Management Plan

for Antarctic Specially Protected Area (ASPA) No. 173 CAPE WASHINGTON & SILVERFISH BAY, TERRA NOVA BAY, ROSS SEA

Introduction

Cape Washington and Silverfish Bay are located in northern Terra Nova Bay, Victoria Land, Ross Sea. Approximate area and coordinates: 286 km^2 (centered at 164° 57.6′ E, 74° 37.1′ S), of which 279.5 km^2 is marine (98 %) and 6.5 km^2 is terrestrial (2 %). The primary reasons for designation of the Area are the outstanding ecological and scientific values. One of the largest emperor penguin (Aptenodytes forsteri) colonies in Antarctica breeds on sea ice adjacent to Cape Washington, with around 20,000 breeding pairs comprising approximately eight percent of the global emperor population and ~21% of the population in the Ross Sea. Several factors, such as location, ice conditions, weather and accessibility provide relatively consistent and stable opportunities to observe emperor chick fledging reliably and the presence of a variety of other species make it an ideal place to study ecosystem interactions. The extended record of observations of the emperor colony at Cape Washington is of important scientific value. Approximately 20 km west of Cape Washington, the first documented 'nursery' and hatching area for Antarctic silverfish (*Pleuragramma antarctica*) is located at Silverfish Bay. Recent research has shown that the concentration of spawning on occasions extends all the way across the embayment to Cape Washington. The first ground-breaking studies on the life-history of this species have been made at the site, and its relative accessibility to nearby research stations make the Area important for biological research. The Area also has important geoscientific values, as it features extensive volcanic rock exposures originating from the nearby active volcano Mount Melbourne.

The Area was originally designated though Measure 17 (2013) after approval under the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). The Area requires long-term special protection because of the outstanding ecological and scientific values and the potential vulnerability of the Area to disturbance from scientific, logistic and tourist activities in the region.

Antarctic Important Bird Area No. 176 Cape Washington is identified within the Area. The Area is situated in Environment U – North Victoria Land Geologic based on the Environmental Domains Analysis for Antarctica (Resolution 3 (2008)) and in Region 8 – Northern Victoria Land based on the Antarctic Conservation Biogeographic Regions classification (Resolution 3 (2017)).

1. Description of values to be protected

The Area at northern Terra Nova Bay comprising Cape Washington and Silverfish Bay (Map 1) was proposed by Italy and the United States on the grounds that it contains one of the largest emperor penguin (*Aptenodytes forsteri*) colonies known, and the colony and its associated ecosystem is the subject of on-going scientific studies that began in 1986. Recently, large quantities of eggs of the Antarctic silverfish (*Pleuragramma antarctica*) were discovered under sea ice in northern Terra Nova Bay, making it the first documented 'nursery' and hatching area for this species. This discovery has greatly expanded understanding of the life-history of this species, and the proximity of the site to nearby scientific stations makes it of outstanding scientific value for continuing study. The site of the original Antarctic silverfish egg discovery was named Silverfish Bay (Map 2), and more recent research has revealed the rich concentration of *P. antarctica* eggs found there extends in some years across the embayment towards Cape Washington. The total area is 286 km^2, of which the marine component is ~279.5 km^2 (98 %) and the terrestrial component is 6.5 km^2 (2 %).

The Cape Washington emperor colony, usually centered around one kilometer northwest of the cape (at 165°22' E, 74°38.8' S), was the largest known in Antarctica in the 1993 and 1994 seasons, with counts of around 24,000 chicks being slightly greater than that of nearby Coulman Island at the time. In other years for which counts are available the Coulman Island colony was the slightly larger of the two. The colony appears to maintain a reasonably stable population, with ~17,000 chicks being counted in 2010. This relative stability makes the colony particularly suited to scientific study and monitoring, since long-term trends may be more readily studied and detected. Moreover, a relatively long time-series of scientific data exists for the Cape Washington emperor colony. Because of the location, ice conditions, weather and accessibility, Cape Washington is one of only two Ross Sea colonies where October through December studies can be conducted and emperor chick fledging can be observed reliably. All of these qualities make the Cape Washington emperor colony of outstanding ecological and scientific value.

The Area at Cape Washington and Silverfish Bay is also of considerable scientific interest because of the variety of other species that frequent the Area, making it an ideal location to study ecosystem interactions. Cape Washington itself is a nesting area for south polar skuas (*Stercorarius maccormicki*) and snow petrels (*Pagodroma nivea*). Adélie penguins (*Pygoscelis adeliae*) are present in the emperor colony and on the sea-ice edge daily from November to mid-January. Large groups of killer whales (*Orcinus orca*), both B1 and C type, and Antarctic minke whales (*Balaenoptera bonaerensis*) are regularly present and/or forage in the area, as well as Weddell (*Leptonychotes weddellii*) and leopard (*Hydrurga leptonyx*) seals. The embayment is an important haul-out and breeding area for Weddell seals, with several hundred typically congregating along sea ice leads and near Markham Island throughout the season. Crabeater seals (*Lobodon carcinophagus*) and Arnoux's beaked whales (*Berardius arnuxii*) are occasionally seen at the sea ice edge in the region. Cape Washington is the only place known where the interaction between leopard seals and emperor penguins can be so reliably observed.

The Area has exceptional value for observations of the interactions and predator / prey relationships between many different members of the marine ecosystem within a relatively compact area that is accessible to scientists supported by nearby research stations.

The boundaries of the Area are defined taking an integrated approach to inclusion of all components of the local ecosystem.

The Area has considerable geoscientific value because it features extensive volcanic rock exposures related to the nearby active volcano Mount Melbourne. The Area serves as a key marker region for evaluating the young, neotectonic evolution of the western Ross Sea. It borders the deepest waters of the Ross Sea and includes Markham Island, a volcanic outcrop that is located over a negative magnetic anomaly, the origin of which is not yet known.

Cape Washington is relatively accessible by sea-ice, sea and air from nearby research stations in Terra Nova Bay. Aircraft activity in the region is frequent throughout the summer season, with fixed-wing aircraft operating from the sea ice runway in Gerlache Inlet (Map 2), and helicopter movements within the region around Mount Melbourne on a regular basis.

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

2. Aims and objectives

Management at Cape Washington and Silverfish Bay aims to:

- avoid degradation of, or substantial risk to, the values of the Area by preventing unnecessary human disturbance to the Area;
- allow scientific research on the ecosystem, in particular on the emperor penguins and ecosystem interactions, while ensuring protection from oversampling or other possible scientific impacts;
- allow other scientific research, scientific support activities and visits for educational and outreach purposes (such as documentary reporting (visual, audio or written) or the production of educational resources or services) provided that such activities are for compelling reasons that cannot be served elsewhere and that will not jeopardise the natural ecological system in that Area;
- prevent or minimize the introduction of alien plants, animals and microbes into the Area;
- minimise the possibility of the introduction of pathogens that may cause disease in faunal populations within the Area;
- allow visits for management purposes in support of the aims of the management plan.

3. Management activities

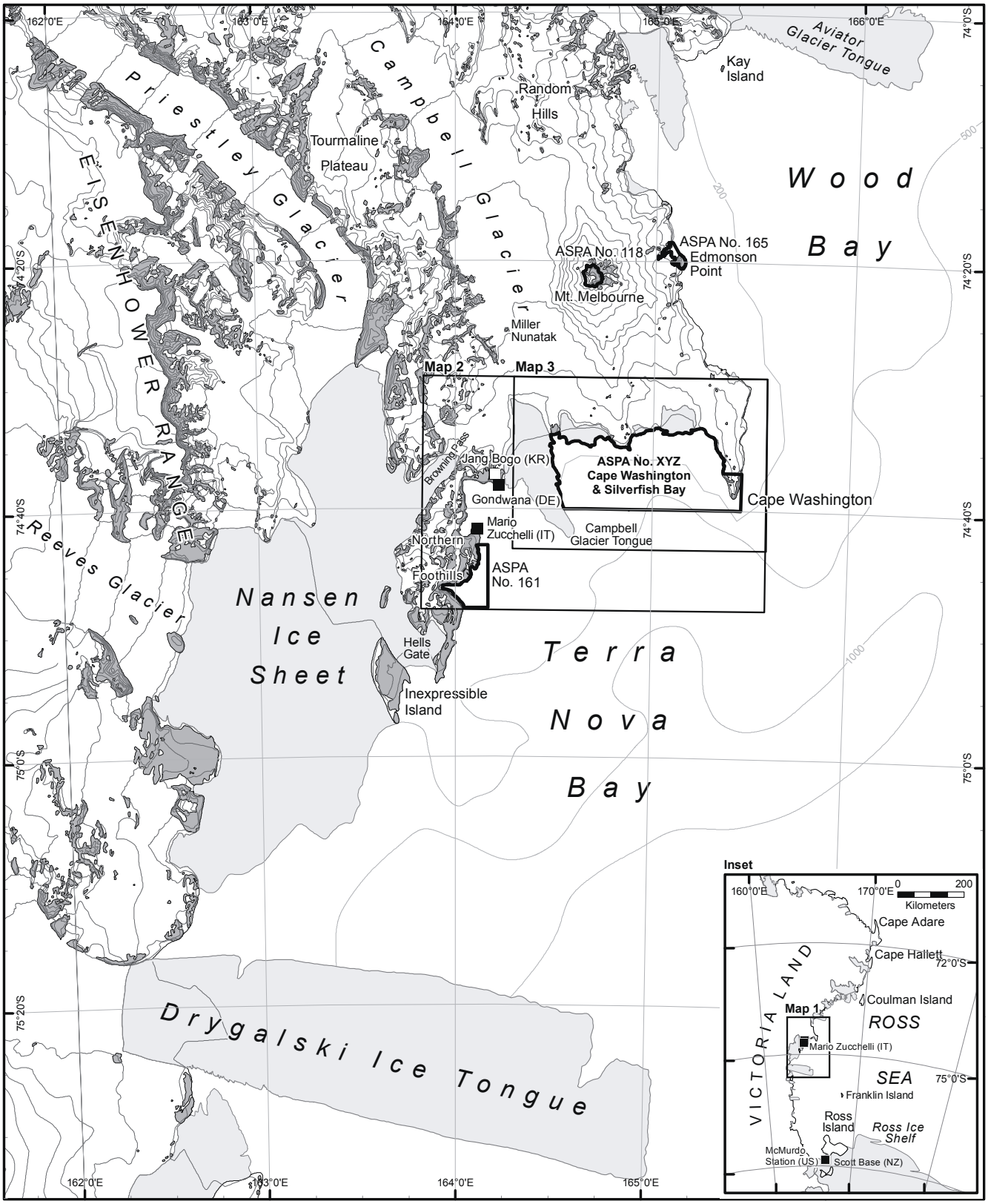
The following management activities shall be undertaken to protect the values of the Area:

- Signs showing the location of the Area (stating the special restrictions that apply) shall be displayed prominently, and a copy of this Management Plan shall be kept available, at all scientific stations located within 75 km of the Area;
- Copies of this Management Plan shall be made available to all vessels and aircraft visiting the Area and/or operating in the vicinity of the adjacent stations, and all pilots and ship captains 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 within are marked on relevant maps and nautical / aeronautical charts;
- Markers, signs or structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition, and removed when no longer required;
- Any abandoned equipment or materials shall be removed to the maximum extent possible provided doing so does not adversely impact on the environment and the values of the Area;
- Visits shall be made as necessary (no less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate;
- National Antarctic Programs operating in the region shall consult together with a view to ensuring that the above provisions are implemented.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs



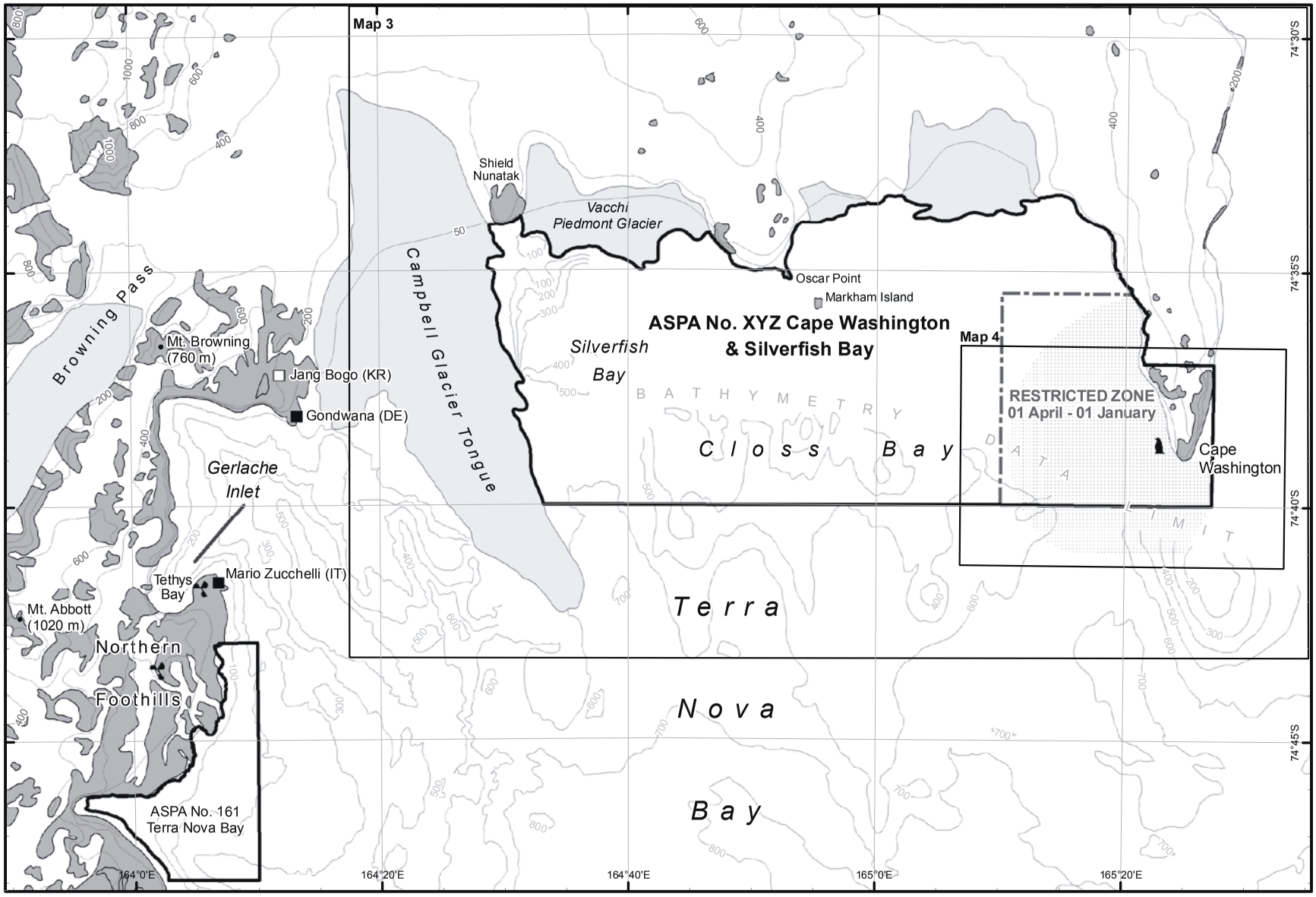
Map 1: ASPA No. XYZ - Cape Washington & Silverfish Bay - Regional Map

22 Mar 2013
United States Antarctic Program
Environmental Research & Assessment

Contour (200 m)
Bathymetry
Ice free ground
Permanent ice
Ice shelf / Ice tongue
Antarctic Specially Protected Area (ASPA) boundary
Station
Station under construction

0 10 20
Kilometers
N

Projection: Lambert Conic Conformal, Spheroid and Datum: WGS84.
Data sources:
Topography: ADD v.5; Bathymetry: GEBCO (1997); Stations: PNRA (2012).



Map 2: ASPA No. XYZ - Cape Washington & Silverfish Bay - topographic map

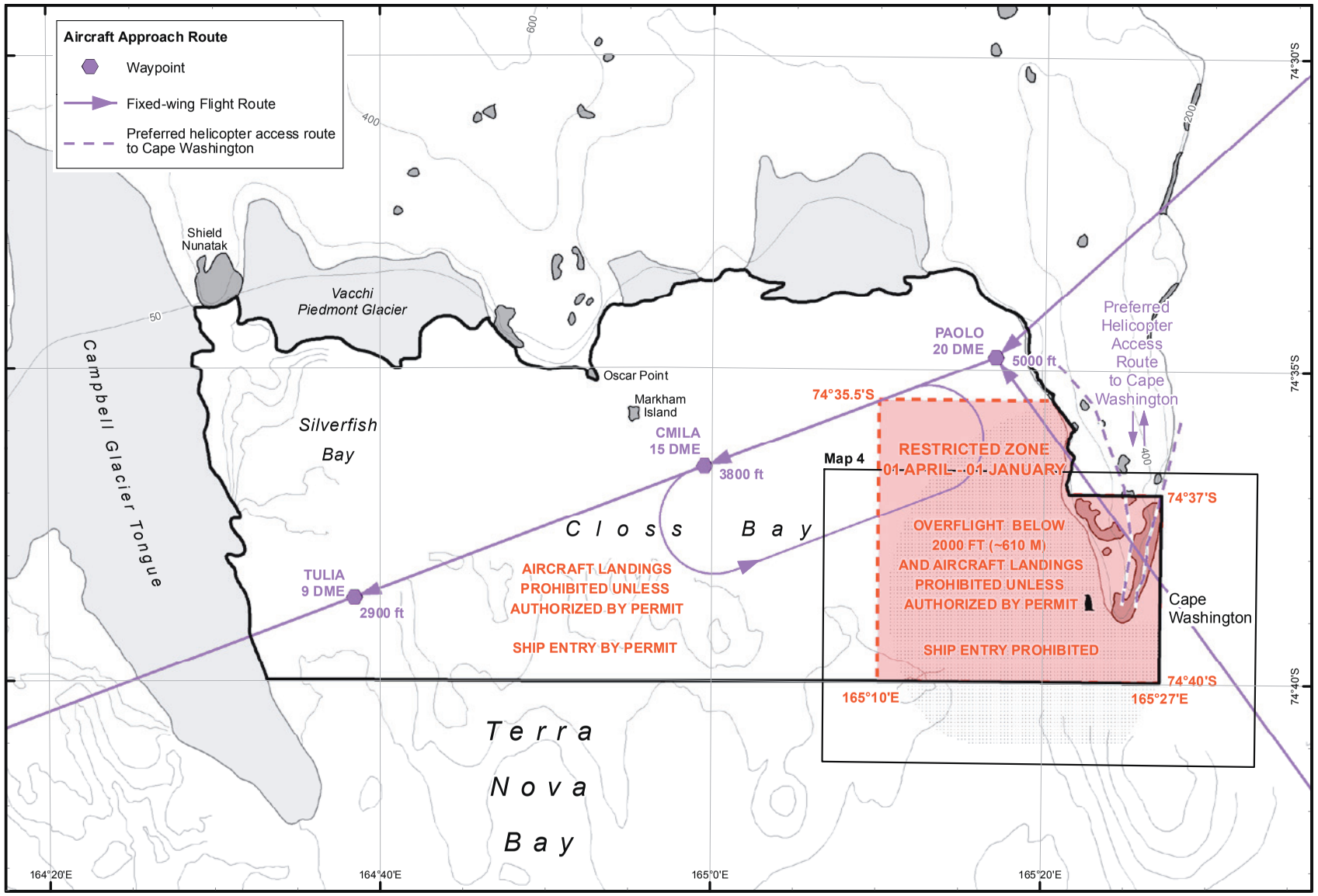
22 Mar 2013
United States Antarctic Program
Environmental Research & Assessment

- Peak
- Contour (200 m)
- Bathymetry (100 m)
- Ice free area
- Permanent ice
- Ice shelf / Ice tongue
- Sea ice runway
- Antarctic Specially Protected Area (ASPA) boundary
- Restricted Zone
- Automatic weather station (AWS)
- Station
- Station (under construction)
- Usual Emperor penguin colony centroid
- Emperor breeding area (approx.)

0 5 10 Kilometers

N

Projection: Lambert Conic Conformal, Spheroid and Datum: WGS84.
Data sources:
Topography: ADD v.5; Bathymetry: PNRA (2000); Stations, AWS: PNRA (2012).



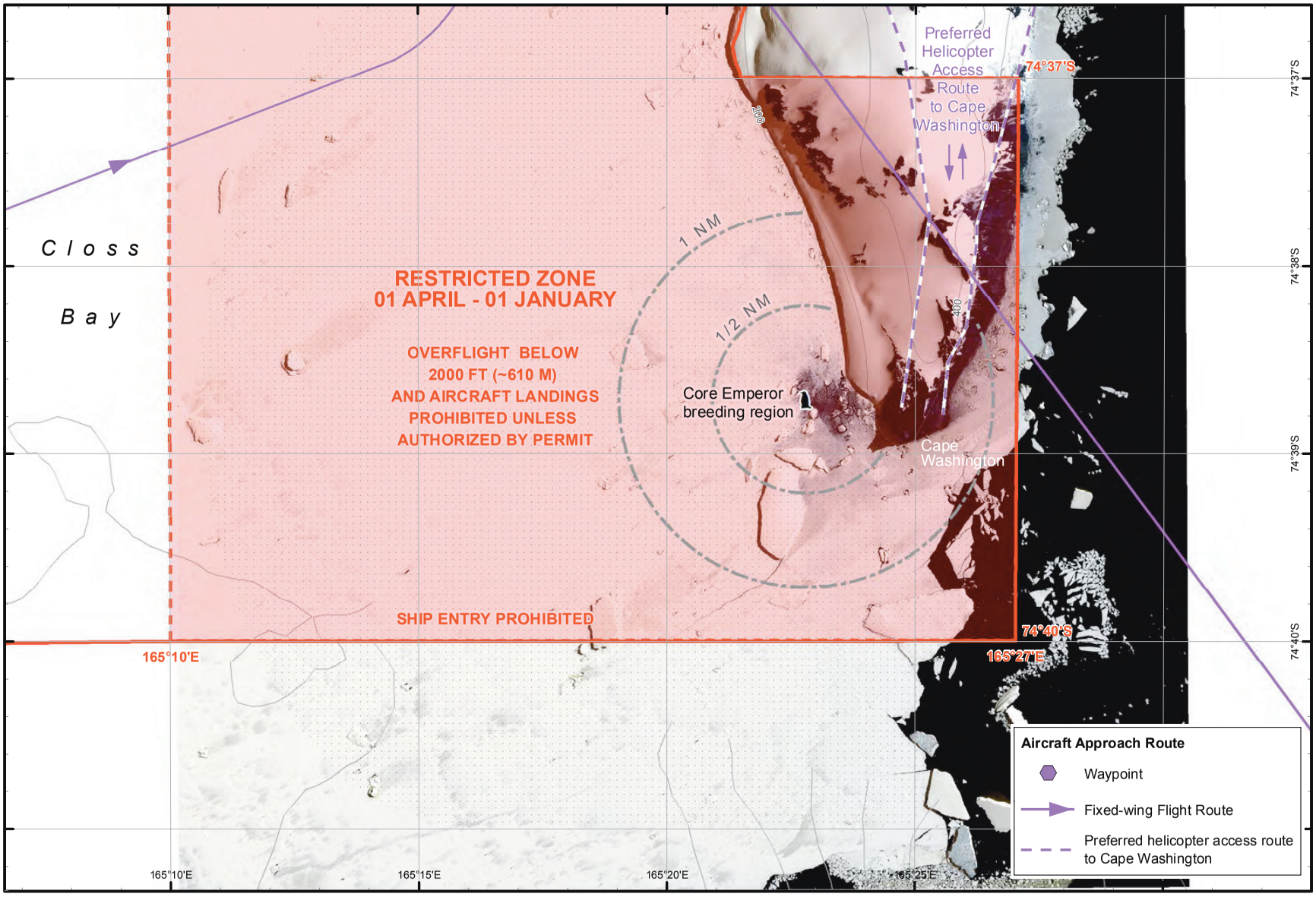
Map 3: ASPA No. XYZ - Cape Washington & Silverfish Bay - Access guidance

22 Mar 2013
United States Antarctic Program
Environmental Research & Assessment

Peak
Contour (200 m)
Bathymetry (100 m)
Ice free area
Permanent ice
Ice shelf / Ice tongue
Antarctic Specially Protected Area (ASPA) boundary
Restricted Zone
Usual Emperor penguin colony centroid
Emperor breeding area (approx.)

0 5
Kilometers
N

Projection: Lambert Conic Conformal, Spheroid and Datum: WGS84.
Data sources:
Topography: ADD v.5; Bathymetry: PNRA (2000);
Aircraft Approach: PNRA (2006).



Map 4: ASPA No. 173 - Cape Washington & Silverfish Bay - Restricted Zone

08 Feb 2019
United States Antarctic Program
Environmental Research & Assessment

Peak
Contour (200 m)
Bathymetry (100 m)
Ice free area
Permanent ice
Ice shelf / Ice tongue
Antarctic Specially Protected Area (ASPA) boundary
Restricted Zone
Distance buffers from Emperor penguin colony centroid for reference
Usual Emperor penguin colony centroid
Emperor breeding area (approx.)

0 1 2 Kilometers

N

Projection: Lambert Conic Conformal, Spheroid and Datum: WGS84.
Data sources: Topography: ADD v.5; Bathymetry: PNRA (2000); Aircraft Approach: PNRA (2006); Satellite imagery: Ikonos: 30 Dec 2011.

6. Description of the Area

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

General description

Cape Washington is situated in northern Terra Nova Bay, 40 km east of Mario Zucchelli Station (Italy) (Map 1). The Area is 286 km^2, of which the marine component is 279.5 km^2 (98 %) and the terrestrial component is 6.5 km^2 (2 %).

Sea ice persists in Silverfish Bay and across Closs Bay to Cape Washington from March until January, providing a stable and reliable platform on which the emperors can breed and suitable conditions for the silverfish 'nursery'. The Cape Washington peninsula provides shelter to the emperor colony, which is relatively protected from the strong katabatic winds that descend into other parts of Terra Nova Bay. The eastern coast of the Cape Washington peninsula comprises precipitous cliffs of several hundred meters in height, while the west side comprises more gentle mixed snow and ice-free slopes with some rocky outcrops extending down to sea level. Closs Bay extends uninterrupted across to the Campbell Glacier Tongue, punctuated by the solitary and small Markham Island close to Oscar Point (Map 2).

Boundaries and coordinates

The eastern boundary of the Area at the NE corner extends from the coordinates 165° 27' E, 74° 37' S on the eastern coast of the Cape Washington peninsula due south for ~5.6 km to 165° 27' E, 74° 40' S (Map 2). The boundary thence extends due west across Closs Bay on latitude 74° 40' S for ~26.8 km to the Campbell Glacier Tongue. It then follows the eastern margin of the Campbell Glacier Tongue for ~11.2 km northwards to the coast at Shield Nunatak. The boundary thence follows the coastline eastwards, around the Vacchi Piedmont Glacier, to the western coast of the Cape Washington peninsula, ~23 km in a straight-line from Shield Nunatak. The boundary thence follows the coastline southward ~7.5 km towards the first prominent rock outcrop at latitude 74° 37.03' S on the western coast of the Cape Washington peninsula. The boundary extends eastwards from this coast along the line of latitude 74° 37' S ~ 2.8 km to the NE corner boundary point located on the eastern coast of the Cape Washington peninsula.

Climate

Four meteorological stations are located in Terra Nova Bay, of which 'Eneide', located at Mario Zucchelli Station (164° 05.533' E, 74° 41.750' S) and ~ 25 km from the center of the Area, has the longest time series of data. The mean annual air temperature at Mario Zucchelli Station was -13.8° C during the period 1987 – 2018, with the coldest month being July with an average minimum temperature of -22.6° C and the warmest months are January and December with an average maximum temperature between -0.7 and -0.9° C. The mean annual wind speed at Mario Zucchelli Station was 6.20 m/s (22.3 km/h; 1987 –2018) with an average maximum of 13 m/s (47.0 km/h) in June and an average minimum of 4.4 m/s (15.8 km/h) in December and January.

The strongest mean annual wind speed in the Terra Nova Bay area has been recorded near Inexpressible Island, measured at 12.3 m/s (44.3 km/h) between Feb 1988 – 1989 (Bromwich *et al*. 1993). This is significantly stronger than ordinary katabatic winds (< 10 m/s), as local topographic features channel the air into the 'confluence zones' of the Reeves and the Priestley glaciers (Bromwich *et al*. 1993). These offshore katabatic winds play a significant role in the formation of the Terra Nova Bay polynya.

Oceanography

Terra Nova Bay is a deep basin that reaches a maximum depth of ~1100 m, which is the deepest water in the Ross Sea (Buffoni *et al.* 2002) (Map 1). Ocean circulation in the bay is characterized in summer by a prevailing northward movement in the upper layer, parallel to the coast, and a clockwise rotation with depth (Vacchi *et al.* 2012b). Warmer and more saline waters are observed near the coast, while cooler waters are found in the central part of the bay, and local eddies and upwelling processes are strongly influenced by katabatic winds (Budillon & Spezie 2000; Buffoni *et al*. 2002).

A perennial winter polynya forms in the bay through a combination of persistent katabatic winds driving newly formed ice offshore and the Drygalski Ice Tongue acting as a barrier to the northward drift of pack ice (Bromwich & Kurtz 1984; Van Woert 1999) (Map 1). The polynya generally forms with a maximum east-west extent that appears to be closely related to the length of the Drygalski Ice Tongue (Kurtz & Bromwich 1983). The polynya has been observed to cover a mean area of roughly 1300 km^2 (65 km N/S by 20 km E/W), although in some years it may not exist at all, while in others it can reach a maximum of ~ 5000 km² (65 km N/S by 75 km E/W) (Kurtz & Bromwich 1983).

This polynya plays an important role in the formation of High Salinity Shelf Waters (HSSW) in Terra Nova Bay (Buffoni *et al* 2002). The brine rejected during the ice formation process increases the salt content and density of the water, which consequently causes a thermohaline circulation and convective movements. The HSSW found in this area have the highest salinity content in Antarctica reaching up to 34.87 and a potential temperature near the sea surface freezing point of -1.9 °C.

Marine biology

The silverfish (*Pleuragramma antarctica*) is the dominant pelagic fish (of both the abundance and biomass of Ross Sea midwater fish fauna) in waters of the continental shelf in the Ross Sea and is considered a keystone species providing one of the major links between lower and higher trophic levels (Bottaro *et al*. 2009; La Mesa *et al*. 2004; La Mesa e*t al*. 2010; O'Driscoll *et al*. 2011; Vacchi *et al.* 2012). Silverfish represent the primary food item for most marine vertebrates, such as baleen whale, birds, and other fishes (La Mesa *et al*. 2004), and are the primary fish prey for both emperor penguins and Weddell seals (Burns & Kooyman 2001).

Until a few decades ago little was known of the early life history of silverfish (Guglielmo *et al*. 1998; Vacchi *et al*. 2004). Marine surveys in Terra Nova Bay in the late 1980s yielded samples that suggested the northern part of the bay may represent a nursery ground for early stages of *P. antarctica* (Guglielmo *et al*. 1998). From late October to early December 2002 large quantities of embryonated eggs of *P. antarctica* were found floating among platelet ice under sea ice in northern Terra Nova Bay (Vacchi *et al*. 2004). This was the first documented nursery and hatching area of the Antarctic silverfish. In 2014, Italy and Korea conducted collaborative research on the ecology of Antarctic silverfish, which extended towards winter. Eggs were collected in the nursery as early as September, allowing observation and description of early embryonic development (Ghigliotti *et al.* 2015).

Research conducted over subsequent years showed higher egg concentrations were consistently found within the embayment east of the Campbell Glacier Tongue (which led to naming this area Silverfish Bay), with greatest abundances in areas where the sea was at least 300 m in depth. Since 2005, regular late spring – early summer monitoring of the Antarctic silverfish nursery has been undertaken, revealing annual fluctuations (significant at the site scale) in the distribution patterns of eggs, possibly related to differences in the processes of sea ice formation and local hydrodynamic conditions and winds (Guidetti *et al*. 2015). This and other research has indicated that habitats with particular combinations of geographic and oceanographic features and conditions (e.g. close ice shelf or glacier tongues, canyons, water mass stratification, polynyas, katabatic winds, and sea ice cover) are favorable for the early life history of the silverfish (Vacchi *et al.* 2012b, Ghigliotti *et al.*, 2017). The spatial segregation of Antarctic silverfish eggs in the platelet ice makes this under-ice environment an essential habitat for this specific ecophase, and more research is needed on its biotic and abiotic characteristics (Koubbi *et al.* 2017). Specific molecular and functional adaptation mechanisms, possibly evolved in response to specific environmental conditions typical of the platelet ice, have been detected in the early life stages of Antarctic silverfish. For instance, a marked responsiveness of antioxidant defences has been described as a means to survive the extreme pro-oxidant conditions of platelet ice at the beginning of austral spring (Regoli *et al*. 2005). This feature also influences the susceptibility of this species toward pro-oxidant chemicals of anthropogenic origin (Regoli *et al*. 2005, Giuliani *et al.* 2017).

The Antarctic toothfish (*Dissostichus mawsoni*) is a unique piscine high trophic level predator. In a recent CCAMLR longline sub-adult survey in the Ross Sea, sampling stations were included in vicinity of the Area. The high catch rate at those stations, dominated by 8-10 year old fish, suggested the relevance of this area for slightly older sub-adult toothfish that would deserve regular monitoring (Hanchet *et al*., 2015). Opportunistic observations in Silverfish Bay, carried out through marine acoustics and visual methods, also supported the presence of Antarctic toothfish in the area, specifically large adult specimens under the sea-ice cover (O'Driscoll *et al*. 2018; Ghigliotti *et al.* 2018; Di Blasi *et al.* 2018).

Birds

The emperor penguin colony at Cape Washington is one of the two largest known; the other is the Coulman Island colony 200 km to the north. While in some years the Cape Washington population has exceeded that at Coulman Island, available data suggests that usually the latter is the slightly larger of the two (Barber-Meyer *et al*. 2008). The population generally ranges between approximately 13,000 and 25,000 breeding pairs (Table 1; Barber-Meyer *et al*. 2008). The most recent count available, made on 31 October 2018 from an aerial survey, indicated approximately 14,000 breeding pairs were present (M. La Rue pers. comm. 2019). Data from earlier years indicate that live chick numbers have consistently remained around these levels since studies were initiated in 1986 (Kooyman *et al*. 1990).

Table 1. Cape Washington emperor penguin population from 2000 and 2018.

Year	Live chick count [1]	Estimated breeding pairs (approx.)
2000	17397	20000
2001	18734	20000
2002	11093	13000
2003	13163	15000
2004	16700	20000
2005	23021	25000
2010	17000 [2]	20000
2018	12178	14000

1. Barber-Meyer *et al.* 2008.
2. Kooyman pers. comm. 2012, Kooyman & Ponganis 2017.
3. M. La Rue pers. comm. 2019.

The emperor penguin colony breeds on sea ice that extends from Cape Washington to the Campbell Glacier Tongue in the northern part of Terra Nova Bay. Sea ice formation begins in March and the bay is generally covered by sea ice until ice break-up around mid-January. The Terra Nova Bay polynya generally offers the colony access to open sea throughout the breeding cycle.

The sea ice in the vicinity of the emperor breeding site may be covered with up to 25 cm of snow near the ice edge, with up to about 1 m of snow accumulating on the SW shoreline of the Cape Washington peninsula (Kooyman *et al*. 1990). This area is relatively sheltered from both SW and NW winds. The locality has been observed to enjoy relatively cloud-free conditions from October to January, resulting in elevated levels of direct solar irradiance. This causes the dirty guano-covered snow and ice to soften and melt, forming pools that are difficult or impossible for penguins, and humans, to walk through. As a result, the birds need to shift their breeding sites regularly throughout the summer period. The incubating birds generally cluster adjacent to the SW coast of Cape Washington until September, before spreading away from the Cape in an expanding semi-circle.

The center of the incubation area in 1996 was approximately 165°22.0′ E, 74°38.8′ S. Observations in 1986-87 found the colony dispersed into several groups by the end of October, each containing 1000 to 2000 chicks with attendant adults (Kooyman *et al.* 1990). From the Cape northward along the western coast of the peninsula, there was found to be a gradient in chick development, with the largest chicks in groups closest to the ice-edge near the Cape. By the time of fledging some groups of chicks had moved 5 to 6 km away from the original breeding locality. In 1986-87 fledging occurred abruptly over a ten-day period at the end of December and the beginning of January.

There is evidence that the Cape Washington colony is comparatively stable in population and that it appears to enjoy relatively high levels of breeding success, averaging almost 95% of chicks successfully fledged over a six-year study period (Barber-Mayer *et al.* 2008). This compares with breeding successes of only around 60-70 % at the Point Géologie, Taylor Glacier and Auster colonies in the East Antarctic. The Cape Washington colony is particularly valuable for scientific study because of its comparative low variability in breeding success, which may be in part a function of its large size, with smaller colonies exhibiting greater population fluctuations (Barber-Mayer *et al.* 2008). Moreover, the colony is relatively accessible to nearby scientific stations, making research more practical.

A south polar skua (*Stercorarius maccormicki*) colony comprising approximately 50 pairs is located on the ice-free slopes of Cape Washington, overlooking the emperor colony. Snow petrels (*Pagodroma nivea*) have been recorded as breeding in niches in the Cape Washington cliffs (Greenfield & Smellie 1992), feeding along the ice edge, and have been noted as the most abundant flying bird in the vicinity over the summer months (Kooyman *et al.* 1990). Adélie penguins (*Pygoscelis adeliae*) are observed along the ice edge and within the emperor colony during summer months, while Wilson's storm petrels (*Oceanites oceanicus*) are frequently observed along the ice edge from mid- to late-November. Southern giant petrels (*Macronectes giganteus*) have been observed overflying and landing within the Area (Kooyman *et al.* 1990).

Mammals (seals, whales)

Minke whales (*Balaenoptera bonaerensis*), Arnoux's beaked whale (*Beradius arnuxii*) and both B1 and C Killer whale forms are common in Terra Nova Bay (Kooyman *et al*. 1990; Lauriano *et al.* 2010). Arnoux's beaked whales and minke whales are seasonally present, taking advantage of the highly productive waters and associated prey that becomes available as the ice breaks up. Higher cetacean encounter rates were observed in the region between Edmonson Point and the Campbell Glacier Tongue than in the region south from Mario Zucchelli Station onwards (Lauriano *et al.* 2010). The B1 type killer whale feeds on mammals and commonly occurs along the ice shelf in the austral summer to take advantage of both the seals and Adélie penguin colonies in the area (Andrews *et al.*, 2008; Lauriano *et al.*, 2007). The C type killer whale (or Ross Sea Killer Whale - RSKW) feeds on fish, and is observed in the area between Campbell Ice Tongue and Cape Washington. A satellite telemetry study revealed deep dives (up to 300 m) and Area of Restricted Search (ARS) behaviours in Closs Bay compared to the transit behaviour outside of this area (Lauriano & Panigada, 2015a,b; Lauriano *et al*. submitted). These data emphasise the role of the Area as a feeding ground for this dwarf killer whale form. Moreover, resightings between 2004 and 2015 highlight a site fidelity and confirm the value of the Area. Stable isotope analysis indicates Antarctic toothfish (*Dissostichus mawsoni*) as the main component of the diet of the biopsied animals (Lauriano *et al*. submitted).

Three species of seal – Weddell (*Leptonychotes weddellii*), leopard (*Hydrurga leptonyx*) and crabeater (*Lobodon carcinophagus*) – are common in the Area. The embayment is an important haul-out and breeding area for Weddell seals, which typically congregate along sea ice leads and openings that dynamically form throughout the season. At least 200 Weddell seals were recorded in the bay west of Cape Washington in 1986-87, with 31 pups counted near Markham Island (Kooyman *et al*. 1990), and a similar number of adults was counted in the same region from satellite imagery acquired in November 2011 (La Rue pers. comm. 2012).

Leopard seals (*Hydrurga leptonyx*) were recorded within the Area from mid-November through December in 1986-87, and were observed to prey on emperor penguins around the ice edge. Kooyman *et al*. (1990) estimated that the three individuals they monitored over this period would have taken approximately 150 – 200 adult birds, or about 0.5 % of breeding emperor adults at the colony. Crabeater seals were recorded on occasion at the ice edge or on nearby ice flows in the same season (Kooyman *et al.* 1990).

Human activities / impacts

Three permanent scientific stations are located at nearby Gerlache Inlet and one is under construction on Inexpressible Island. Mario Zucchelli (164° 06.917′ E, 74° 41.650′ S; Italy), established in 1987, operates summer only with a complement of about 90 personnel. Gondwana (164° 13.317′ E, 74° 38.133′ S; Germany), established in 1983, operates on occasional summers with capacity for approximately 25 personnel. Jang Bogo station (164° 11.950′ E, 74° 37.250′ S; Republic of Korea) has been operational since February 2014 and carries a complement of ~20 winter personnel and up to 60 in summer. China is currently establishing a new station on nearby Inexpressible Island at 163° 42.5′ E, 74° 56.15′ S, which will operate year-round with a complement of up to ~30 winter and ~80 summer personnel (CAA 2018).

A gravel airstrip is under construction in the Northern Foothills, approximately six km south of Mario Zucchelli Station and around 40 km from the Area. The airstrip will be capable of receiving large 4-engined wheeled aircraft, although all aircraft operating in the vicinity will be subject to the minimum flying heights specified in this Management Plan when overflying the Area.

The Cape Washington emperor colony has been of interest for tourism for around 20 years, with an average of ~200 tourists visiting Cape Washington per annum over the last decade. The colony has also been of interest for recreational visits by station personnel from nearby Mario Zucchelli Station prior to the designation of the Area. An area frequented by emperor penguins lies immediately south of the southern boundary of the Area at 74° 40′ S (Maps 3 & 4). This region lies within the approximate 6 km buffer from the nominal centroid of the breeding colony within which the birds have been consistently observed when sea ice is present. This region outside of the protected area allows continued opportunities for tourism or recreational visits to view emperor penguins in the Cape Washington vicinity, and other opportunities exist at colonies elsewhere in the Ross Sea and Antarctica more generally.

6(ii) Access to the Area

The Area may be accessed by traversing over land or sea ice, by sea or by air. Particular access routes have not been designated over land or sea ice or for vessels entering the Area by sea. Access to Cape Washington by helicopter should follow the designated access route over the northern part of the Cape Washington peninsula. Overflight, aircraft landing and ship access restrictions apply within the Area, the specific conditions for which are set out in Section 7(ii) below.

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

There are no structures within the Area. Several geodetic reference markers have been established by the Italian Antarctic program at Markham Island and at Cape Washington on ice-free ground, and these are the only known permanent markers in the Area. Mario Zucchelli Station (164° 06.917′ E, 74° 41.650′ S; Italy) is situated ~13 km southwest of the western boundary of the Area on the southern shore of Gerlache Inlet (Map 2). Gondwana Station (164° 13.317′ E, 74° 38.133′ S; Germany) is located 8.7 km west of the western boundary of the Area, also in Gerlache Inlet and 7.2 km north of Mario Zucchelli Station. Jang Bogo Station (164° 11.95′ E, 74° 37.25′ S; South Korea) is located ~9 km west of the western boundary of the Area, ~1.8 km NW of Gondwana Station. A new station is being constructed by China on Inexpressible Island at 163° 42.5′ E, 74° 56.15′ S, ~40 km southwest of the southern boundary of the Area, which is expected to be operational around 2021/22 (CAA 2018). A number of structures associated with national program operations are located nearby, such as a communications facility near the summit of Mount Melbourne, several radar and non-directional beacons to assist summer air operations, and Italy is constructing a new gravel airstrip in the Northern Foothills, although these are all outside of the Area.

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

The nearest protected areas to Cape Washington are the high altitude geothermal sites on Mount Melbourne (ASPA No.175) 23 km north of the northern boundary of the Area, Edmonson Point (ASPA No.165) 24 km north of the northern boundary of the Area, and Terra Nova Bay (ASPA No.161) 13 km from the western boundary of the Area.

6(v) Special zones within the Area

This Management Plan establishes a Restricted Zone within the Area which applies during the period from 01 April through to 01 January inclusive.

Restricted Zone

The Restricted Zone is designated east of the line of longitude 165° 10′ E and south of the line of latitude 74° 35.5′ S (Map 3), which encompasses the primary emperor breeding area and is considered the most ecologically sensitive part of the Area. The Restricted Zone has an area of 62.5 km^2. Access to the Restricted Zone should be for compelling reasons that cannot be served elsewhere within the Area and detailed conditions for access are described in Section 7(ii) below.

7. Terms and conditions for entry permits

7(i) General permit conditions

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

- it is issued only for scientific study of the ecosystem, or for compelling scientific or educational (such as documentary reporting or the production of educational resources or services) reasons that cannot be served elsewhere, or for reasons essential to the management of the Area;
- the actions permitted are in accordance with this Management Plan;
- the activities permitted will give due consideration via the environmental impact assessment process to the continued protection of the environmental, ecological and scientific values of the Area;
- access to the Restricted Zone is allowed only for compelling reasons that cannot be served elsewhere within the Area;
- the permit shall be issued for a finite 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 or by vehicle, by ship or small boat, or by fixed-wing or rotor-wing aircraft.

Access on foot or by vehicle

No special access routes are designated for access to the Area on foot or by vehicle over sea ice or by land. Vehicles may be used over sea ice and glaciers although are prohibited from ice-free ground within the Area. Pedestrian and vehicular traffic should be kept to the minimum necessary consistent with the objectives of any permitted activities and every reasonable effort should be made to minimize disturbance. Vehicle use should be avoided within 100 m of concentrations of emperor penguins or Weddell seals, and permitted visitors should avoid entering penguin sub-groups or approaching seals except as required for essential scientific, educational or management purposes.

Access and overflight by piloted aircraft and Remotely Piloted Aircraft Systems (RPAS)

Resolution 2 (2004), the Guidelines for the Operation of Aircraft near Concentrations of Birds in Antarctica, should be followed at all times. Restrictions on aircraft operations apply during the period from 01 April through to 01 January inclusive, when aircraft shall operate and land within the Area according to strict observance of the following conditions:

1. Overflight below 2000 ft (610 m) and landings within the Area by piloted aircraft, including by helicopters, are prohibited except in accordance with a permit issued by an appropriate national authority;
2. Piloted aircraft landings on sea ice within ½ nautical mile (~930 m) of the emperor colony are prohibited. Pilots should note that the emperor colony may move throughout the breeding season up to six kilometers from the nominal center coordinate of the colony at 165°22′ E, 74°38.8′ S (Map 3), and the colony may break up into a number of smaller units within the Area;
3. Piloted aircraft landings on sea ice within ½ nautical mile (~930 m) of concentrations of Weddell seals are prohibited. Pilots should note that Weddell seals may be present throughout the Area, although tend to congregate along sea ice leads and around Markham Island (Map 3). In the context of management of the Area, a concentration is defined as five or more animals within 300 m of each other;
4. Pilots shall ensure piloted aircraft maintain the minimum separation distance from any part of the emperor colony and / or any concentration of seals when operating over sea ice at all times, excepting when this is impractical because the animals have voluntarily moved closer to the aircraft after it has landed;
5. Pilots making authorized landings beyond ½ nautical mile (~930 m) of the emperor colony and / or concentrations of seals may select landing sites according to visit needs, local conditions and safety considerations. Pilots of piloted aircraft should make a reconnaissance of suitable landing sites from above 2000 feet (~610 m) before descending to land;
6. Landings by helicopter may be made on land within the Restricted Zone at Cape Washington. The preferred helicopter approach route to the Cape is from the north over the Cape Washington peninsula, avoiding overflight of the emperor colony, breeding skua territories situated immediately west of the access route, and seabird breeding sites along the cliffs of the Cape Washington peninsula (Map 3). Pilots flying to the Cape 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 emperor colony;
7. Approaches by fixed wing aircraft to sea ice landing sites in Terra Nova Bay adjacent to Mario Zucchelli Station (Italy) (Map 2) should maintain designated approach paths and elevations as defined in the most recent edition of the Antarctic Flight Information Manual (COMNAP 2019). Should visibility or other conditions be prohibitive of maintaining these paths and / or elevations, pilots should ensure that alternative approaches adopted avoid exceeding the minimum overflight heights that apply within the Restricted Zone.
8. Overflight below 2000 ft (610 m) and landings within the Area by Remotely Piloted Aircraft Systems (RPAS) are prohibited except in accordance with a permit issued by an appropriate national authority. RPAS use within the Area should follow the Environmental Guidelines for Operation of Remotely Piloted Aircraft Systems (RPAS) in Antarctica (Resolution 4 (2018)).

Access by ship or small boat

Restrictions on ship and / or small boat operations apply during the period from 01 April through to 01 January inclusive, when ships and / or small boats shall operate within the Area according to strict observance of the following conditions:

- Ships and / or small boats are prohibited from the Area, including entering sea ice within the Area, unless authorized by permit for purposes allowed for by this Management Plan;
- Ships are prohibited within the Restricted Zone;
- There are no special restrictions on where access can be gained to the Area by small boat, although small boat landings should avoid areas where penguins are accessing the sea unless this is necessary for purposes for which the permit was granted.

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

- Scientific research that will not jeopardize the values of the Area;
- 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 resources or services) that cannot be served elsewhere.

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

- No structures are to be erected within the Area except as specified in a permit and, with the exception of permanent survey markers and signs, permanent structures or installations are prohibited;
- All structures, scientific equipment or markers installed in the Area shall be authorized by permit and clearly identified by country, name of the principal investigator, 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;
- 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

Pfield camps are prohibited within the Area. Temporary camp sites are permitted within the Area. There are no specific restrictions on the precise locality for temporary camp sites within the Area, although it is recommended that initial sites selected should be more than 1000 m from concentrations of breeding emperor penguins. It is recognized that the birds move from their original breeding locations throughout the season. As the birds will subsequently set their own distance limits from any camp established, it is not considered necessary to keep moving the camp in response to the shifting positions of the emperor colony. It is recommended that camp sites be located approximately 500 m offshore from the western coast of the Cape Washington peninsula because the near-shore area is subject to snow overburden and subsequent meltwater flooding. Camping within the terrestrial part of the Area is not restricted to a particular location, but where possible camp sites should be located on snow covered ground.

7(vi) Restrictions on materials and organisms that 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:

- deliberate iintroduction 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* (CEP 2017), and in the *Environmental Code of Conduct for terrestrial scientific field research in Antarctica* (Resolution 5 (2018));
- All poultry brought into the Area shall be managed appropriately to minimize any risk of transmission of diseases and all poultry not consumed or used within the Area, including all parts, products and / or wastes of poultry, shall be removed from the Area or disposed of by incineration or equivalent means that eliminates risks to native flora and fauna;
- 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 minimises 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; and
- If release occurs which is likely to compromise the values of the Area, removal is encouraged only where the impact of removal is not likely to be greater than that of leaving the material *in situ*.

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

Taking 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 Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica.

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

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

7(ix) Disposal of waste

All wastes, except human wastes, shall be removed from the Area. Small quantities of human wastes, such as arising from groups of no more than 10 people within a given season, may be disposed of onto annual sea ice or directly into the sea within the Area, or otherwise 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 after the visit has been completed in accordance with national procedures.
- Such reports should include, as appropriate, the information identified in the visit report form contained in the Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas (Resolution 2 (2011)). If appropriate, the national authority should also forward a copy of the visit report to the Party that proposed the Management Plan, to assist in managing the Area and reviewing the Management Plan.
- Parties should, 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.
- The appropriate authority should be notified of any activities / measures undertaken, and / or of any materials released and not removed, that were not included in the authorized permit.

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