



Management Plan

for Antarctic Specially Protected Area No. 178 INEXPRESSIBLE ISLAND AND SEAVIEW BAY, ROSS SEA

Introduction

Inexpressible Island and Seaview Bay is located in Terra Nova Bay, Victoria Land, Western Ross Sea at 74° 54.2' S, 163° 43.5' E (Map 1). The ASPA (hereinafter also referred to as Area) has an approximate area of 3.31 km², 0.99 km² marine (35 %) and 2.32 km² terrestrial (65%) (Map 2) and was proposed by China, Italy and the Republic of Korea. The Area is distinctive and the primary reasons for its designation as an ASPA is the need to protect environmental and outstanding scientific values. In particular, this Area hosts one of the oldest Adélie penguin (*Pygoscelis adeliae*) colony and an important breeding site of South Polar Skua (*Stercorarius maccormicki*). The Area was identified as an important bird area (IBA 178) by BirdLife International on the basis of the South Polar Skua colony and the concentration of seabirds, in particular Adélie Penguin (Resolution 5, 2015). Its particular ecosystem is related to the adjacent Terra Nova Bay polynya and allows comparison with other nearby sites with different sea ice dynamics along the year. Moreover, in the ASPA, several lakes are influenced by guano nutrient inputs, while others are not impacted.

The first documented record of an Adélie penguin breeding group in the Area was in 1963, and continuous monitoring has been carried out from the 1980s to the present, with so far one of the earliest statistical record of the Adélie penguin in the Ross Sea region. The active penguin colony in the Area has had continuous occupation for the past ~7,000 years, which is the longest existing Adélie penguin colony in the Ross Sea region. There are more than 20,000 breeding pairs of Adélie penguins. The proposed ASPA includes crucial penguins' foraging access area to Terra Nova Bay polynya. Concerning South Polar Skuas, while up to 60 breeding pairs were reported in the 80's, recent investigation found no more than 30 breeding pairs, resulting in a quite low breeding success of these species in the area.

The ASPA is located within Domain S (McMurdo–South Victoria Land geologic) based on the Environmental Domains Analysis for the Antarctic continent (Resolution 3, 2008). Moreover, the ASPA sits within Antarctic Conservation Biogeographic Region (ACBR) 8 Northern Victoria Land (Resolution 3, 2017).

The marine area of the ASPA is located within the General Protection Zone of the Ross Sea Region Marine Protected Area. The research and monitoring data generated from the ASPA could benefit the scientific work for the RSRMPA.

1. Description of values to be protected

The exceptional scientific and ecological values of the Area are based on the following:

The Adélie penguin colony of Inexpressible Island is one of the longest monitored (over 30 years) Adélie penguin population in the Ross Sea region (Woehler and Croxall, 1997). Located in Seaview Bay (74°54'04"S, 163°43'20"E) and South Bay (74°54'40"S, 163°43'31"E), the penguin colony is currently made up by more than 20,000 breeding pairs in Seaview Bay, and about 100 breeding pairs in South Bay (Map 3). The latest count gives a total number of 29,899 breeding pairs in 2019 (MOE, 2020). Long-term planned population dynamic monitoring will provide support for studying the dynamics of breeding penguin populations, and the relationship between populations and climate change.

The Adélie penguin breeding colony have the longest continuous occupation history, longer than 7,000 years in the Area (Baroni and Orombelli, 1991, 1994; Lambert *et al.*, 2002; Baroni and Hall, 2004; Shepherd *et al.* 2005; Emslie *et al.* 2007; Mazguc *et al.*, 2017). Extraction of ancient DNA from remains is important for estimating and correcting molecular evolution rates, and exploring population historical dynamics, genetic structural changes, as well as climate change (Lambert *et al.*, 2002; 2010; Ritchie *et al.*, 2004; Sheperd *et al.*, 2005; Millar *et al.*, 2008; 2012; Submaranian *et al.*, 2009; Parks *et al.*, 2015). Subfossil bone samples that retain DNA for 7,000 years of the Adélie penguin have been cryopreserved in the area. In fact, in the current breeding grounds, there is high density (1-5/m²) of well-preserved penguin mummies of different ages, which would provide a rich and unique sample library for studying the historical dynamics, climate change and molecular evolution at geological scale. Additionally, penguin guano input in the lacustrine sediment is also ideal for paleoecology research. Sub-fossil remains of southern elephant seals (*Mirounga leonina*) were also recovered in the area (Hall *et al.*, 2006; Koch *et al.*, 2019).



In Terra Nova Bay and surrounding areas (Wood Bay) three colonies of Adélie penguin are present: Edmonson Point (Wood Bay, ASPA 165), Adélie Cove, and Inexpressible Island (c. 2,000, 11,000 and 25,000 pairs, respectively Lyver *et al.* 2014; Pezzo *et al.*, 2007) located in a stretch of coast of about 75 km in a straight line (Map 1). The bigger Inexpressible Island penguin's population, located in a high-quality habitat nearby the polynya, may act as a source for smaller neighboring subpopulations of Adélie penguin colonies (Olmastroni, personal communication).

South Polar Skua nests are distributed around Adélie penguin colony of the ASPA (Map 3). The nests are shallow depressions located on flat ground among glacial boulders in the terraces of different heights formed from the moraine ridge. Up to 60 breeding pairs have been recorded in the past (Ainley *et al.*, 1986). More recently, census by Italian (2010) and Chinese (2018) scientists reported 25–29 breeding pairs and 17–34 non-breeders in the penguin colony area. Long-term monitoring and research on the reproductive population dynamics, ecology and interspecific relationships of the top trophic level omnivorous South Polar Skua not only supports the conservation of the species, which is known to have a low breeding success in the Terra Nova Bay area (Pezzo *et al.*, 2001), but also helps to reveal the response of their various preys to climate change (Rehinardt *et al.*, 2000; Hahn *et al.*, 2008).

The vicinity between breeding sites of Adélie penguin and South Polar Skua on Inexpressible Island and Terra Nova Bay polynya could enhance the feeding efficiency and determine the diet composition of Adélie penguins, as presence of polynya has been shown to positively influence the foraging ecology of Adélie penguins elsewhere around the continent (e.g. Widmann *et al.*, 2015). This vicinity to the hot spot of the polynya, could explain the possible differences in breeding success (Davis *et al.*, 2017), trophic position and exposure to pollutants, when Inexpressible Island population is compared with other areas of the Ross Sea (Ainley 2002, Ainley *et al.*, 1998, Olmastroni *et al.*, 2004, Signa *et al.*, 2018, Olmastroni *et al.*, in press). Notably, ASPAs of Edmonson Point and Cape Hallett (No.165 and No.106 respectively), located northward in the Ross Sea both outside the polynya area, include colonies of Adélie penguin and South Polar Skua which are already studied by Italian and Korean scientists, thus representing useful sites for comparisons with similar levels of protection.

This Area is a reference site concerning studies on the marine food-web structure and the effect of sea ice dynamics on the benthic and pelagic marine ecosystem. In effect, the presence of the polynya allows to study the undisturbed marine food-web structure and functioning under ice free conditions allowing comparisons over time and space with what is observed in other nearby areas where sea ice coverage is more persistent (Norkko *et al.*, 2007; Mezgec *et al.*, 2017; Cummings *et al.*, 2018; Calizza *et al.*, 2018). The benthic community of Terra Nova Bay (ASPA 161) has been studied for a long time and could offer opportunity for comparison. This provides an important scientific value to the site of Inexpressible Island.

This Area also hosts several freshwater lakes within the penguin colonies, allowing for comparison studies between lakes receiving nutrient inputs from guano and lakes with no inputs. Higher levels of nutrients coupled with higher-salinity, as a result of sea spray, and higher Chl-a produce particular physiochemical and trophic statuses with respect to the other oligotrophic freshwater bodies in continental Antarctica (Barbaro *et al.*, 2014, Borghini *et al.*, 2007; Michaud *et al.*, 2012; Wei *et al.*, 2016). Rich nutrient conditions and historical deposits of guano may generate distinct aquatic communities with low abundance of pico-cyanobacteria and the consistently pronounced abundance of the Gammaproteobacteria.

The beaches of Inexpressible Island have risen by 30 m in the Holocene (Baroni and Orombelli, 1991), and there are the best-preserved ocean landforms in Terra Nova Bay (Baroni and Hall, 2004). Inexpressible Island and Seaview Bay have 14-level coastal terraces at 0–33 m above sea level, with abandoned penguin nests and/or ancient penguin remains distributed at all levels in ornithogenic soils (Orombelli *et al.*, 1990; Baroni and Orombelli, 1991, 1994; Lambert *et al.*, 2002; Baroni and Hall, 2004; Emslie *et al.*, 2007). This unique geomorphological feature is of great scientific value for studying geological and glacial changes, the evolution of penguin distribution patterns, and Holocene climate change.

Inexpressible Island and Seaview Bay are accessible by land, sea, and air from the new planned Chinese station in the vicinity of the Area and from nearby research stations in Terra Nova Bay. Flight activity in the region is frequent throughout the summer season with mostly helicopter movements.

The ASPA requires long-term special protection because of the outstanding environmental, scientific and ecological values and its potential vulnerability to disturbance from scientific, logistic and tourist activities.



2. Aims and objectives

Management of ASPA 178 Inexpressible Island and Seaview Bay aims to:

- avoid any major changes in the functions and ecosystems of the Area, any degradation of, or substantial risk to, the values of the ASPA by preventing unnecessary human disturbance to the area.
- preserve the environmental values of the ASPA as a reference area for future comparative studies with other breeding populations of Adélie penguins and South Polar Skuas in Terra Nova Bay and neighboring areas, and for research and long-term monitoring of terrestrial, marine and lacustrine ecosystems.
- allow continued studies on historical clues of the evolution of the Adélie penguin and other species subfossil remains and ornithogenic soil.
- allow scientific research respecting the natural ecological system in the Area, promoting international coordination thus ensuring protection from oversampling, especially of soil, fauna and flora to reduce the cumulative impact within the Area.
- allow visits for educational purposes in the Area provided it is for compelling reasons which cannot be served elsewhere and that they will not jeopardize the natural ecological system in the Area.
- prevent, to the maximum extent practicable, the introduction of non-native species and pathogens that may endanger or alter the local pristine ecosystems.
- allow visits for management purposes in support of the aims of the Management Plan.

3. Management activities

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

- Signs showing the location and boundaries of the Area (stating the special restrictions that apply) secured and maintained in good condition, and removed when no longer required. They will be placed in such a way as to respect as much as possible the ASPA's aesthetic value.
- Copies of this Management Plan shall be made available to all stations located within 50 km of the Area, to all vessels and aircraft visiting the Area and/or operating in the vicinity of the adjacent stations, and all personnel operating in the region shall be informed of the location, boundaries and restrictions applying to entry and overflight within the Area.
- National programs shall take steps to ensure the boundaries of the Area and the restrictions that apply are marked on relevant maps and nautical/aeronautical charts.
- Any abandoned equipment or material shall be removed to the maximum extent possible provided doing so does not adversely affect the environment and the values of the Area.
- The Area shall be visited, as necessary (no less than once every five years), to assess whether it continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate.
- National Antarctic Programs operating in the region shall consult together and share information on foreseen activities to be implemented, in view to minimize the overall impact on the Area.

4. Period of designation

Designated for an indefinite period

5. Maps

Map 1: ASPA 178: Inexpressible Island and Seaview Bay – Regional Map.

Map 2: ASPA 178: Inexpressible Island and Seaview Bay – topographic map with access guidance and bathymetry.

Map 3: ASPA 178: Inexpressible Island and Seaview Bay – Adélie Penguin Colony.



6. Description of the Area

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

General description

The ASPA is situated in middle Terra Nova Bay (Map 1). The area lies in the southern portion of the Island, which is bordered by two ice shelves, The Nansen Ice Sheet to the west and the Hells Gate Ice shelf, this latter being fed by marine ice (Baroni, 1988, Sochez *et al.*, 1991). The Area includes an ice-free area with some lakes, facing Seaview Bay and the northern part of South Bay in Inexpressible Island, and a marine coastal area, which defines the eastern border of the Area (Maps 2 and 3). The strong katabatic winds from the Nansen Ice Shelf and Hells Gate Ice shelf opened a large polynya in the eastern waters off the Adélie penguin nesting area, potentially promoting the foraging efficiency and thus the raising of chicks. This Area has a special landform with well-defined raised beaches, marine sediments, wave-cut terraces and wave-washed bedrock characterizing the ice-free land (Baroni *et al.*, 2004) and mainly includes 14-level coastal curved terraces formed by beach ridges at 0–33 m above sea level. These are one of the best-preserved ocean landforms of Terra Nova Bay (Salvatore *et al.*, 1997; Baroni *et al.*, 2005). Marine deposits ranging in size from boulder to gravel are distributed on the terraces. Patches of finer marine deposits retain marine subfossil shells (*Adamussium colbecki* and *Laternula elliptica*) suitable for radiocarbon dating of beach deposits.

Boundaries and coordinates

The Area is located in the eastern central part of Inexpressible Island, including the Seaview Bay and the northern part of the South Bay. The total area of the ASPA is 3.31 km², of which 2.32 km² is terrestrial and 0.99 km² is marine area. The total extent of the boundaries is 7.86 km. Eastwards, the boundary of the ASPA is mainly marine, and includes the foraging access routes that penguins use intensively to access the sea. Westwards, the boundary borders the current South Polar skua nesting area and the historical distribution area of the Adélie penguin, including freshwater lakes far away from the birds' nests.

The eastern boundary of the Area at the NE corner extends from the coordinates B1 on the eastern coast of the Seaview Bay due south for to B8 of the South Bay (Table 1, Map 2). The northern boundary from B1 follows along the coastline to B2, then to B3 and B4, along the foot of the hill to B5. The western boundary is from B5 to B6 (the same longitude with B5), and then to B7 (the same latitude with B8).

Table1. Boundary coordinates of ASPA 178 (see map 2 and 3 for the site)

Name	Latitude	Longitude
B1	74°53'46.13"S	163°45'00.00"E
B2	74°53'40.41"S	163°44'31.07"E
B3	74°53'29.99"S	163°43'44.97"E
B4	74°53'14.17"S	163°43'30.65"E
B5	74°53'14.17"S	163°42'11.02"E
B6	74°54'28.93"S	163°42'11.02"E
B7	74°54'46.54"S	163°43'11.11"E
B8	74°54'46.54"S	163°45'00.00"E

Climate

Eight weather stations have been set up in the southern and central parts of Inexpressible Island, with two of them directly inside of the boundaries of the proposed ASPA. According to the data of Manuela Automatic Weather Station (74°56'45.6"S, 163°41'13.2"E, 78 m above sea level), the annual average temperature in the Area is -18.5°C. The number of days below -40 °C does not exceed 0.1%, the number of days between -30 ~ -15°C is about 63%, and the number of days between -15 ~ 0°C is 33%. The minimum annual average temperature is -19.2°C (1998), and the maximum is -17.4°C (2012). The average daily temperature in winter is below -35°C, the lowest is -40.6°C (September 2, 1992); the average daily maximum temperature in summer exceeds 0°C, the highest value is 6.9 °C. The average temperature in December was the highest, at -3.6 ± 1.26 °C, the lowest in August, at -26.66 ± 2.87 °C.

The annual average wind speed is 14.2 m/s, the daily average maximum wind speed is 34.2 m/s (July 1989), and the maximum instantaneous wind speed is 45 m/s (February 1985) (Bromwich, 1988). In November, December and January, wind speeds below 15 m/s accounted for 90%. The wind speed has varied according to seasonal changes. The highest monthly average wind speed is in August (16.54 m/s), and the lowest in December (5.20 m/s). A total of 298 strong katabatic wind events occurred in 10 years, of which 49.8% occurred in winter (21% in July), and the average duration was about 10 hours. No strong katabatic wind events were recorded in December and January. The monthly average wind speed of strong katabatic wind is between 25–30 m/s, with the maximum wind speed of above 40 m/s.

According to the observation data of weather stations (74°54'04.02"S, 163°43'45.85"E) located in the ASPA, the average temperature in January is -4.8°C, the average instantaneous wind speed is 5.7 m/s, with the maximum instantaneous wind speed of 18.1 m/s.



Marine area and polynya

Terra Nova Bay is one of the deepest water basins in the Ross Sea, with a maximum depth of about 1,100 m (Buffoni *et al.*, 2002). The ocean circulation in the bay moves parallel to the north through the upper layer in summer, parallel to the coast, and rotates clockwise with depth (Vacchi *et al.*, 2012). The strong katabatic wind and the blocking of the ice floe by Drygalski Ice Tongue forms a huge polynya in the Terra Nova Bay (Bromwich and Kurtz, 1984; Van Woert, 1999), with an average area about 1,300 km² (0–5,000 km², Kurtz and Bromwich, 1983), and up to 2,500 km² in December 2017. The salt discharged from the ice formation increased the salinity of the seawater (up to 34.87 ‰), and the sea surface freezing point was -1.9°C.

The marine portion of the ASPA includes the coastal area facing the Adélie penguin colony, extending for 0.99 km² and less than 50 meters depth (Map 2). The benthic communities of this area are poorly known. Preliminary surveys through underwater cameras indicate a rich macroalgae coverage consisting mainly of *Iridaea cordata* at 5–10 meters depth (M.C. Chiantore, pers. comm.), and associated rich coverage of filamentous aggregates of unknown composition. Some animal organisms were observed during the survey. These include the two small-size fish species *Trematomus bernacchii* and *T. pennellii*, the sea star *Odontaster validus* and amphipods possibly belonging to the family Lysianassidae (M. Vacchi and E. Calizza, pers. comm.).

Freshwater lakes and brackish lagoon

The Area presents a distribution of 6 freshwater lakes and 1 brackish lagoon (Map 3) with a distance from the coast from 0.130 km to 1.16 km, and an estimated total surface of 17,780 m² (range from 97 m² to 8,162 m²). Some of them, in vicinity of the Adélie penguin colony and South Polar Skua, are influenced by guano nutrient input, while others located at a greater distance, may serve as reference of present conditions and for long term comparisons (Blais *et al.*, 2005; Borghini *et al.*, 2007).

Six freshwater lakes in this area were investigated in both 2017/2018 and 2018/2019 summer seasons and an incredibly high concentration of nutrients was recorded. The concentration of NH₄-N ranged from 0.40 mg/L to 61.22 mg/L, the concentration of NO₂- ranged 0.8 to 0.49 mg/L and the freshwater PO₄³⁻ concentration ranged from 0.08 to 17.72 mg/L. The concentration of TOC ranged from 5.12 mg/L to 33.38 mg/L. These concentrations are high compared to the ones of other typical ultra-oligotrophic polar lakes, including the ones of three freshwater lakes sampled at a greater distance outside of the area in 2018/2019 summer season too. There were 42 phytoplanktons detected, and the *Bacillariophyta*, *Cyanophyta*, *Chlorophyta* were the dominant phytoplankton taxa. The density ranged from 1.65×10⁴–1.02×10⁷ cells/L. The *Prorodon viridis*, *Urotricha farcta*, *Lacrymaria minima*, *Trachelophyllum sigmoides*, *Colpoda cucullus*, *Vorticella* sp. and *Strobilidium gyrans* were the dominant zooplankton species (Zhang, pers. comm.).

Birds

The latest count of 2017 reported 25,089 breeding pairs of Adélie penguins (*Pygoscelis adeliae*) (MOE, 2019). The penguins are mainly distributed in the central part of Seaview Bay, and there are about 100 breeding pairs (131 breeding pairs in 2017) in South Bay (Map 3). There is not significant genetic divergence of the penguins between the South Bay and Seaview Bay on the basis of Single Nucleotide Polymorphism analysis (Zhang, pers. comm.). The first documented record of Adélie penguin with 11,000 breeding pairs in the area was published in 1963, one of the earliest statistical record of Adélie penguin in the Ross Sea (Stonehouse, 1969; Woehler and Croxall, 1997). Since the '80s, scientists from New Zealand, Italy, Korea and China have monitored the population. GPS tracking in 2019 showed that penguins disperse to Ross Island within a given breeding season (Xia and Zhang, pers. comm.).

Table 2. The population size of Adélie penguins in ASPA 178 (breeding pairs).

Year	Population Size	Reference
1963	11,000	Stonehouse, 1969
1982	9,217	Woehler and Croxall, 1997
1983	17,120	He <i>et al.</i> , 2017
1984	24,864	Wilson <i>et al.</i> , 2017
1987	28,715	Woehler and Croxall, 1997
1989	23,528	Woehler and Croxall, 1997
1991	20,029	Woehler and Croxall, 1997
2001	24,142	Oлмаstroni <i>et al.</i> , in press
2012	24,450	Lyver <i>et al.</i> , 2014
2017	25,089	MOE, 2019
2019	29,899	MOE, 2020



In Seaview Bay, the penguins breeding grounds are distributed on 10–700 m wide slopes along the coastline. The nest site is 0.5–33 meters above sea level, and more than 80% of the breeding individuals are distributed between 0.5–10 meters above sea level. During the breeding period, the Adélie penguins carrying food reach the core colony area and then travel 14.4 ± 19.3 minutes to reach the highest breeding area. Adélie penguins' nests were built along the low-to-high terraces, composed of many hilly nests of different heights. Later in the season, "crèches" ranging from a dozen to thousands of chicks form on the hills. Studies carried out on chick-rearing Adélie penguin showed that diet composition in the Terra Nova Bay area consisted mainly of Antarctic silverfish (*Pleuragramma antarctica*) and also of ice krill (*Euphausia crystallorophias*), and Antarctic krill (*E. superba*) to a lesser extent (Olmastroni *et al.*, in press).

In South Bay, the nesting site is located on the southern slope 5–10 meters from the shoreline, 3–10 meters above sea level, and the nesting area is no more than 1000 m². Chicks form a single "crèche" there.

Penguin remains have attracted scientific interest from Italy, United States and other countries in the past 30 years (Stuiver, 1981; Whitehouse *et al.*, 1989; Orombelli *et al.*, 1990; Baroni and Orombelli, 1987, 1991, 1994; Baroni and Hall, 2004; Lambert *et al.*, 2002; 2010; Ritchie *et al.*, 2004; Sheperd *et al.*, 2005; Emslie *et al.*, 2007; Millar *et al.*, 2008; Submaranian *et al.*, 2009; Lorenzini *et al.*, 2009; 2010, 2011, 2012, 2014; Parks *et al.*, 2015; Megzecz *et al.*, 2017).

Scientists from Italy and New Zealand have extracted in the past 15 individual Adélie penguin sub-fossils, dating from about 6,100 years ago and have carried out genetic analysis and phylogeny (Lambert *et al.*, 2002; 2010; Ritchie *et al.*, 2004; Shepherd *et al.*, 2005; Millar *et al.*, 2008; Submaranian *et al.*, 2009). Several samples of guano and other remains of Adélie penguins, dug in the 14th terrace of Seaview Bay, South Bay and in the outskirts of the colonized area, have been collected by Italian researchers (Orombelli *et al.*, 1990; Baroni and Orombelli, 1991; 1994; Baroni and Hall, 2004). Orrnithogenic soils allowed to retrieve relevant information on past environmental conditions and on Holocene Adélie penguin diet, through eggshells, bones, and prey remains (fish bones and ooliths, squid beaks, etc.; Lorenzini *et al.*, 2009; 2010, 2014). Chinese scientists in the last 5 years, collected more than 130 samples (see supplementary material). These precious materials can provide the possibility for studying climate change and molecular evolution.

Up to 60 breeding pairs of South Polar skua were recorded in the Area (Ainley *et al.*, 1986). The number of mature South Polar Skuas globally is 6,000–15,000 (Birdlife International, 2017), or 5,000–8,000 breeding pairs (de Hoyo *et al.*, 1996). The South Polar skuas mainly breed in the rock belt around the Adélie penguin breeding colony, and in some areas the nests of both bird species present a mosaic distribution (Map 3 for 2018 breeding points). Groups of 20–30 South Polar Skuas are sometimes observed. The investigations in late December 2016 and 2017 found that there were 2 eggs and/or 2 chicks in each nest of South Polar skuas. An investigation conducted in January 2018 showed that no more than one chick was found in each nest (Zhang and Xia, pers. comm.), suggesting conspecific predation (de Hoyo *et al.*, 1992). Similarly, South Polar skuas of Edmonson Point produce 1.9 ± 0.2 eggs, but the reproductive success is limited to 0.2 ± 0.4 chicks. Conspecific aggressive behavior, siblicide (large chicks kill small ones), harsh weather, and late egg laying are the main causes of low reproductive success (Pezzo *et al.*, 2001). The breeding success and the factors affecting skua reproduction at Inexpressible Island require further investigation.

In the Area, Emperor penguins (*Aptenodytes forsteri*), Wilson's Storm petrels (*Oceanites oceanicus*), Snow petrels (*Pagodroma nivea*), Antarctic petrels (*Thalassoica antarctica*) can also be observed occasionally. No breeding record for the above avian species in the area exists.

Mammals

Weddell seals (*Leptonychotes weddellii*), Leopard seals (*Hydrurga leptonyx*) and less frequently Crabeater seals (*Lobodon carcinophagus*) can be observed in the seawaters near the Area. Weddell seals are often found resting in the penguin colony. Leopard seals have been observed regularly preying on penguins (adults and juveniles) in the seawaters in front of the colony (2001– onwards, Olmastroni pers. comm.). In 2017, two unusual attacks by Weddell seals against Adélie penguins were observed (Miao, pers. comm.). Subfossil remains of elephant seals indicate a large presence of this species in the past (Hall *et al.*, 2006). At the present time, the occurrence of elephant seals (*Mirounga leonina*) is very rare in Terra Nova Bay (just one record in the last two decades).

Seals remains (bones, skin, internal organ and blubber) were found in the beaches (Baroni and Hall, 2004; Hall *et al.*, 2006; de Bruyn *et al.*, 2009, 2014). Mummified elephant seals (*Mirounga leonina*) in various state of preservation rest on Holocene raised beaches and testify Holocene breeding colonization of the area that crashed ca 1000 yrs ago (Koch *et al.*, 2019).

Terrestrial invertebrates

Only *Gressittacantha terranova* (Collembola, Entognatha) were recorded by Fanciulli *et al.* (2001) in the first study on population genetics of Antarctic soil microarthropods and *Acutuncus antarcticus* (Eutardigrada, Hypsibiidae) recorded by Cesari *et al.* (2016).

Mosses and lichens

Scientists have determined that the biodiversity of mosses and lichens was high in specialized terrestrial habitats in this region (Castello, 2003; Cannone and Seppelt, 2008). A total of nine different lichens were recorded in 2016–2017, including the widely-distributed species *Buellia frigida* (as the constructive species), and other species as *Acarospora gwynnii*, *Candelariella flava*, *Lecanora expectans*, *Lecanora fuscobrunnea*, *Umbilicaria decussata*, *Xanthoria elegans* and *Xanthomendoza borealis*. In the south rock ridge of the penguin colony in Seaview Bay, *Bryum argenteum* is sparsely distributed. Lichens develop on marine boulders and cobbles with individual thalli increasing in size as a function of elevation. The maximum size *Buellia* sp. thalli is > 290 mm at 24 m a.s.l. and testifies the increasing age of raised beaches as a function of progressive emersion of coastal areas (Baroni and Orombelli, 1987; Baroni, 1994).



Terrestrial algae and microorganisms

The cold-tolerant fungi as *Chrysosporium verrucosum* Tubaki, *Thelebolus microspores* Kimbrough and White yeasts were found from penguin guano and soil in the Area (Del Frate and Caretta, 1990). A fungal strain, isolated from Inexpressible Island, was plate-screened for its ability to produce extracellular enzymes (Fenice *et al.*, 1997). The bacteria in five different lakes from this Area were recorded in 2017/2018 summer season by Illumina Miseq sequencing, genera *Flavobacterium* within Bacteroidetes was the most occurring in all the lakes, and other genera, such as *Polaribacter* (Bacteroidetes) and Cyanobacteria were very abundant in two of those lakes. Michaud *et al.* (2012) have documented in a lake of Inexpressible Island the consistently pronounced abundance of the Gammaproteobacteria (which are typically marine), the lack of Actinobacteria (which are of major importance in freshwater environments), as well as the low abundance of pico-cyanobacteria (whose presence is not favored by relatively high N: P ratio).

Algal species diversity in lakes of the Area is similar to that of Lake Gondwana and of Dry Valleys lakes. The typical prokaryotic (*Synechococcus*) and eukaryotic (*Chlorella*) genera were determined by both flow cytometry and electron microscopy (Andreoli *et al.*, 1992).

In lacustrine sediments pigments confirmed that Cyanophyta was the most important algal group, followed by Chlorophyta and Bacillariophyta (Borghini *et al.*, 2011). Microbial eukaryotes in five different lakes from this area were recorded in 2017/2018 summer season by microscopy and Illumina Miseq sequencing. Genus *Geminigera* (Cryptophyceae) was significantly predominant in three lakes, and in the other two lakes *Chlamydomonas* (Chlorophyta) and *Spumella* (Chrysophyta) were dominant.

Geology

The land basement is glacial boulder, the main intrusive rock type is quartz monzonite, and a small amount of quartz monzobiorite. The main outcrops in this area are Quaternary hail deposits and modern coastal accumulation and the Caledonian Paleozoic Ordovician intrusive monzonites and granites (Wang *et al.*, 2014). The surface of the wavy boulders in Seaview Bay and South Bay is the Holocene wind-selected surface (Baroni and Hall, 2004). A coastal terrace at an altitude of 0–33 meters and a coastline of 0–700 meters is formed.

HSM14

The Historic Site and Monument HSM14 is just outside the boundaries of the Area and related to the Robert Falcon Scott's Terra Nova Expedition (1910–1913), in which the Northern Party, led by Victor Campbell, forcibly overwintered in 1912. The snow cave of 3.7 m × 2.7 m and a height of 1.7 m was dug in March 1912, and it offered repair to the crew during the winter under extreme conditions. The snow cave site was designated as the No.14 Antarctic historical site or monument (HSM14) in 1995. An anchorage point for boats is suggested in Map 2 and access to HSM14 is encouraged by small boat. Landing is suggested along the shoreline outside of ASPA borders. The HSM14 location can then be reached on foot from the preferred landing point. The orography of the site and the ice conditions do not allow having a clearly indicated pathway.

Human activities

Since the 80s there have been regular human activities in the Terra Nova Bay area. Gondwana Station (Germany, 74°38'07"S, 164°13'15"E), established in 1983, operates in occasional summers with capacity for approximately 25 personnel, and is 35 km from the Area. Mario Zucchelli Station (Italy, 74°41'43"S, 164°06'55"E), established in 1985, operates in summer only with a complement of up to 100 personnel, and is 27 km from the Area. Jang Bogo Station (ROK, 74°37'26vS, 164°13'40"E), 36 km from the Area, operates as a year-round station, with a complement of 17 winter personnel and up to 60 in summer since 2014. China intends to establish a year-round scientific research station (74°56'04"S, 163°42'52"E) with a complement of 30 winter personnel and up to 80 personnel in summer on Inexpressible Island, which will be about 3 km away from the Area.

The current research activities in the Area of nearby scientific stations are focused on the remains of penguins and excavation of ornithogenic soils, the genetic flux, ecology and quantitative monitoring of Adélie penguins and South Polar skua, molecular ecology, paleogeology, plankton, biodiversity survey in terrestrial and marine environment and food web ecology. In the past 10 years, tourists have visited Inexpressible Island, with an average of 100 individuals per year, between 2003 and 2017 and up to 480 visitors in the 2005–2006 season (see supplementary material) (IAATO, <https://iaato.org/tourism-statistics>)

6(ii) Access to the Area

The Area can be accessed by land, sea or air. There is no specific route to enter the Area by land. Helicopter access is recommended at the suggested landing sites (Map 2) outside the Area. Access from the sea may be by small boats. Transiting through the Area by a small boat should be limited to reduce disturbance to wildlife. Small boats entering the waters should preferably anchor between B1–B2, while large vessels should not enter the Area. See section 7(ii) for details. Access should always be chosen so as to exceed minimum wildlife separation distance and, as far as possible, to minimize disturbance on approach.

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

No permanent structures are present within or adjacent to the Area. A total of four weather stations are installed around the Area and provide detailed weather data. Two weather stations from Korea (74°54'01.00"S, 163°43'33.00"E) and China (74°54'04.02"S, 163°43'45.85"E) are present in the Area (see Map 2). The other two are located outside the proposed ASPA region (USA–Manuela, ITA–Virginia) and could not be shown in Maps. In Terra Nova Bay area, other weather stations are also located in nearby research stations.



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

- Other protected areas in the vicinity include (see Map 1):
- HSM 14, Site of ice cave at Inexpressible Island, 74°54' S, 163°43' E, on the northern boundary of the Area.
- ASPA 161, Terra Nova Bay, 74°45' S, 164°01' E, 16 km to the north.
- ASPA 173, Cape Washington & Silverfish Bay, 74° 37' 06" S, 164° 57' 36" E, 48 km to the northwest.
- ASPA 175, High Altitude Geothermal sites of the Ross Sea Region, Mount Melbourne, 74°21' S, 164° 42' E, 68 km to the north.
- ASPA 165, Edmonson Point, 74° 20' S, 165° 08' E, 76 km to the north.
- Besides the abovementioned-protected areas, CCAMLR has established Ross Sea Region Marine Protected Area. The marine area of the ASPA is located within the General Protection Zone of the RSRMPA.

6(v) Special zones within the ASPA

There are no special zones within the Area.

7. Terms and conditions for entry permits

7(i) General permit conditions

Entry into the Area is prohibited except in accordance with a permit issued by an appropriate national authority. Conditions for issuing a permit to enter the Area are that:

- it is issued for compelling conservation, scientific, educational or outreach reasons which cannot be served elsewhere, or for reasons essential to the management of the Area.
- the activities permitted will give due consideration via the environmental impact assessment procedures to the continued protection of the scientific and ecological values of the Area.
- the actions permitted are in accordance with this Management Plan.
- the permit shall be issued for a definite period.
- the permit, or a copy, shall be carried when in the Area.

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

Access into the Area is permitted on foot, by small boat, or by helicopter only for compelling reasons, as authorized by the issued permit. Clothing (particularly all footwear and outer clothing) and field equipment shall be thoroughly cleaned before entering the Area.

Access on foot

No special access routes are designated for access to the Area on foot but it is required to avoid walking across the raised beaches unless permitted for a compelling scientific purpose. Every reasonable effort should be made to minimize disturbance. A minimum distance of 5 m from wildlife is required. If disturbance of wildlife is observed, separation distance should be increased or the activity modified until there is no visible disturbance. Exceptions to this are only allowed when a closer approach distance is authorized in a permit.

Access by vehicle

Vehicles are prohibited within the Area.

Access by aircraft

The Guidelines for the Operation of Aircraft near Concentrations of Birds in Antarctica Resolution 2 (2004) should be followed at all times. According to the breeding habitats in this area, restrictions on helicopter apply during the period from 15 October through to 15 February inclusive according to strict observance of the following conditions:

- The preferred helicopter approach route and landing sites out of the Area are designated as shown in Map 2. Pilots should avoid overflight of the penguin colony and breeding skua territories. Pilots should follow the designated approach route to the maximum extent practicable and abort the journey should it be likely that conditions would force a route that might lead to overflight of the penguin colony.
- Landing by helicopter within the Area is prohibited, unless authorized by permit for purposes allowed for by this Management Plan
- Overflight of the area below 2,000 feet (~610 m) is prohibited, unless authorized by permit for purposes allowed for by the Management Plan. Helicopters with two engines are due to respect a minimum overflight height and horizontal distance of 3,281 feet (1,000 m) to limit disturbance.
- If due to weather conditions or other safety consideration, pilots could not follow the designated approach route and landing sites, pilots should return to the take off point if possible or land outside the Area. It is allowed to land within the Area only in emergency.
- overflight of bird colonies within the Area by Remotely Piloted Aircraft Systems (RPAS) shall not be permitted unless for scientific or operational purposes, in accordance with a permit issued by an appropriate national authority, and consulting and following as appropriate recommendations contained in the Environmental Guidelines for Operation of RPAS in Antarctica (Resolution 4, 2018).



Access by ships/small boat

There is no designated landing area for small boats that refers to the boats with capacity of 15 personnel or less, such as Zodiac inflatable dinghies or similar size. The ships are suggested to anchor outside of the Area as shown on Map 2 (74°54'02.03"S, 163°45'52.31"E). During the penguin breeding period from 15 October to 15 February small boats should only land on the coastline to the northeast of Seaview Bay between boundary points B1 and B2. During that period small boat landings in other locations are prohibited, unless authorized by permit for compelling scientific reasons. Approaching to the landing site between boundary points B1 and B2 is required to be at low speed to minimize disturbance and avoid contact with penguins.

Suggested landing point (74°53'50.96"S, 163°45'20.85"E) for visiting the HSM14 is shown on Map 2.

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

Activities which may be conducted within the Area shall not jeopardize scientific and ecological values of the Area. Activities which may be conducted within the Area include:

- compelling scientific research which cannot be undertaken elsewhere.
- sampling, which should be the minimum required for approved research programs.
- essential management activities, including monitoring and inspection.
- activities for educational or outreach purposes such as documentary reporting (e.g. visual, audio or written) or the production of educational and outreach resources or services.

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

- No structures are to be erected within the Area except for compelling scientific or management reasons and for a pre-established period, as specified in a permit.
- All structures, scientific equipment or markers installed in the Area shall be clearly identified by country, name of the principal investigator, year of installation and date of expected removal. All such items should be free of organisms, propagules (e.g. seeds, eggs) and non-sterile soil, and be made of materials that can withstand the environmental conditions and pose minimal risk of contamination of the Area.
- Installation (including site selection), maintenance, modification or removal of structures or equipment shall be undertaken in a manner that minimizes disturbance to the values of the Area.
- Structures and installations must be removed when they are no longer required, or on the expiry of the permit, whichever is the earlier.
- Removal of specific structures/equipment for which the permit has expired shall be the responsibility of the authority which granted the original permit, and shall be a condition of the permit.

7(v) Location of field camps

Permanent field camps are prohibited within the Area. There is a campsite (74°54'34.76"S, 163°42'03.22"E) located outside of the Area.

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

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

- deliberate introduction of animals, plant material, micro-organisms and non-sterile soil into the Area is prohibited. Precautions shall be taken to prevent the accidental introduction of animals, plant material, micro-organisms and non-sterile soil from other biologically distinct regions (within or beyond the Antarctic Treaty area).
- visitors shall ensure that sampling equipment and markers brought into the Area are clean. To the maximum extent practicable, footwear and other equipment used or brought into the Area (including backpacks, carry-bags and tents) shall be thoroughly cleaned before entering the Area. Visitors should also consult and follow as appropriate recommendations contained in the Committee for Environmental Protection *Non-native Species Manual* (Resolution 4, 2016), and in the SCAR's *Environmental Code of Conduct for Terrestrial Scientific Field Research in Antarctica* (Resolution 5, 2018).
- No fresh eggs or fresh poultry products shall be introduced in the Area. Cooked poultry wastes shall be completely removed from the Area.
- no herbicides or pesticides shall be brought into the Area.
- fuel, food, chemicals, and other materials shall not be stored in the Area, unless specifically authorized by permit and shall be stored and handled in a way that minimizes the risk of their accidental introduction into the environment.
- all materials introduced 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 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 animal taking or harmful interference is involved, this should, as a minimum standard, be in accordance with the SCAR's Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica (Resolution 4, 2019).

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

Unless specifically authorized by permit, visitors to the Area are prohibited from interfering with or from handling, taking or damaging any anthropogenic material. Similarly, relocation or removal of artefacts for the purposes of preservation and protection is allowable only by permit. Any new or newly identified anthropogenic materials found should be notified to the appropriate national authority.

Collection or removal of anything should be conducted to following conditions:

- material may be collected or removed from the Area only in accordance with a permit and should be limited to the minimum necessary to meet scientific or management needs.
- material of human origin likely to compromise the values of the Area, and which was not brought into the Area by the permit holder or otherwise authorized, may be removed from the Area, unless the impact of removal is likely to be greater than leaving the material in situ: if this is the case the appropriate authority must be notified and approval obtained.

7(ix) Disposal of waste

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

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

Permits may be granted to enter the Area to:

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

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 in accordance with national procedures.
- Such reports should include, as appropriate, the information identified in the visit report form contained in the Revised Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas (Resolution 2, 2011).
- 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 working in the Area are encouraged to exchange information on visit reports annually. Wherever possible, Parties 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 organizing the scientific use of the Area.

8. Supporting documentation

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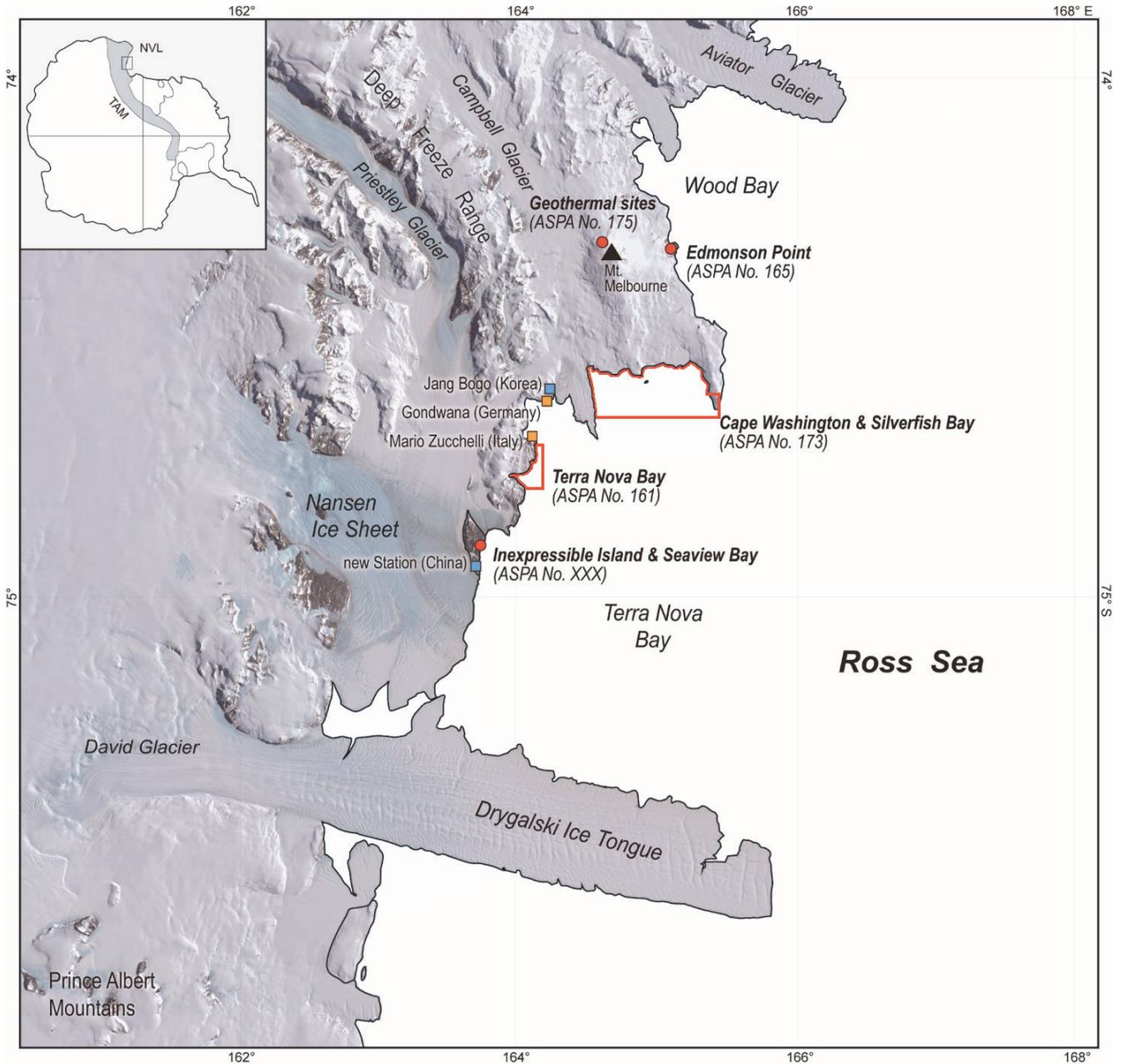
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SUPPLEMENTARY MATERIAL

Supplementary Material of Proposal for a new Antarctic Specially Protected Area at Inexpressible Island and Seaview Bay, Ross Sea can be found at the link, including "A Summary of Dated Penguin Guano and Remains on Inexpressible Island" and "Figure: The number of visitors to Inexpressible Island since 2003". <http://www.chinare.org.cn/en/difDetailPublic/?id=9800>

Map 1. ASPA 178: Inexpressible Island and Seaview Bay – Regional Map



Map 1: ASPA No. XXX - Inexpressible Island & Seaview Bay - Regional Map

- ASPA
- Year round Station
- Summer Station

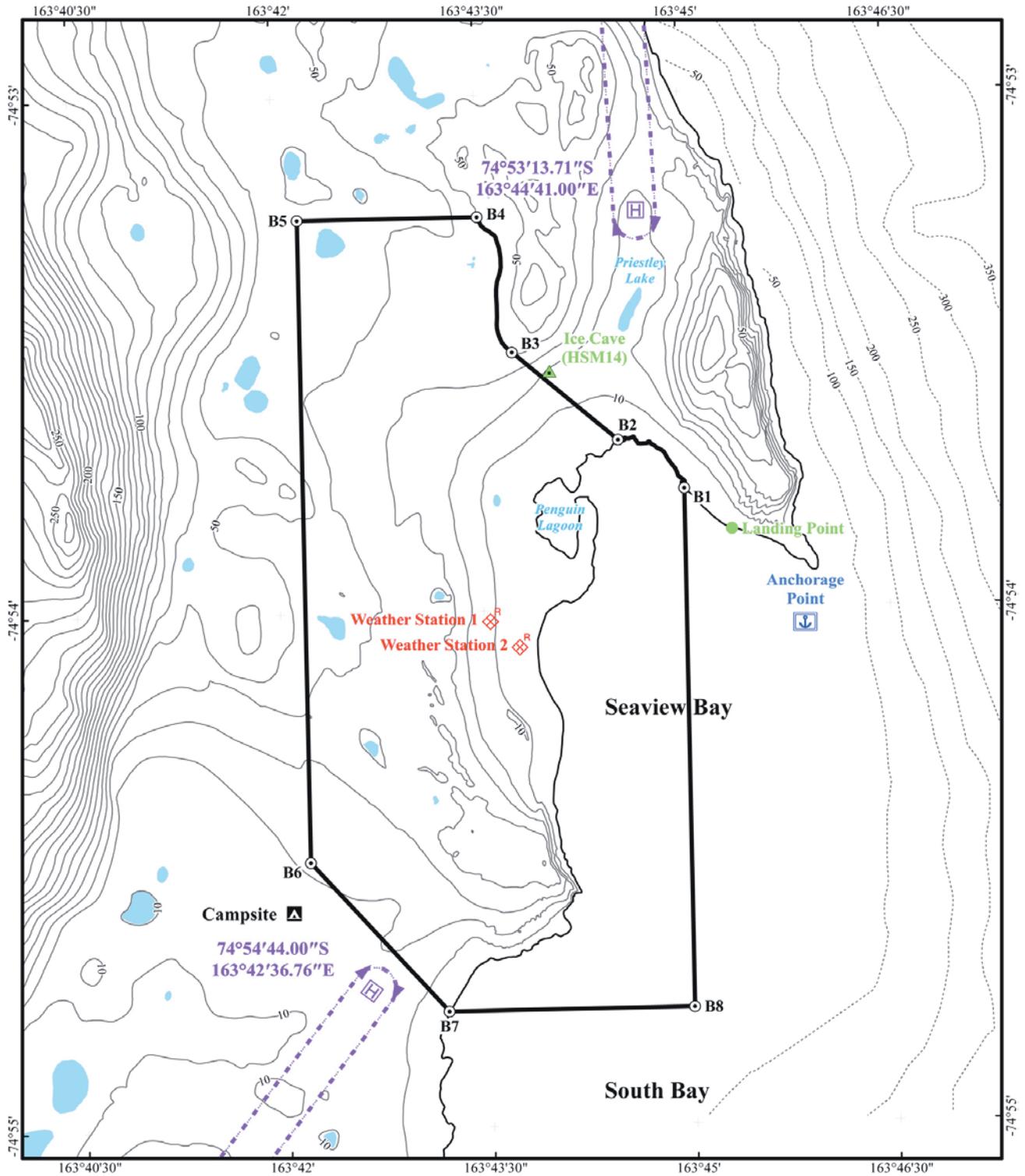
0 10 20 30 40 50 km

Projection: Polar Stereographic
 Spheroid and horizontal datum: WGS84
 Vertical datum: Mean Sea Level
 Straight-vertical Longitude from Pole: 0
 Standard Parallel: -71
 False Easting: 0
 False Northing: 0
 Data sources: LIMA





Map 2. ASPA 178: Inexpressible Island and Seaview Bay – topographic map with access guidance and bathymetry



Map2: ASPA XXX–Seaview Bay and South Bay – topographic map with access guidance and bathymetry

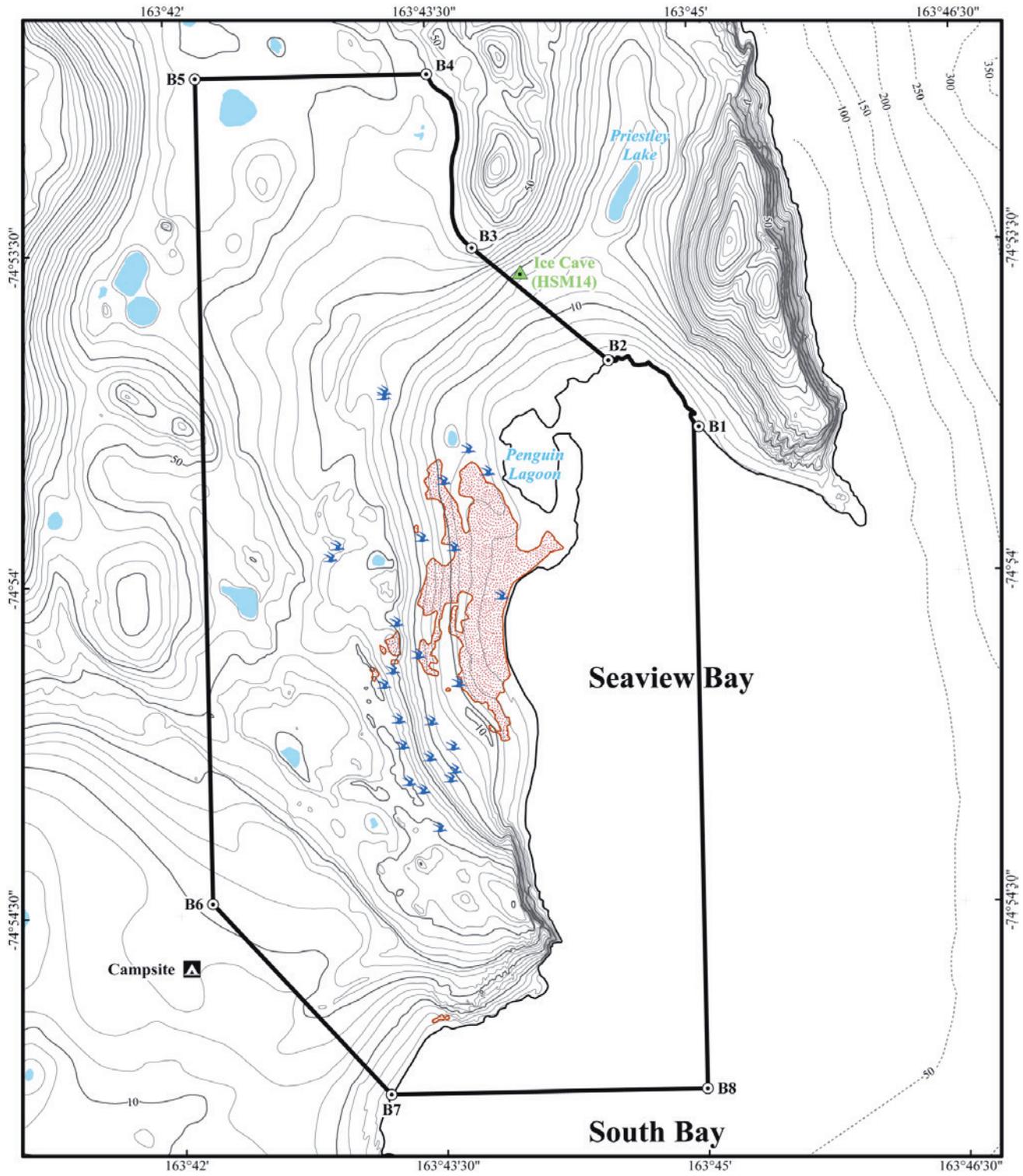
- | | |
|-------------------------|--------------------------|
| Camp | Ice Cave |
| Helicopter Landing Site | ASPA Boundary Point |
| Weather Station | Anchorage Point |
| Landing Point | Contour(10m) |
| Helicopter Flight Route | Bathymetric Contour(50m) |
| Lake | ASPA Boundary |



Projection: Transverse Mercator
 Spheroid and horizontal datum: WGS84
 Vertical datum: Mean Sea Level
 Central Meridian: 165°00'E
 Latitude of Origin: 0°00'
 Data sources: Topography: Aircraft Approach: Jan 2013



Map 3. ASPA 178: Inexpressible Island and Seaview Bay – Adélie Penguin Colony



Map3:ASPA XXX – Seaview Bay and South Bay – Adélie Penguin Colony

- Camp
- South Polar Skua Breeding Site
- Lake
- Penguin Colony
- ASPA Boundary
- Ice Cave
- ASPA Boundary Point
- Contour(2.5m)
- Bathymetric Contour(50m)

Meters
0 125 250 500

Projection: Transverse Mercator
 Spheroid and horizontal datum: WGS84
 Vertical datum: Mean Sea Level
 Central Meridian: 165°00'E
 Latitude of Origin: 0°00'
 Data sources: Topography: Aircraft Approach: Jan 2013