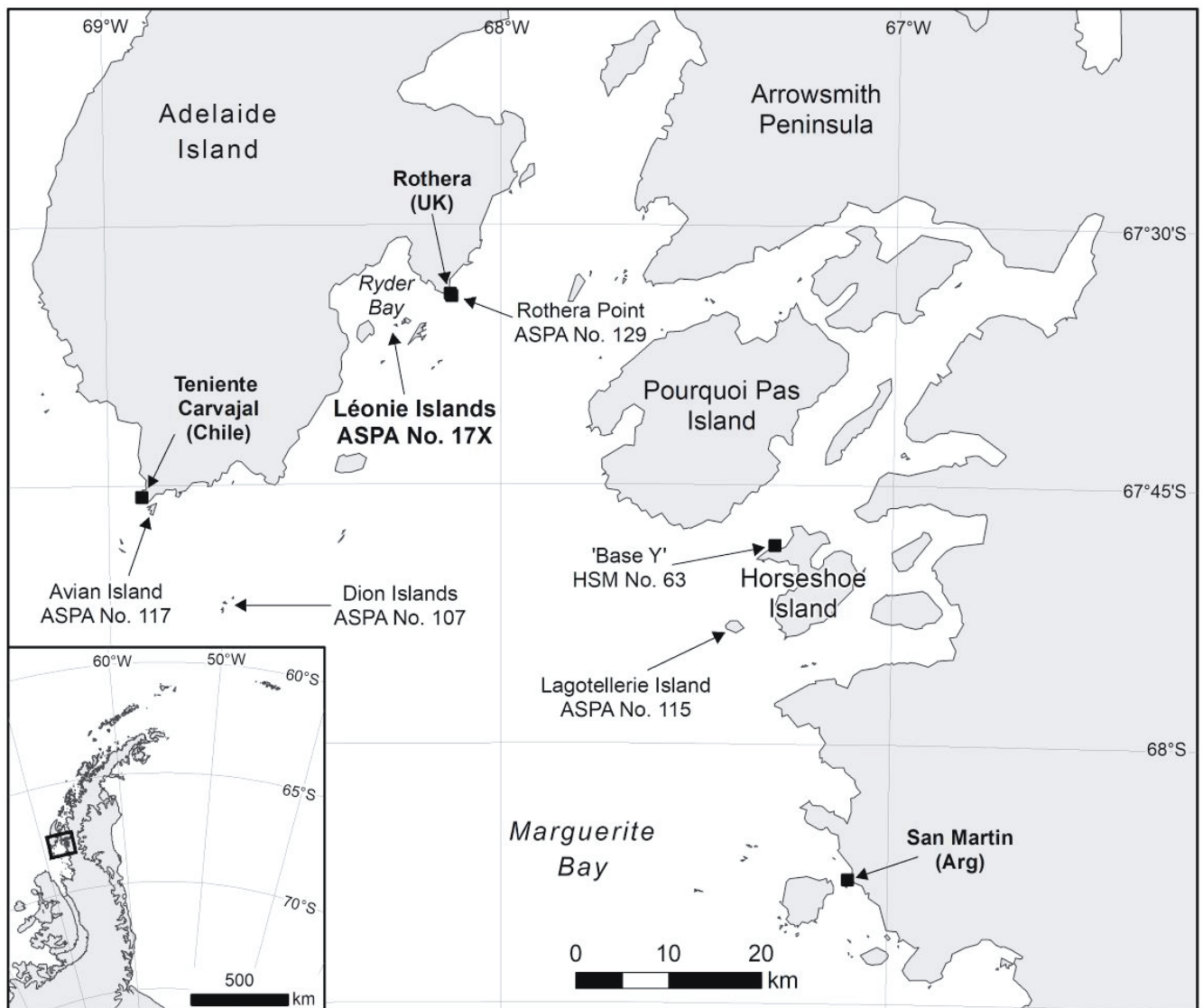
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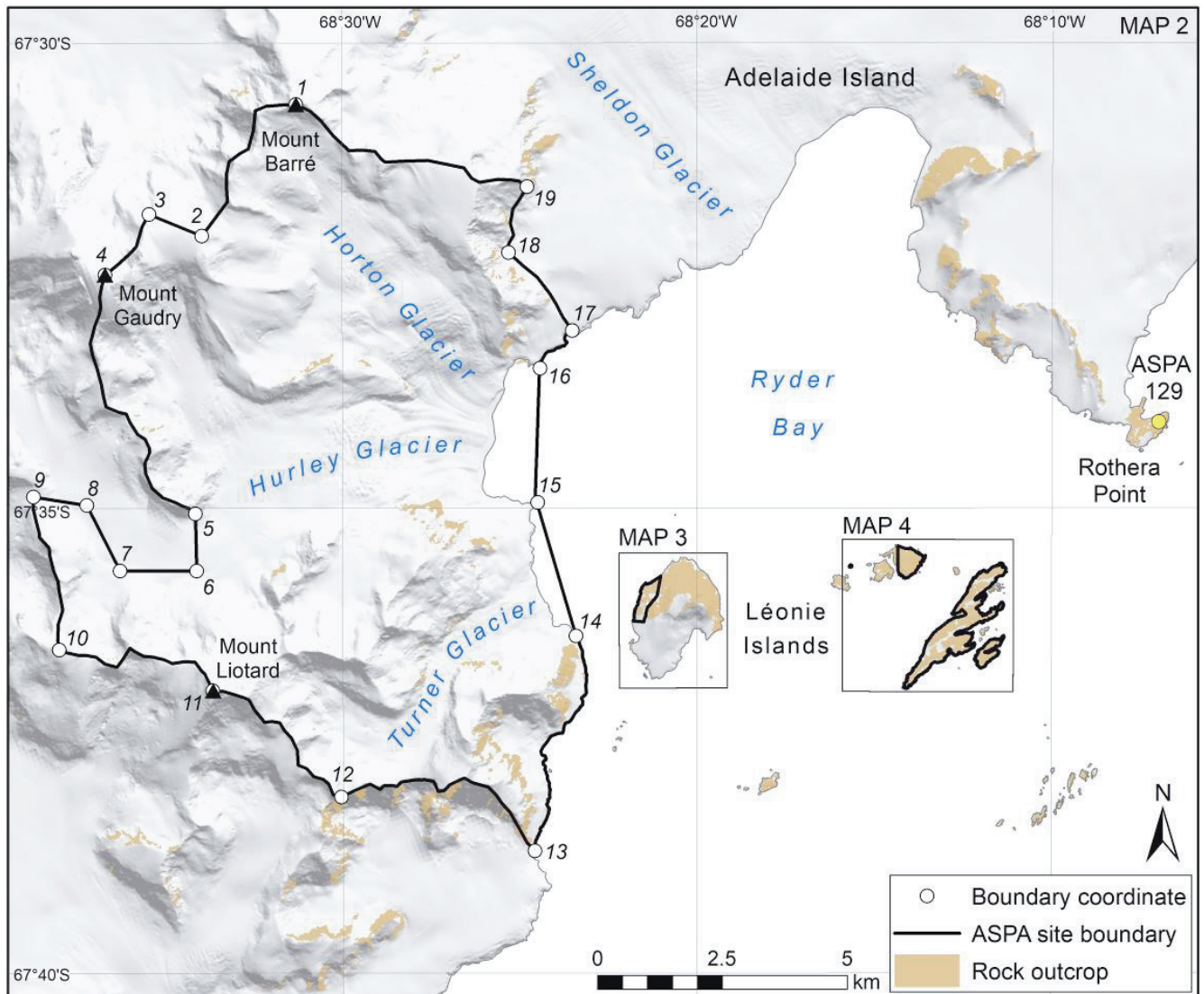


Map 1. Location of ASPA No. 177 Léonie Islands and south-east Adelaide Island, within the wider Marguerite Bay area. Map specifications: WGS84 UTM Zone 19S. Central Meridian 68°W. (Inset map: WGS84 Antarctic Polar Stereographic. Central Meridian 55°W, Standard Parallel: 71°S).



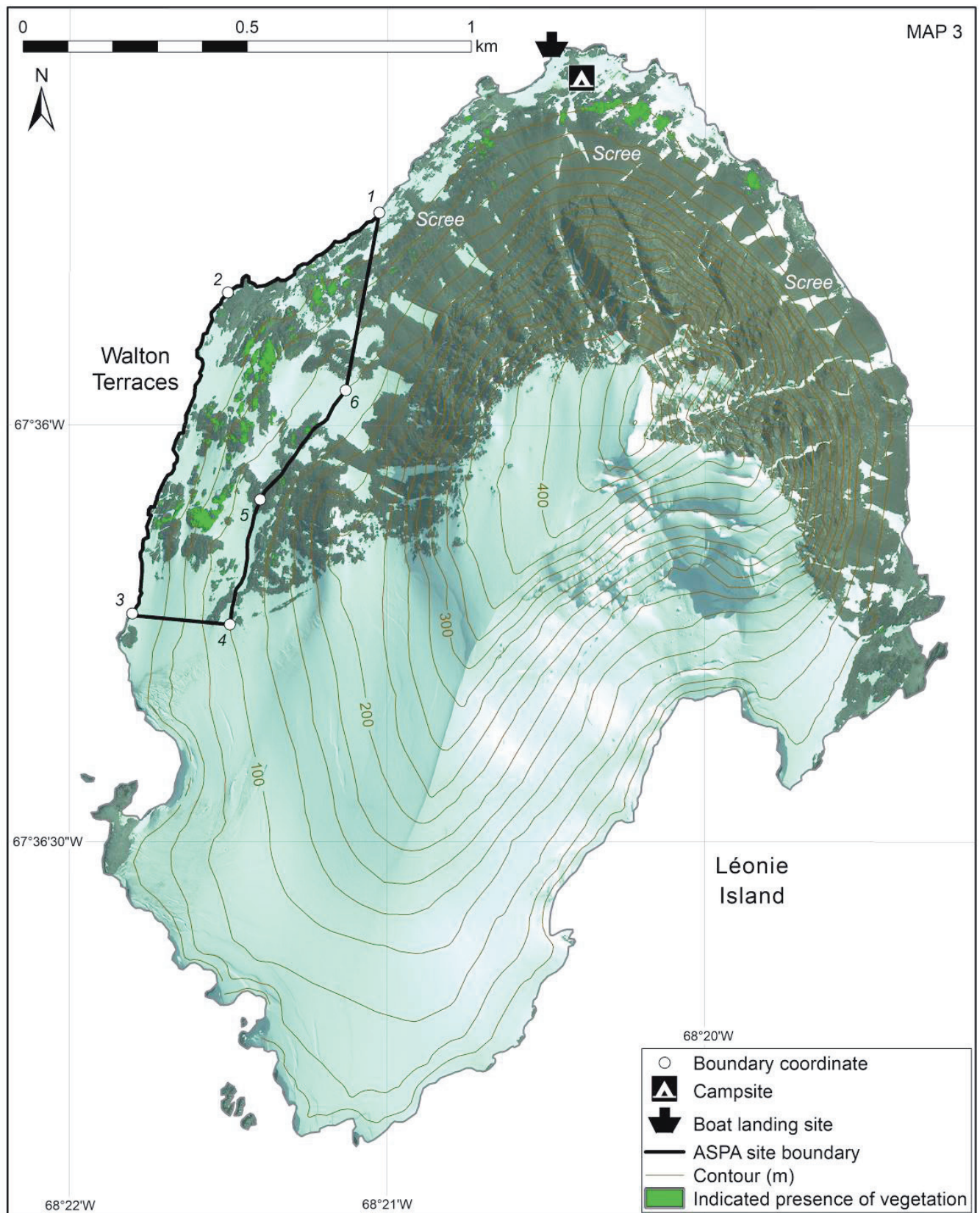


Map 2. Overview map of the multi-site ASPA No. 177 Léonie Islands and south-east Adelaide Island, Antarctic Peninsula. The Horton, Hurley and Turner Glaciers site is detailed in the map below. The Walton Terraces site on Léonie Island is detailed in Map 3. The Anchorage Island, East Lagoon Island, Donnelly Island and Mucklescarf Island sites are detailed in Map 4. Map specifications: WGS84 UTM Zone 19S. Central Meridian 68°W. Boundary coordinate details can be found in Table 3.





Map 3. Map of the Walton Terraces site which is part of the multi-site ASPA No. 177 Léonie Islands and south-east Adelaide Island, Antarctic Peninsula. Map specifications: WGS84 UTM Zone 19S. Central Meridian 68°W. Boundary coordinate details can be found in Table 3.





Map 4. Map of the Anchorage Island, East Lagoon Island, Donnelly Island and Mucklescarf Island sites, which are part of the multi-site ASPA No. 177 Léonie Islands and south-east Adelaide Island, Antarctic Peninsula. Map specifications: WGS84 UTM Zone 19S. Central Meridian 68°W. Boundary coordinate details can be found in Table 3.

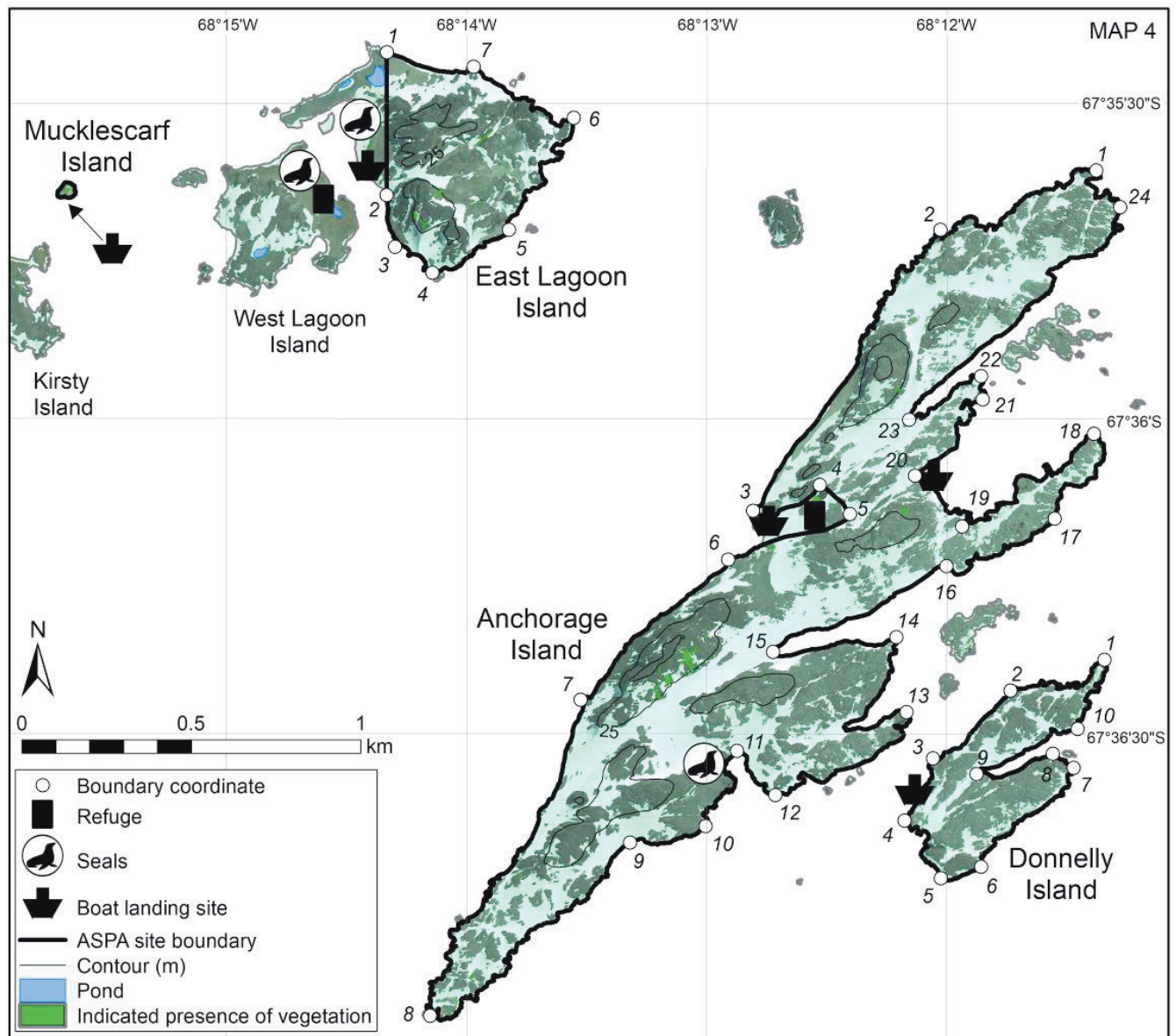




Table 2. Outstanding values present in each of the sites that comprise ASPA No. 177 Léonie Islands and south-east Adelaide Island, Antarctic Peninsula.

	Values					
	Scientific		Environmental		Wilderness	Aesthetic
	Research	Environmental monitoring control area	Avifauna	Terrestrial communities		
Anchorage Island	✓		✓	✓		
Donnelly Island		✓	✓			
East Lagoon Island			✓	✓		
Walton Terraces, Léonie Island			✓	✓	✓	✓
Mucklescarf Island			✓			
Horton, Hurley and Turner Glaciers					✓	✓



Table 3. Boundary co-ordinates for the five sites that comprise ASPA No. 177 Léonie Islands and south-east Adelaide Island, Antarctic Peninsula.

Area site	Area (ha)	Boundary coordinate number	Latitude	Longitude
Anchorage Island	60	1	-67.59343	-68.18966
		2	-67.59500	-68.20047
		3	-67.60244	-68.21346
		4	-67.60175	-68.20882
		5	-67.60252	-68.20673
		6	-67.60373	-68.21517
		7	-67.60744	-68.22540
		8	-67.61580	-68.23586
		9	-67.61121	-68.22198
		10	-67.61078	-68.21674
		11	-67.60879	-68.21456
		12	-67.60996	-68.21190
		13	-67.60777	-68.20280
		14	-67.60578	-68.20351
		15	-67.60617	-68.21206
		16	-67.60390	-68.20002
		17	-67.60264	-68.19252
		18	-67.60040	-68.18981
		19	-67.60285	-68.19893
		20	-67.60151	-68.20222
		21	-67.59949	-68.19752
		22	-67.59887	-68.19763
		23	-67.60003	-68.20262
		24	-67.59441	-68.18798
Donnelly Island	12	1	-67.60637	-68.18904
		2	-67.60719	-68.19556
		3	-67.60899	-68.20094
		4	-67.61063	-68.20291
		5	-67.61216	-68.20040
		6	-67.61185	-68.19761
		7	-67.60923	-68.19119
		8	-67.60886	-68.19263
		9	-67.60940	-68.19792
		10	-67.60820	-68.19092
East Lagoon Island	20	1	-67.59032	-68.23888
		2	-67.59409	-68.23888
		3	-67.59547	-68.23829
		4	-67.59615	-68.23571
		5	-67.59502	-68.23040
		6	-67.59205	-68.22590
		7	-67.59070	-68.23286



Area site	Area (ha)	Boundary coordinate number	Latitude	Longitude
Walton Terraces, Léonie Island	15	1	-67.59574	-68.35042
		2	-67.59734	-68.35836
		3	-67.60377	-68.36337
		4	-67.60399	-68.35826
		5	-67.60149	-68.35666
		6	-67.59930	-68.35218
Mucklescarf Island	0.2	1	-67.59410	-68.26058
		2	-67.59376	-68.26123
		3	-67.59413	-68.26170
Horton, Hurley and Turner Glaciers	10100	1	-67.51119	-68.52134
		2	-67.53467	-68.56568
		3	-67.53070	-68.59038
		4	-67.54162	-68.61102
		5	-67.58448	-68.56908
		6	-67.59470	-68.56860
		7	-67.59465	-68.60456
		8	-67.58291	-68.62003
		9	-67.58135	-68.64524
		10	-67.60882	-68.63338
		11	-67.61618	-68.56115
		12	-67.63532	-68.50071
		13	-67.64501	-68.40963
		14	-67.60650	-68.39021
		15	-67.58256	-68.40812
		16	-67.55850	-68.40703
		17	-67.55176	-68.39190
		18	-67.53782	-68.42167
		19	-67.52601	-68.41303



Table 4. Species of vascular plants, mosses, lichens, algae occurring within sites comprising ASPA No. 177 Léonie Islands and south-east Adelaide Island, and other ASPAs in the Marguerite Bay area. Data taken from Cannone et al. (2018) and the British Antarctic Survey database. Data for Donnelly Island and Mucklescart Islands are unavailable; however, the flora of Donnelly Island is likely to be a subset of the Anchorage Island flora due to their close proximity (115 m separation at their closest point). Plant diversity for Mucklescart Island is likely to be very low due to the high density of breeding birds, which cover almost all of the terrain, and the small size of the island (55 m at maximum width). No data are available for the Horton, Hurley and Turner Glaciers site, but vegetation diversity is likely to be low due to the altitude and steepness of the available ice-free ground.

Site name	Léonie Island*	Anchorage Island	Lagoon Islands*	ASPA No. 129 Rothera Point	ASPA No. 117 Avian Island	ASPA No. 115 Lagotellerie Island
Data Source	BAS	BAS	BAS	Cannone et al. (2018)	BAS	BAS
Vascular Plants						
<i>Deschampsia antarctica</i>	1	1	1	1		1
<i>Colobanthus quitensis</i>	1	1	1	1		1
Hepatics						
<i>Barbilophozia hatchery</i>	1				1	1
<i>Cephalozia varians</i>	1	1	1			
<i>Lophozia excisa</i>	1		1			
<i>Marchantia berte roana</i>	1					
Mosses						
<i>Andreaea depressinervis</i>	1	1	1	1	1	
<i>Andreaea parallela</i> var. <i>gainii</i>	1					
<i>Andreaea regularis</i>	1	1	1	1		1
<i>Bartramia patens</i>	1	1	1	1		1
<i>Brachythecium austro-salebrosum</i>	1	1	1	1	1	1
<i>Bryoerythrophyllum recurvirostrum</i>	1					
<i>Bryum archangelicum</i>	1	1	1	1		1
<i>Bryum argenteum</i>	1		1	1	1	1
<i>Bryum pallescens</i>	1					1
<i>Bryum pseudotriquetrum</i>	1				1	1
<i>Bryum urbanskyi</i>	1					
<i>Ceratodon purpureus</i>	1	1		1	1	1
<i>Coscinodon reflexidens</i>	1			1		
<i>Didymodon brachyphyllus</i>	1					
<i>Distichium capillaceum</i>	1					
<i>Encalypta thaptocarpa</i>	1					
<i>Grimmia plagiopodia</i>	1					1
<i>Hennediella heinii</i>		1				1
<i>Hypnum revolutum</i>	1			1		1



Site name	Léonie Island*	Anchorage Island	Lagoon Islands*	ASPA No. 129 Rothera Point Cannone et al. (2018)	ASPA No. 117 Avian Island	ASPA No. 115 Lagotellerie Island
Data Source	BAS	BAS	BAS		BAS	BAS
Mosses						
<i>Orthogrimmia sessitana</i>	1					1
<i>Platydictya jungermannioides</i>						
<i>Pohlia cruda</i>	1		1		1	
<i>Pohlia nutans</i>	1	1	1		1	1
<i>Polytrichastrum alpinum</i>	1		1			
<i>Sanionia uncinata</i>	1	1	1	1	1	1
<i>Schistidium andinum</i>	1					
<i>Schistidium antarctici</i>	1	1	1			
<i>Syntrichia magellanica</i>	1	1	1		1	1
<i>Syntrichia sarconeurum</i>	1					1
<i>Tortella alpicola</i>	1					
<i>Warnstorfia fontinaliopsis</i>					1	
<i>Willia austroleucophaea</i>						1
Lichens						
<i>Acarospora convoluta</i>	1					
<i>Acarospora macrocyclos</i>		1		1		1
<i>Amandinea coniops</i>	1					
<i>Amandinea isabellina</i>				1	1	
<i>Amandinea petermannii</i>	1	1		1		
<i>Bacidia tuberculata</i>	1					
<i>Bryonora pelata</i>	1					
<i>Buellia anisomera</i>	1				1	
<i>Buellia babingtonii</i>			1		1	
<i>Buellia cladocarpiza</i>	1					
<i>Buellia darbishirei</i>					1	
<i>Buellia falklandica</i>	1					
<i>Buellia illaetabilis</i>					1	



Site name	Léonie Island*	Anchorage Island	Lagoon Islands*	ASPA No. 129 Rothera Point	ASPA No. 117 Avian Island	ASPA No. 115 Lagotellerie Island
Data Source	BAS	BAS	BAS	Cannone et al. (2018)	BAS	BAS
Lichens						
Buellia latemarginata	1	1		1		
Buellia perlata				1		
Buellia pycnogonoides	1			1		
Buellia russa				1		
Buellia sp.				1		
Caloplaca athallina			1			
Caloplaca cirrochrooides				1		
Caloplaca isidioclada	1			1		1
Caloplaca lucens	1					
Caloplaca psoromatis	1					
Caloplaca sublobulata	1			1		
Caloplaca tirolensis	1					
Candelariella flava	1			1		
Candelariella vitellina	1					1
Cladonia fimbriata					1	
Cladonia galindezii	1					1
Cladonia pleurota	1		1			
Cladonia pocillum						1
Cladonia pyxidata	1					
Dermatocarpon polyphyllizum	1					
Flavoparmelia gerlachei	1		1			1
Frutidella caesiocatra	1					
Huea cerussata						1
Huea corallifera	1			1		
Lecania brialmontii			1			1
Lecanora dispersa agg.	1			1		



Site name	Léonie Island*	Anchorage Island	Lagoon Islands*	ASPA No. 129 Rothera Point	ASPA No. 117 Avian Island	ASPA No. 115 Lagotellerie Island
Data Source	BAS	BAS	BAS	Cannone et al. (2018)	BAS	BAS
Lichens						
<i>Lecanora physciella</i>	1			1		
<i>Lecanora polytropa</i>	1			1		1
<i>Lecidea atrobrunnea</i>	1					1
<i>Lecidea placodiiformis</i>	1					
<i>Lepraria caesia</i> alba	1	1		1		
<i>Lepraria</i> sp.						
<i>Leproloma cacuminum</i>				1		
<i>Leproloma vouauxii</i>						1
<i>Leptogium puberulum</i>	1		1			1
<i>Massalongia carnosa</i>			1	1		
<i>Mastodia tessellata</i>	1			1		1
<i>Megaspora verrucosa</i>	1					
<i>Ochrolechia frigida</i>	1	1	1	1		
<i>Parmelia saxatilis</i>	1		1			
<i>Phaeophyscia endococcina</i>	1					
<i>Physcia caesia</i>	1		1	1	1	1
<i>Physconia muscigena</i>	1		1			1
<i>Pleopsidium chlorophanum</i>				1		1
<i>Pseudephebe minuscula</i>	1		1	1		
<i>Pseudephebe pubescens</i>			1	1		1
<i>Psoroma cinnamomeum</i>			1			
<i>Psoroma hypnorum</i>	1		1			
<i>Rhizocarpum disporum</i>	1					
<i>Rhizocarpum distinctum</i>				1		
<i>Rhizocarpum geographicum</i>						
<i>Rhizocarpum grande</i>	1			1		



Site name	Léonie Island*	Anchorage Island	Lagoon Islands*	ASPA No. 129 Rothera Point	ASPA No. 117 Avian Island	ASPA No. 115 Lagotellerie Island
Data Source	BAS	BAS	BAS	Cannone et al. (2018)	BAS	BAS
Lichens						
Rhizocarpon griseolum	1					
Rhizoplaca aspidophora	1	1	1			1
Rhizoplaca melanophthalma	1		1	1		1
Rinodina olivaceobrunnea	1		1	1		
Stereocaulon alpinum	1		1			
Stereocaulon antarcticum	1			1		
Umbilicaria antarctica	1	1	1			
Umbilicaria decussata	1		1	1		1
Umbilicaria kapperi			1	1		
Umbilicaria nylanderiana	1					
Umbilicaria umbilicarioides	1					
Usnea antarctica	1	1	1	1	1	1
Usnea aurantiaco-atra	1	1	1			
Usnea sphacelata	1			1		1
Usnea subantarctica	1	1	1	1		
Xanthoria candelaria	1		1	1		1
Xanthoria elegans	1	1	1	1		1
Other						
Prasiola crispa		1		1		

* Data may include some species on Léonie and Lagoon Islands found outside the boundary of the ASPA.



Table 5. Microarthropods recorded from Anchorage, Lagoon and Léonie Islands.

Site name	Anchorage Island	Lagoon Islands	Léonie Island
Cryptostigmata			
<i>Austropia crozetensis</i>			?
<i>Alaskozetes antarcticus</i>	1	1	1
<i>Halozetes belgicae</i>	1	1	1
<i>Globoppia loxolineata</i>	1		1
<i>Globoppia intermedia</i>			?
<i>Magellozetes antarcticus</i>	1	1	1
Mesostigmata			
<i>Gamasellus racovitzai</i>	1	1	1
Prostigmata			
<i>Eupodes exiguus</i>		1	
<i>Eupodes minutus</i>			1
<i>Eupodes parvus</i>			1
<i>Apotriophydeus</i> sp.	1		
<i>Pretriophydeus tilbrooki</i>	1	1	
<i>Nanorchestes berryi</i>	1	1	1
<i>Nanorchestes gressitti</i>	1		1
<i>Nanorchestes</i> sp.	1	1	
<i>Stereotydeus villosus</i>	1	1	1
<i>Rhagidia gerlachei</i>	1	1	1
Collembola			
<i>Cryptopygus antarcticus</i>	1	1	1
<i>Cryptopygus badasa</i>	1	1	1
<i>Friesia grisea</i>	1	1	1
<i>Folsomotoma octo-oculata</i>			1