

Management Plan for Antarctic Specially Protected Area No 124

CAPE CROZIER, ROSS ISLAND

1. Description of values to be protected

An area at Cape Crozier was originally designated as Specially Protected Area No 6 by Recommendation IV-6 (1966) after a proposal by the United States of America on the grounds that the region supports a rich bird and mammal fauna as well as microfauna and microflora, and that the ecosystem depends on a substantial mixing of marine and terrestrial elements of outstanding scientific interest. With adoption by Antarctic Treaty Parties of the Site of Special Scientific Interest (SSSI) category of protection in 1972, Cape Crozier's designation as an SPA was terminated by Recommendation VIII-2 (1975) and the site was re-designated as SSSI No 4 by Recommendation VIII-4 (1975). The reason for designation of SSSI No 4 was to protect long-term studies of the population dynamics and social behaviour of emperor (*Aptenodytes forsteri*) and Adélie (*Pygoscelis adeliae*) penguin colonies in the region. Information gathered since the designation of SSSI No 4 supported the inclusion of skua populations and vegetation assemblages as important values to be protected at Cape Crozier. In 2002 (Measure 1) the boundaries were extended south to Igloo Spur to protect the range of vegetation assemblages representative of the Cape Crozier region. The western boundary of the Area has been modified in the current plan to follow a simple line of longitude because visitors found the previous boundary hard to follow.

The emperor penguin colony at Cape Crozier was first recorded by members of the British National Antarctic Expedition in 1902. The colony is the most southerly known and has the longest record of study on an emperor penguin population. The colony breeds on fast ice that forms between large cracks, which develop where the Ross Ice Shelf abuts Cape Crozier. The positions of these cracks shift with movement of the ice shelf, and the colony itself is known to move around different parts of the cracks during the breeding season. The boundaries of the Area have been designed to include fast-ice areas consistently occupied by breeding birds.

Cape Crozier has a large Adélie penguin (*Pygoscelis adeliae*) population numbering around 150,000 breeding pairs, making it one of the largest Adélie colonies in Antarctica. The colony is divided into two main groups 1km apart known as East and West Colonies (Maps 1 and 2). In addition, well-preserved ancient Adélie penguin remains found within the Area have particular scientific value for genetic studies. Associated with the penguin colonies is a large south polar skua (*Catharacta maccormicki*) colony, estimated at 1000 breeding pairs.

Weddell seals (*Leptonychotes weddellii*) breed within the Area, while leopard seals (*Leptonyx hydrurga*) are frequent visitors and crabeater seals (*Lobodon carcinophagus*) are commonly seen at sea and on ice floes. Orca are also frequently seen close off shore within the Area. While the mammal species recorded at Cape Crozier are not unique to the Area nor known to be outstanding in this context, they form an integral and representative part of the local ecosystem.

There are moss, algae and lichen assemblages in the Area. Expanses of snow algae at Cape Crozier cover an area of more than 4 ha adjacent to the skua and penguin colonies. Growths as extensive as those at Cape Crozier have been remarked on only once before in the Continental Antarctic Zone, on the Wilkes Land Coast, and Cape Crozier has one of the most southerly records of snow algae. Lichens are also abundant, with large areas of bright orange encrusting (crustose) lichens on rocks

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and stones on the slopes above the Adélie colony, and rich growths of foliose and fruticose lichens in the vicinity of Wilson's Stone Igloo.

A message post from Scott's National Antarctic Expedition (1901-04) is situated in West Colony (169°16'14"E, 77°27'15"S) and was designated as Historic Site and Monument (HSM) No 69 in Measure 4 (1995). Wilson's Stone Igloo (169°18'E, 77°51'S), designated as HSM No 21 in Recommendation VII-9 (1972), is situated in the south of the Area. The rock shelter was constructed in July 1911 by members of the 1910-1913 British Antarctic Expedition during their winter journey to Cape Crozier to collect emperor penguin eggs.

The high scientific, ecological and historic values of this area along with its vulnerability to disturbance through trampling, sampling, pollution or alien introduction, are such that this Area requires long-term special protection.

2. Aims and objectives

Management at Cape Crozier aims to:

- avoid degradation of, or substantial risk to, the values of the Area, and in particular the avifauna and vegetation assemblages within the Area;
- allow scientific research, especially of the avifauna and vegetation assemblages, in the Area while ensuring it is protected from oversampling or other possible scientific impacts;
- allow other scientific research provided it will not jeopardize the values of the Area;
- minimize the possibility of introduction of alien plants, animals and microbes into the Area;
- allow visits to the historic sites, but under strict control by permit;
- allow visits for management purposes in support of the aims of the Management Plan.

3. Management activities

- Durable wind direction indicators should be erected close to the primary designated helicopter landing site whenever it is anticipated there will be a number of landings at the site in a given season. These should be replaced as needed and removed when no longer required.
- Brightly colored markers, which should be clearly visible from the air and pose no significant threat to the environment, should be placed to mark the primary and secondary designated helicopter landing sites adjacent to the field hut.
- 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, in the research hut facility at Cape Crozier.
- Markers, signs or structures erected within the Area for scientific or management purposes shall be secured and maintained in good condition, and removed when no longer necessary.
- Visits shall be made as necessary (no less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure management and maintenance measures are adequate.
- National Antarctic Programs operating in the region shall consult together for the purpose of ensuring that the above provisions are carried out.

4. Period of designation

Designated for an indefinite period.

5. Maps and photographs

- Map 1: ASPA No 124 Cape Crozier: Topography and boundary. Map specifications: Projection: Lambert conformal conic; Standard parallels: 1st 77° 27' S; 2nd 77° 32' S; Central meridian: 169° 15' E; Latitude of Origin: 77° S; Spheroid: WGS84; Datum: McMurdo Sound Geodetic Control Network 1992.
 - Inset 1: Ross Sea region, showing location of Inset 2.
 - Inset 2: Ross Island region, showing the location of Map 1 and McMurdo Station (US) and Scott Base (NZ).
- Map 2: ASPA No 124 Cape Crozier: Access, facilities and wildlife. Map specifications are the same as those for Map 1.

6. Description of the Area

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

Cape Crozier (169° 21' 30" E, 77° 30' 30" S) is at the eastern extremity of Ross Island, where an ice-free area comprises the lower eastern slopes of Mount Terror. The designated area is situated in the vicinity of Post Office Hill (407 m), extending to encompass the adjacent Ross Ice Shelf where large cracks in the shelf are covered by fast-ice which is occupied annually by breeding emperor penguins.

The Area includes a terrestrial region and ice shelf above the mean high water mark as well as the adjacent fast-ice within the boundaries occupied by breeding emperor penguins. The north boundary of the Area extends 6.5km along the 77° 26' 00" S line of latitude from 169° 11' 30" E to 169° 28' 00" E. The west boundary extends 1.5km south from the northern boundary to the coast, thence in a SW direction following a low ice-free ridge that passes 30m west of the hut and helicopter pad. The boundary then follows this ridge in a southerly direction to the saddle SW of the summit of Post Office Hill at 169° 11' 30" E 77° 28' 00" S, before following the 169° 11' 30" E line of longitude south to a point at 169° 11' 30" E 77° 31' 00" S, which is close to the summit of Bomb Peak (740m). The boundary extends down the SE ridge of Bomb Peak to Igloo Spur at 169° 20' 00" E 77° 32' 00" S, from where it extends due east along latitude 77° 32' 00" S to the east boundary at 169° 28' 00" E.

The ice-free ground at Cape Crozier is of recent volcanic origin, with numerous small cones and craters evident among gentle slopes of scoria and fine-grained basalt lava. Several of these hills, including Post Office Hill, shelter the penguin colonies from south-westerly winds. On the surface are many volcanic bombs and other evidence of small-scale volcanic explosions. To the south of the Area coastal cliffs adjacent to the ice shelf are up to 150m high. The cliff faces show bedded lava and brown palagomite tuffs with several lenticular patches of columnar basalt towards the base. Large rocks of continental origin transported by glacial action can be found on the northern side of Cape Crozier. Prevailing winds tend to be from between the south-west and west, with temperatures generally about 8° colder than those at McMurdo Sound.

The emperor penguin (*Aptenodytes forsteri*) colony at Cape Crozier was discovered in October 1902 by R.S. Skelton, a member of Scott's Discovery Expedition. The presence of the colony depends on fast-ice locked between cracks in the Ross Ice Shelf where it abuts Cape Crozier. The size of the

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colony is limited by the area and condition of the fast ice, which also affects the availability of breeding sites sheltered from the strong katabatic winds that descend from Mount Terror. The location of the colony varies from year to year and the colony moves within a breeding season, beginning the season near to shore and moving off shore as fledging approaches. The breeding population has fluctuated widely since the turn of the century, for example with 400 adults recorded in 1902, 100 in 1911, and 1,300 in 1969. The number of chicks fledged and the fledging success of the colony has also been variable (Table 1).

Table 1. Cape Crozier emperor penguin live chick counts 1983–2006

Year	Chicks	Year	Chicks	Year	Chicks	Year	Chicks
1983	78	1993	?	1998	1108	2003	333 (a)
1986	?	1994	645	1999	798	2004	475
1989	?	1995	623	2000	1201	2005	0
1990	324	1996	859	2001	0	2006	339 (b)
1992	374	1997	821	2002	247		

Source: Barber-Meyer, Kooyman & Ponganis 2008.

a) All chicks not counted due to rugged ice conditions and thus one chick assumed per adult counted.

b) G. Kooyman, *pers. comm.*, Nov. 2007.

In 2000, a section of the Ross Ice Shelf calved to form an iceberg 295km long and 40km wide. A fragmented section of this iceberg, known as B15A, together with another iceberg (C16) lodged near Ross Island in 2001. These icebergs had a major effect on sea ice distribution and primary production, and impeded the arrival of emperor penguins. In 2001 and several subsequent years, icebergs C16 and B15A affected the breeding success and colony locations of emperor and Adélie penguins by blocking access to foraging areas and destroying nesting habitat. In 2005, the emperor colony remained well below its pre-2000 size, with no sign of breeding (Kooyman *et al.* 2007). However, in 2006 the colony had returned to its pre-iceberg location and 339 chicks were produced (G. Kooyman, *pers. comm.*, Nov. 2007; Table 1).

A comprehensive population study of Adélie penguins occurred at Cape Crozier from 1961-62 through the 1981-82 austral summers, with 2000 to 5000 chicks banded yearly. There are two Adélie penguin (*Pygoscelis adeliae*) colonies at Cape Crozier, known as East and West Colonies. These are about 1km apart, separated by a 45-m high ridge and a sloping ice field across which the birds do not travel. A coastline of 1.6km with three beaches separated by rock outcrops provides penguins with access to West Colony. By contrast, East Colony has one 50-m wide rocky beach and 550m of sea cliffs. The population of the two colonies has increased substantially over the last 50 years, numbering 65,000 breeding pairs in 1958, 102,500 in 1966 and 177,083 in 1987. Numbers fell to 136,249 in 1989 and 106,184 in 1994. In 2000, the number of breeding pairs was estimated to be 118,772 (based on a projection from counts of selected subcolonies) (Ainley *et al.*, 2004). The combined population of the East and West Colonies at Cape Crozier make it one of the largest Adélie colonies in Antarctica. The presence of the B15A and C16 icebergs from 2001 to 2005 had a significant effect on the Adélie penguin colony at Cape Crozier (Arrigo *et al.*, 2002).

Approximately 1000 pairs of south polar skuas (*Catharacta maccormicki*) breed on ice-free ground surrounding the Adélie penguin colony. A demographic study of this colony began in 1961-62 and was still continuing in 1996-97. Chinstrap penguins (*Pygoscelis antarctica*), Wilson's storm petrels (*Oceanites oceanicus*), snow petrels (*Pagodroma nivea*), Antarctic petrels (*Thalassoica antarctica*), southern fulmars (*Fulmaris glacialisoides*), southern giant petrels (*Macronectes giganteus*), black-backed gulls (*Larus dominicanus*), and south polar skuas from more northerly breeding sites, have been recorded as visitors to Cape Crozier.

Weddell seals (*Leptonychotes weddellii*) breed within the Area, with approximately 20 pups being recorded in recent years. Leopard seals (*Leptonyx hydrurga*) frequent the Area, with approximately 12 individuals recognized as regular visitors, while crabeater seals (*Lobodon carcinophagus*) are commonly seen at sea and on ice floes in the vicinity. Other mammals frequently observed within the Area include killer whales (*Orcinus orca*), of which several distinct types have been recognized.

Algae can be found throughout the Area on large patches of snow and on soils and stones, often below the soil surface layer. Large areas of green snow algae, covering more than 4 ha, can be found in the north of the Area in snowfields around the periphery of the Adélie penguin colony and skua nesting areas (Broady 1989). Particularly large patches have been reported in the snow-filled valley between the two coastal hills at the northern end of the Adélie colony, with snow-tinted green over at least one hectare. However, the extent of snow algae is not always obvious, with the green color often not revealed until a surface crust of white ice is broken away. Snow algae samples are dominated by a species of *Chlamydomonas*, and associated with occasional *Ulothrix*-like filaments and diatoms. Growth requires percolating meltwater during summer and nutrients derived from the bird colonies.

Prasiola crispa grows in slow water flows in the vicinity of the penguin colonies and ribbon-like growths of *P. calophylla* are found where water percolates over stones on the tallus slopes. Numerous small ponds are found throughout the Area, from small pools 1-m in diameter to a lake 150-m in diameter situated immediately south of The Knoll. The four ponds in the penguin colonies contain abundant phytoplankton populations of *Chlamydomonas* cf. *snowiae*, while ponds elsewhere support growths of red-brown to dark blue-green benthic felts dominated by Oscillatoriaceae. Occasional epilithic algae (dominated by *Gloeocapsa*, *Nostoc* and *Scytonema*) are found as blackish crusts coating rock surfaces where meltwater percolates.

Mosses are sparse and scattered in their distribution with most occurrences being of one or a small number of isolated cushions no larger than 10cm in diameter. Richer growths than this occur up to 0.5km NE of the hut on north and NW facing slopes and on slopes immediately above the coastal cliffs about 1km south of the penguin colonies. The moss species occurring at Cape Crozier have yet to be identified.

Encrusting orange lichens are present in shallow hollows, on rock outcrops, boulders and encrusting bryophytes on the slopes above the penguin colonies. Also present adjacent to Wilson's Stone Igloo is the fruticose lichen *Usnea* and the foliose lichen *Umbilicaria*, both duller in color but structurally more complex. Green algal crusts are found throughout the Area.

6(ii) Restricted and managed zones within the Area

None.

6(iii) Structures within and near the Area

The Cape Crozier hut (US) (169° 11' 14" E, 77° 27' 39" S) is situated on the NW side of a low peak (locally known as 'Pat's Peak') (Maps 1 and 2). A radio communications repeater is installed above the hut on a seasonal basis (Map 2). An observation hide dating from research programs in the 1960–80 period is located at the base of the north side of Post Office Hill. An old 'Jamesway' hut was built on a small terrace approximately 1km NE of the present hut (Map 2), although this was destroyed by fire and all hut debris has since been removed. Some materials such as nails, screws and hinges remain at the site.

A historic message post, designated as HSM No 69 under Measure 4 (1995), is situated in the West Colony on the NE coast of the Area (169° 16' 14" E, 77° 27' 15" S). The post was used by the 1901–04 British National Antarctic Expedition to provide information to the expedition's relief ships. An

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historic rock hut known as Wilson's Stone Igloo (HSM No 21) (169° 17' 48" E, 77° 31' 48" S) is located on Igloo Spur (Map 1).

6(iv) Location of other protected areas within close proximity of the Area

The nearest protected areas to Cape Crozier are on Ross Island: Lewis Bay (ASPA No 156), the site of the 1979 DC-10 passenger aircraft crash is the closest and 45km west; Tramway Ridge (ASPA No 130) near the summit of Mt. Erebus is 55km west; Discovery Hut on the Hut Point Peninsula (ASPA No 158 and HSM No 18); Arrival Heights (ASPA No 122) is 70km to the SW adjacent to McMurdo Station; Cape Royds (ASPA No 121), Backdoor Bay (ASPA No 157 and HSM No 15) and Cape Evans (ASPA No 155) are 75km west; and New College Valley (ASPA No 116) are 75km NW at Cape Bird.

7. 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 scientific research, and in particular for research on the bird fauna as well as on the vegetation assemblages in the Area, or for essential management or educational purposes;
- access to the historic sites may be permitted for scientific, management, educational or historical purposes on the condition that movement within the Area be restricted to accessing the historic sites;
- the actions permitted will not jeopardize the ecological, scientific or historic values of the Area;
- any management activities are in support of the objectives of the Management Plan;
- the actions permitted are in accordance with the Management Plan;
- the permit, or a copy, shall be carried within the Area;
- a visit report shall be supplied to the authority named in the permit;
- permits shall be issued for a stated period.

7(i) Access to and movement within the Area

Access into the Area is permitted by foot or by helicopter. Use of land vehicles within the Area is prohibited.

Aircraft may operate and land within the Area according to strict observance of the following conditions:

- All overflight of the Area for purposes other than access shall be at a height greater than 2500 ft (~750m) Above Ground Level, except when specifically permitted for scientific purposes.
- The primary designated helicopter landing site preferred for most access to the Area is located at 169° 11' 25" E, 77° 27' 42" S (elevation 240m) (Map 2). This landing site is below and 150m north-west of the Cape Crozier field hut (US) and is marked by a circle of bright orange painted rocks. An alternative, secondary, landing site is located 150m above the hut, which may also be used when necessary.
- A third designated helicopter landing site is located above and 350m north-west of Wilson's Stone Igloo (Map 1) in an area of relatively flat terrain.

- When required for scientific, educational or management purposes, landings may be made elsewhere within the Area provided this is specifically authorized by permit.
- To minimize the risks of inadvertent overflight of bird colonies, helicopter pilots accessing the Area for the first time should be accompanied by another pilot with previous experience of flying into the Area.
- Use of helicopter smoke grenades is prohibited unless absolutely necessary for safety, and all grenades should be retrieved.
- When transporting permitted visitors, pilots, air crew, or passengers en route elsewhere on helicopters are prohibited from moving on foot beyond the immediate vicinity of the designated landing site and field hut unless specifically authorized by a Permit.
- Pedestrian 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 effects.
- Permitted visitors should keep to natural penguin tracks when walking through bird colonies and should not approach occupied nests except as required for scientific or management purposes. Care should be taken to avoid trampling nests when moving through skua territories.
- Visitors should avoid walking on visible vegetation and care should be exercised walking in areas of moist ground, where foot traffic can easily damage sensitive soils, plant and algal communities and degrade water quality.

7(ii) Activities that are or may be conducted in the Area, including restrictions on time or place

Activities that may be conducted within the Area include:

- scientific research or educational visits that will not jeopardize the ecosystem of the Area;
- essential management activities, including monitoring;
- visits to historic sites for scientific, management, educational or historical reasons subject to the conditions described within this plan;
- activities with the aim of preserving or protecting the historic resources within the Area.

7(iii) Installation, modification or removal of structures

- No structures are to be erected within the Area except as specified in a permit;
- All scientific equipment installed in the Area must be authorized by permit and clearly identified by country, name of the principal investigator and year of installation. All such items should be made of materials that pose minimal risk of contamination of the Area;
- Removal of specific 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(iv) Location of field camps

Camping within the Area should be within a 100-m radius of the hut (169° 11' 14" E, 77° 27' 39" S). Camping is permitted outside of the hut vicinity where access is required to distant parts of the Area. Such camping should preferably be at sites that have been previously used, are not vegetated or occupied by breeding birds, and should be on snow or ice-covered ground if available. Researchers should consult with the appropriate national authority to obtain up-to-date information on any sites where camping may be preferred.

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7(v) *Restrictions on materials and organisms that can be brought into the Area*

- No living animals, plant material, microorganisms or soils shall be deliberately introduced into the Area, and the precautions listed below shall be taken against accidental introductions;
- To help maintain the ecological and scientific values of the Area visitors shall take special precautions against introductions. Of particular concern are microbial, invertebrate and vegetation introductions from soils at other Antarctic sites, including stations, or from regions outside Antarctica. To minimize the risk of introductions, visitors should thoroughly clean footwear and any equipment to be used in the area – particularly sampling equipment and markers – before entering the Area.
- In view of the presence of breeding bird colonies at Cape Crozier, no poultry products, including products containing uncooked dried eggs, including wastes from such products, shall be released into the Area;
- No herbicides or pesticides shall be brought into the Area;
- Any other chemicals, including radio-nuclides or stable isotopes, which may be introduced for scientific or management purposes specified in the permit, shall be removed from the Area at or before the conclusion of the activity for which the permit was granted;
- Fuel, food, and other materials are not to be stored in the Area, unless required for essential purposes connected with the activity for which the permit has been granted or are contained within an emergency cache authorized by an appropriate authority;
- All materials introduced shall be for a stated period only, shall be removed at or before the conclusion of that stated period, and shall be stored and handled so that risk of their introduction into the environment is minimized;
- If release occurs which is likely to compromise the values of the Area, removal is encouraged only where the impact of removal is not likely to be greater than that of leaving the material *in situ*.

7(vi) *Taking or harmful interference with native flora or fauna*

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

7(vii) *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, which was not brought into the Area by the permit holder or otherwise authorized, may be removed from any part of the Area, unless the impact of removal is likely to be greater than leaving the material *in situ*. If this is the case the appropriate authority should be notified.
- Unless specifically authorized by permit, visitors are prohibited from interfering with or attempting restoration of Wilson's Stone Igloo in any way, or from handling, taking or damaging any artifacts. Evidence of recent changes, damage or new artifacts observed should be notified to the appropriate national authority. Relocation or removal of artifacts for the purposes of preservation, protection, or to re-establish historical accuracy is allowable by permit.

7(viii) Disposal of waste

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

7(ix) Measures that are necessary to ensure that the aims and objectives of the Management Plan can continue to be met

- Any specific sites of long-term monitoring shall be appropriately marked.

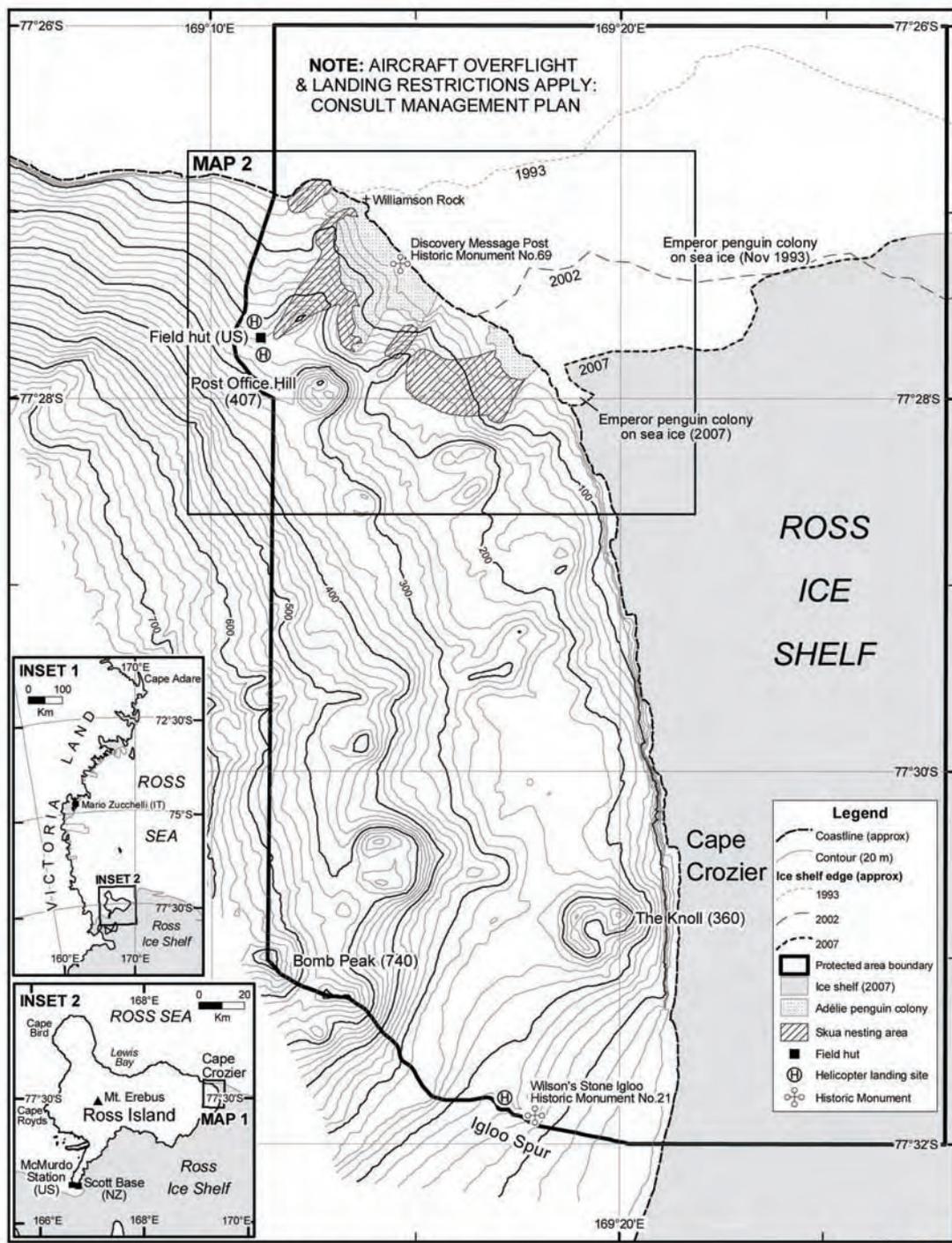
7(x) Requirements for reports

- Parties should ensure that the principal holder of each permit issued submit to the appropriate authority a report describing the activities undertaken. Such report should include, as appropriate, the information identified in the Visit Report form contained in Appendix 4 of Resolution 2 (1998)(CEP I).
- Parties should maintain a record of such activities, and, in the annual Exchange of Information, should provide summary descriptions of activities conducted by persons subject to their jurisdiction, in sufficient detail to allow evaluation of the effectiveness of the Management Plan. Parties should, wherever possible, deposit originals or copies of such original reports in a publicly accessible archive to maintain a record of usage, to be used both in any review of the Management Plan and in organizing 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.

8. Selected references

- Ainley, D.G., C.A. Ribic, G. Ballard, S. Heath, I. Gaffney, B.J. Karl, K.J. Barton, P.R. Wilson, & S. Webb. 2004. Geographic structure of Adélie penguin populations: overlap in colony-specific foraging areas *Ecological Monographs* **74**(1):159–78.
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- Barber-Meyer, S.M., G.L. Kooyman, & P.J. Ponganis. 2008. Trends in western Ross Sea emperor penguin chick abundances and their relationships to climate. *Antarctic Science* **20** (1), 3–11.
- Broady, P.A. 1989. Broadscale patterns in the distribution of aquatic and terrestrial vegetation at three ice-free regions on Ross Island, Antarctica. *Hydrobiologia* **172**: 77-95.
- Kooyman, G.L. 1993. Breeding habitats of emperor penguins in the western Ross Sea. *Antarctic Science* **5**(2): 143-48.
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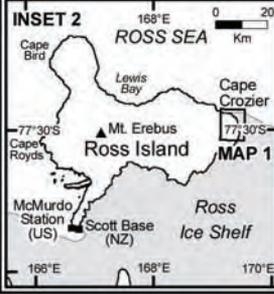
NOTE: AIRCRAFT OVERFLIGHT & LANDING RESTRICTIONS APPLY: CONSULT MANAGEMENT PLAN

MAP 2

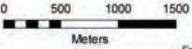
**ROSS
ICE
SHELF**

**Cape
Crozier**

- Legend**
- Coastline (approx)
 - Contour (20 m)
 - Ice shelf edge (approx)
 - 1993
 - 2002
 - 2007
 - Protected area boundary
 - Ice shelf (2007)
 - Adélie penguin colony
 - Skua nesting area
 - Field hut
 - Helicopter landing site
 - Historic Monument

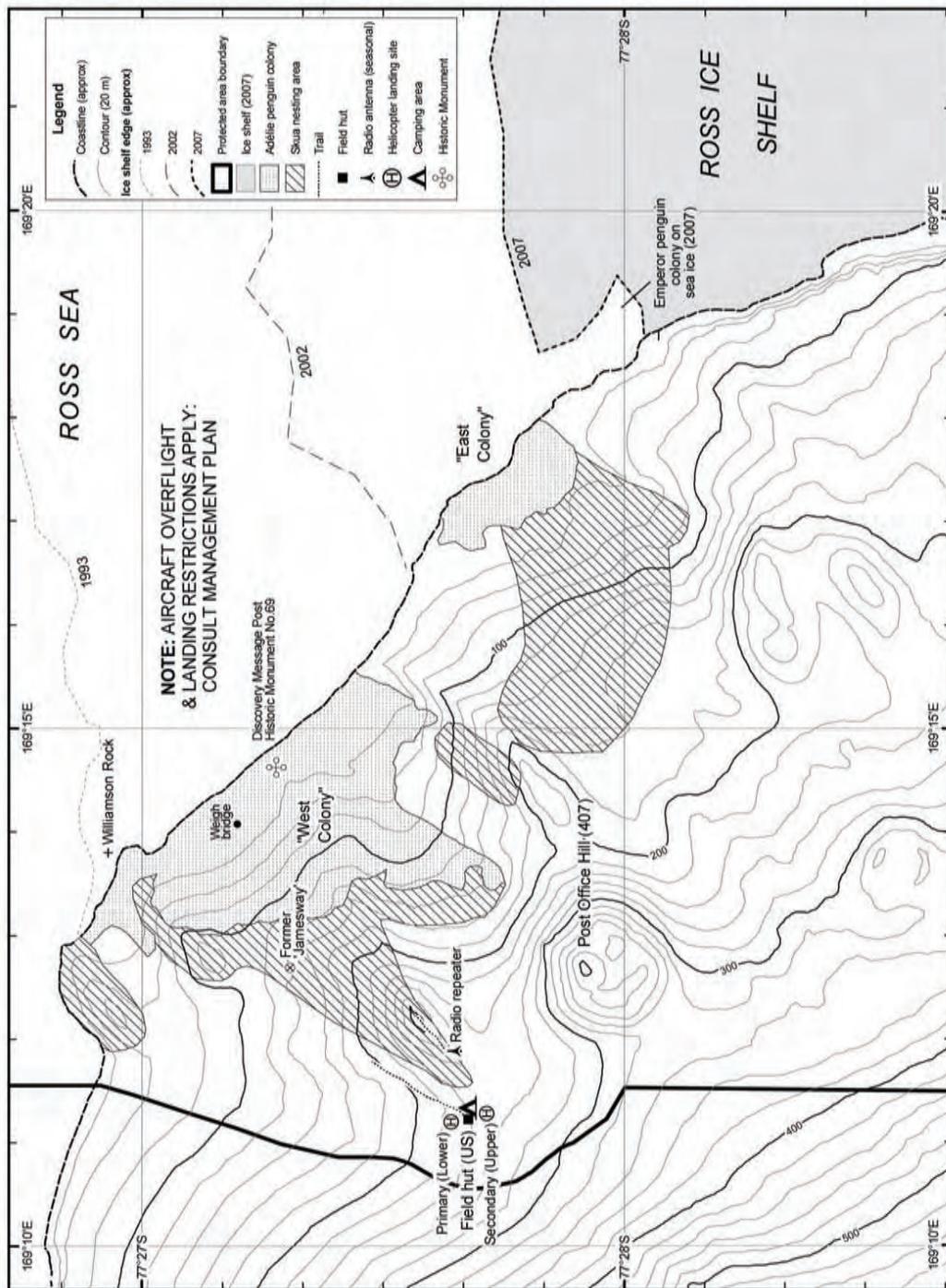


**ASPANo. 124: Cape Crozier
Map 1: Topography & boundary**



14 April 2008
United States Antarctic Program
Environmental Research & Assessment

Projection: Lambert Conformal Conic
 CM 169°15', SP1 77°27', SP2 77°32', LO 77°
 Spheroid: WGS84, Datum: McMurdo GCN 1982.
 Contour interval: 20 m; Heights in meters.
 Data sources: Coastline, contours and bird data supplied by
 Gateway Antarctica; Ice shelf estimated from satellite imagery.



ASPA No. 124: Cape Crozier
Map 2: Access, facilities, and wildlife

Source: USGS, National Geospatial Data Agency, Digital Elevation Model (DEM) 1:250,000, 30m resolution, LO 77°S, 169°10'E to 169°20'E, 77°25'S to 77°28'S. Spheroid: WGS84, Datum: NAD83, UTM Zone 18Q, Projection: UTM, Units: Meters. Contour interval: 20m. Data source: Coastline, contours and bird data supplied by Gateway Antarctica Facilities - RASC GPS survey (25 Dec 2007). Ice shelf estimated from satellite imagery.