Management Plan for Antarctic Specially Protected Area No. 169

AMANDA BAY, INGRID CHRISTENSEN COAST, PRINCESS ELIZABETH LAND, EAST ANTARCTICA

Introduction

The Amanda Bay Antarctic Specially Protected Area (ASPA) is located adjacent to Prydz Bay, on the Ingrid Christensen Coast of Princess Elizabeth Land, East Antarctica, at 69°15'S, 76°49'E (Map A). The ASPA was designated under Measure 3 (2008) following a proposal by China and Australia, primarily to protect the breeding colony of several thousand pairs of emperor penguins (*Aptenodytes forsteri*).

Only three other East Antarctic emperor penguin colonies are protected within ASPAs (ASPA 101 Taylor Glacier, ASPA 120 Point Géologie Archipelago and ASPA 167 Haswell Island). Being proximate to research stations in the Larsemann Hills and Vestfold Hills, Amanda Bay is among the most accessible emperor penguin colonies in East Antarctica. Its location facilitates the collection of valuable long-term population monitoring data and comparative studies with other East Antarctic emperor penguin colonies. Although advantageous for research purposes, Amanda Bay's proximity to research stations increases the potential for human disturbance of the emperor penguin colony.

Amanda Bay and its resident emperor penguin colony were discovered on 30 November 1956 during an aerial survey by expeditioners from the former Soviet Union. On 26 August 1957 an Australian surveying party observed an astro fix at the Larsemann Hills. During the return flight to Davis, the area was photographed and named Amanda Bay after the newly-born daughter of the pilot, RAAF Squadron Leader Peter Clemence. Since 1957 the colony has been visited by researchers from Australia, China, Russia and the former Soviet Union (see Appendix 1). A small number of tourist operators have also made visits.

1. Description of values to be protected

The Area is primarily designated to protect the breeding colony of emperor penguins. The colony possesses intrinsic and scientific values. The collection of long-term population monitoring data in the Area is valuable for comparative studies with other emperor penguin colonies in East Antarctica.

During winter, the emperor penguin colony is located on the fast ice in the south-west corner of Amanda Bay. As the breeding season progresses, the various parts of the colony move away from the wintering ground and cover most of the southern section of the ASPA. The colony comprises up to 11 000 pairs, however the number of birds attending the colony is highly variable (Wienecke and Pedersen 2009).

Emperor penguins live all year in Antarctic waters and have a circumpolar breeding distribution. There are currently 46 known breeding colonies (Fretwell *et al*. 2012). Many of these colonies have not been systematically counted.

The first estimate of the global population of emperor penguins drew upon satellite imagery and indicated that there may be some 238 000 breeding pairs (Fretwell *et al*. 2012).

Emperor penguin colonies are typically located on winter fast ice in areas where this ice forms early in the year and remains stable until early summer. Only two are located on land – one near Taylor Glacier, Mac.Robertson Land (ASPA 101, 67°28'S, 60°53'E) and one in the area of Richardson Lakes near Amundsen Bay in Enderby Land (66°45'S, 50°38'E). A small colony (less than 200 breeding pairs) existed on Dion Island in Marguerite Bay on the western Antarctic Peninsula (ASPA 107, 67°52'S, 68°43'W) but this is now deemed to be extinct (Trathan *et al.* 2011).

The Amanda Bay area also supports breeding colonies of other seabird species and is a haul-out area for Weddell seals.

2. Aims and objectives

Management at Amanda Bay aims to:

- avoid degradation of, or substantial risk to, the emperor penguin colony by preventing/minimising unnecessary human disturbance;
- provide for ongoing research and monitoring of the emperor penguin colony, and other compelling scientific activities which cannot be undertaken elsewhere;
- gather survey data on the population status of the emperor penguin colony on a regular basis; and
- minimise the possibility of the introduction of pathogens which may cause disease in fauna populations within the Area.

3. Management activities

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

- information about the Area including its boundaries and the special restrictions that apply within it, plus copies of this management plan, shall be made available at research and field stations in the Vestfold Hills and Larsemann Hills, and to ships that visit the vicinity;
- pilots operating in the region shall be informed of the location, boundaries and restrictions applying to entry and over-flight in the Area;
- national program personnel undertaking activities in the vicinity of, accessing or flying over the Area, shall be specifically instructed by their national program as to the provisions and contents of the management plan;
- visits shall be made to the Area as necessary (where practicable, not less than once every five years) to assess whether the Area continues to serve the purposes for which it was designated and to ensure that management activities are adequate;
- the management plan shall be reviewed at least every five years and updated as required; and
- national Antarctic programs operating in the Area shall consult with a view to ensuring the above management activities are implemented.

4. Period of designation

Designated for an indefinite period.

5. Maps

- Map A: Amanda Bay Antarctic Specially Protected Area, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica. Location Amanda Bay on Ingrid Christensen Coast. Map Specifications: Projection: Lambert Conical Conformal; Horizontal Datum: WGS84; Vertical Datum: Mean Sea Level.
- Map B: Amanda Bay Antarctic Specially Protected Area, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica. Location of Emperor Penguin Colony and Physical Features. Map Specifications: Horizontal Datum: WGS84; Vertical Datum: Mean Sea Level.

6. Description of the Area

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

General description

Amanda Bay (69°15'S, 76°49'E) lies south-west of the Brattstrand Cliffs, between the Vestfold Hills to the north-east and the Larsemann Hills to the south-west, on the Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica (see Map A). Amanda Bay is approximately 3 km wide and 6 km long and opens north-west into Prydz Bay. It is flanked by the Flatnes Ice Tongue and the Hovde Glacier on its south-west and south-east side respectively. Its southern side is bounded by continental ice cliffs and rock outcrops. There are small islets in the south-western section and several un-named islands a few kilometres offshore.

The ASPA comprises the rocks, islands and water (including fast ice) commencing at a point to the north-east of Hovde Island at the terminus of the Hovde Glacier, 76°53'54.48"E, 69°13'25.77"S; then south along the coastline at the base of the Hovde Glacier ice cliffs, to a point at 76°53'44.17"E, 69°16'22.72"S; then west along the coastline at the base of a series of ice-free bluffs to a point 76°49'37.47"E, 69°16'58'48"S; then north along the base of the Flatnes Ice Tongue ice cliffs, to a point at the terminus of the Flatnes Ice Tongue, 76°46'41.07'E, 69°14'44.37"S; then a straight line in a north-easterly direction connecting with the originating point at 76°53'54.48"E, 69°13'25.77"S (Map B).

Emperor penguins

During winter the emperor penguin colony is located on the fast ice in the south-west corner of Amanda Bay. Throughout the breeding season and especially once the chicks are mobile, various small groups form to the north, south and west of the wintering area. The islands are also occupied during spring and summer. Strong circular currents in Prydz Bay render the sea ice unstable for most of the year, thus providing the emperor penguins with good access to open water for feeding. The colony has occupied a number of sites within Amanda Bay since its discovery in 1957.

Other biota

South polar skuas (*Catharacta maccormicki*) and Wilson's storm petrels (*Oceanites oceanicus*) are known to breed on the islands of Amanda Bay, however the size of their breeding populations are currently unknown. More than 20 juvenile south polar skuas also occupy these islands in summer. Adélie penguins (*Pygoscelis adeliae*) frequently visit the Area and use these islands during their annual moult. Dozens of Weddell seals (*Leptonychotes weddelli*) regularly haul out in the Area, particularly in the southern area where the sea ice remains for most of the summer.

Climate

Amanda Bay is almost completely filled by fast ice (even during summer months) making it an important and rare habitat for both emperor penguins and Weddell seals.

Limited meteorological data exists for the immediate region. The nearest areas with a substantial record of meteorological data are the Vestfold Hills (Davis station), 75 km to the north-east, and the Larsemann Hills (Zhongshan, Progress and Bharati stations), 22 km to the south-west.

The prevailing wind within Amanda Bay appears to be highly variable but comes mainly from the east-south-east. The prevailing winds at Davis are northeast to east and of moderate strength. The mean annual wind speed is 18 km/hr. On average the windiest month is November and the least windy month is April. In the Larsemann Hills, violent southerly winds are often encountered. Persistent and strong katabatic winds also blow off the plateau from the northeast on most summer days.

From December to February daytime air temperatures in the Larsemann Hills frequently exceed 4°C and can exceed 10°C, and the mean monthly temperature is a little above 0°C. Mean monthly winter temperatures are between 15°C and -18°C. Precipitation occurs as snow and is unlikely to exceed 250 mm water equivalent annually. Davis experiences a mean monthly temperature range from +1°C in January to -18°C in July. Snowfall is very light and most snow accumulation is the result of drift snow blown from the plateau between March and October.

Geology

Rock outcrops in southern Prydz Bay – the Svenner Islands, the Brattstrand Cliffs, Amanda Bay, the Larsemann Hills, Bolingen Islands, Søstrene Island, the Munro Kerr Mountains and Landing Bluff – consist of interleaved paragneiss and orthogneiss with high temperature mineral assemblages and structures about 500 Ma in age (Pan African). The paragneiss preserves no conclusive evidence of earlier metamorphism, however the orthogneiss has local relics of high-grade metamorphism at 1000 Ma. The Pan-African event involved crustal thickening and burial of the paragneiss followed by exhumation. There are also a number of igneous intrusions that post-date peak metamorphism, including granitoid plutons and widespread pegmatic dykes which cross-cut the gneiss and plutons. One such granitoid pluton is found at Amanda Bay. This is K-feldspar rich and post-dates early foliations in the country gneiss. The pluton exhibits a biotite foliation, contains garnet, spinel and apatite and is thought to be syntectonic, intruded during the later stages of metamorphism.

6(ii) Access to the Area

The Area may be accessed via helicopter or ground vehicle in accordance with the conditions presented in section 7(ii) of this plan.

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

Two automated cameras are temporarily located on the large island in the south eastern corner of Amanda Bay – for the purposes of monitoring the colony and ice conditions.

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

The Larsemann Hills, Antarctic Specially Managed Area No 6 is located approximately 22 km to the south-west (69°30’S 76°19’58"E) of Amanda Bay. The other closest protected areas are Marine Plain, ASPA No 143 (68°36’S, 78°07’E) and Hawker Island, ASPA No 167 (68°35’S, 77°50’E), approximately 75 km north-east in the Vestfold Hills.

6(v) Special zones within the Area

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:

- the permit is issued only for compelling scientific reasons that cannot be served elsewhere, in particular for the scientific study of the avifauna and ecosystem of the Area, or for essential management purposes consistent with the objectives of this management plan, such as inspection, management or review;
- the actions permitted will not jeopardise the values of the Area or other permitted activities;
- the actions permitted are in accordance with this Management Plan;
- the permit, or an authorised copy, shall be carried within the Area;
- a visit report will be supplied to the authority that approved the permit, as soon as practicable after the visit to the ASPA has been completed, but no later than six months after the visit has occurred;
- permits shall be issued for a finite period;
- permit holders shall notify the appropriate authority of any activities or measures undertaken that were not authorised by the permit; and
- all census and GPS data shall be made available to the permitting authority and to the Parties responsible for the development of the management plan.

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

Disturbance of the colony should be minimised at all times noting that environmental conditions and the location of the colony vary between and during seasons.

The coastline is partially comprised of a very large ice wall. This ice wall prevents direct land access from the west, south and east.

There are no marked pedestrian routes within the Area. Unless disturbance is authorised by a permit, pedestrians should keep at least 50 m from any penguin or concentrations of penguins.

Vehicle access should be overland from the south or from sea ice to the north, avoiding crossing between the colony and the sea. Vehicles should be kept at least 500 m from any penguin or concentrations of penguins.

As the emperor penguin colony does not remain in one fixed location it is not possible to designate helicopter landing sites and flight paths that will prevent disturbance at all times. Appropriate flight paths and a viable landing site (VLS) need to be assessed on a visit-by-visit basis, and caution exercised in accordance with the provisions of this management plan. When approaching and departing a VLS, the topography should be used to shield concentrations of penguins from direct noise.

The following conditions apply to the use of aircraft:

- aircraft shall not be operated over the Area between 01 May and 01 October each year;
- fixed wing aircraft shall not be landed in the Area;
- aircraft shall not be refuelled within the Area;
- helicopters may only land at a VLS, identified on each visit by making an initial assessment flight around the outer perimeter of the Area to determine penguin distribution and concentrations in relation to the topography;
- for twin-engine helicopters, the VLS must be located at least 1000 m from concentrations of penguins;
- for single-engine helicopters, the VLS must be a distance of 1000 m from concentrations of penguins, or where the topography (icebergs, islands etc) will shield concentrations of penguins from direct noise. (Note: A VLS *may* be present on the inner side of the eastern coastal edge of the large island in the south east corner of Amanda Bay at 69°16’21.2”S, 76°50”52.6”E).

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

The following activities may be conducted in the Area:

- compelling scientific research, which cannot be undertaken elsewhere and which will not jeopardise the avifauna or the ecosystem of the Area;
- essential management activities, including monitoring; and
- sampling, which should be the minimum required for the approved research programs.

As the emperor penguins are particularly sensitive to disturbance during the following periods:

- from mid-May to late July when they are incubating eggs;
- from late July to late September when adults are brooding chicks;
- from late November to late December when the chicks moult and fledge; and
- in late summer during the adults’ moult

visitors should exercise particular care not to unduly disturb or interfere with the emperor penguins during these periods.

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

Permanent structures and installations are prohibited in the Area. Temporary structures and installations may only be established in the Area for compelling scientific or management reasons as specified in a permit.

Any temporary structure established in the Area must be:

- clearly identified by country, name of the principal agency, date of installation and date of expected removal;
- first cleaned of organisms, propagules (e.g. seeds, eggs) and non-sterile soil;
- made of materials that can withstand Antarctic conditions and pose minimal contamination risk to the Area; and
- removed when they are no longer required, or before the expiry of the permit, whichever is earlier.

7(v) Location of field camps

Camping may only be undertaken within the Area if:

- it facilitates compelling scientific research or management operations;
- it is temporary only; and
- every effort is made to locate and keep the camp at least 500 m from penguin concentrations.

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

The following restrictions apply:

- no poultry products, including dried food containing egg powder, are to be taken into the Area;
- no depots of food or other supplies are to be left within the Area beyond the time period for which they are required;
- no living animals, plant materials, microorganisms or non-sterile soils are to be deliberately introduced into the Area. Precautions must be taken to prevent the accidental introduction of living animals, plant materials, microorganisms or non-sterile soils into the Area;
- no herbicides or pesticides are to be taken into the Area. Any other chemicals (including radionuclides or stable isotopes which may be introduced for scientific or management purposes specified in a permit) will be removed from the Area at or before the conclusion of the activity for which the permit was granted;
- fuel must not to be stored in the Area unless it is required for essential purposes connected with the activity for which the permit has been granted. All such fuel must be removed from the Area at or before the conclusion of the permitted activity. Permanent or semi-permanent fuel depots are not permitted; and
- all material introduced to the Area shall be for a stated time period only and if left unattended, labelled with a country identifier. All material introduced to the Area will be removed at or before the conclusion of that stated time period, and will be stored and handled in a manner that will minimise the risk of environment impacts.

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

Taking of or harmful interference with native flora and fauna is prohibited except in accordance with a permit. Where taking or harmful interference with animals is involved this should, as a minimum standard, be in accordance with the *SCAR Code of Conduct for the Use of Animals for Scientific Purposes in Antarctica.*

Ornithological research on the breeding birds present within the Area shall be limited to activities that are non-invasive and non-disruptive. If the capture of individuals is required, capture should occur outside the Area if at all possible to reduce disturbance to the colony.

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

Material may only be collected or removed from the Area in accordance with a permit and should be limited to the minimum quantity necessary to meet scientific or management needs.

Material of human origin likely to compromise the values of the Area, and which was not brought into the Area by the permit holder or otherwise authorised, may be removed unless the impact of the removal is likely to be greater than leaving the material *in situ*. If this is the case, the appropriate national authority must be notified and approval obtained.

7(ix) Disposal of waste

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

7(x) Measures that may be necessary to ensure that the aims and objectives of the management plan can continue to be met

Permits may be granted to allow biological monitoring and Area management and inspection activities which may involve:

- the collection of samples for analysis or review;
- the establishment or maintenance of scientific equipment, structures and signposts; and
- other protective measures.

Any specific sites of long-term monitoring shall be appropriately marked and GPS coordinates obtained for lodgement with the Antarctic Data Directory System through the appropriate national authority.

Ornithological research shall be limited to activities that, where practicable, are non-invasive and non-disruptive to the breeding birds present within the Area. Invasive and/or disruptive research activities shall only be authorised if they will have no effect or only a temporary and transient effect on the population.

Visitors shall take special precautions against the introduction of alien organisms into the Area. Of particular concern are pathogenic, microbial or vegetation introductions sourced from soils, flora or fauna at other Antarctic sites (including research stations). To minimise the risk of introductions, before entering the Area all visitors shall thoroughly clean their footwear, sampling equipment, markers etc.

7(xi) Requirements for reports

Parties shall ensure that the principal permit holder for each permit issued submits, to the appropriate national authority, a report on activities undertaken.

Such reports shall include, as appropriate, the information identified in the visit report form contained in Appendix 4 of the *Guide to the Preparation of Management Plans for Antarctic Specially Protected Areas* appended to Resolution 2 (1998).

Parties shall maintain a record of such activities.

In the Annual Exchange of Information, Parties shall provide summary descriptions of activities conducted by persons subject to their jurisdiction, in sufficient detail to allow an evaluation of the effectiveness of the management plan.

Parties shall, wherever possible, deposit original reports or copies of such in a publicly accessible archive to maintain a record of usage for the benefit of a review of the management plan and the organisation of science in the Area.

A copy of the report shall be forwarded to the Party responsible for the development of the management plan.

Additionally, visit reports shall provide detailed information on census data, locations of any new colonies or nests not previously recorded, a brief summary of research findings, and copies of photographs taken in the Area.

8. Supporting documentation

Some or all of the data used within this paper were obtained from the Australian Antarctic Data Centre (IDN Node AMD/AU), a part of the Australian Antarctic Division (Commonwealth of Australia).

Budd, G.M. (1961). The biotopes of emperor penguin rookeries. *Emu* 61:171-189.

Budd, G.M. (1962). Population studies in rookeries of the emperor penguin *Aptenodytes forsteri*. *Proceedings of the Zoological Society, London* 139:365-388.

Cracknell, G.S. (1986). Population counts and observations at the emperor penguin *Aptenodytes forsteri* colony at Amanda Bay, Antarctica. *Emu* 86(2):113-117.

Crohn, P.W. (1959). A contribution to the geology and glaciology of the western part of the Australian Antarctic Territory. *Bulletin of the Bureau of Mineral Resources, Geology and Geophysics Australia* No 32.

Easther, R. (1986). Winter journey to the Amanda Bay emperor penguin rookery. *ANARE News* September 1986. P. 14.

Fitzsimons, I. (1988). Amanda Bay region geology studies fill important information gap. *ANARE News*, March 1988. P. 5.

Fitzsimons, I. (1997). The Brattstrand Paragneiss and the Søstrene Orthogneiss: A Review of Pan-African Metamorphism and Grevillian Relics in Southern Prydz Bay. In *The Antarctic Region: Geological Processes*. Pp. 121-130.

Fretwell, P.T., LaRue, M. A., Morin, P., Kooyman, G.L., Wienecke, B., Ratcliffe, N., Fox, A.J., Fleming, A.H.

Porter, C. and Trathan, P. (2012). An emperor penguin population estimate: the first global, synoptic survey of a species from space. *PLoS ONE* 7(4): e33751. doi:10.1371/journal.pone.0033751

Gales, N.J., Klages, N.T.W., Williams, R. and Woehler, E.J. (1990). The diet of the emperor penguin, *Aptenodytes forsteri*, in Amanda Bay, Princess Elizabeth Land, Antarctica. *Antarctic Science* 2(1):23-28.

Giese, M. and Riddle, M. (1999). Disturbance of emperor penguin *Aptenodytes forsteri* chicks by helicopters. *Polar Biology* 22(6):366-371.

Horne, R.S.C. (1983). The distribution of penguin breeding colonies on the Australian Antarctic Territory, Heard Island, the McDonald Islands and Macquarie Island. *ANARE Research Notes* No 9.

Johnstone, G.W., Lugg, D.J. and Brown, D.A. (1973). The biology of the Vestfold Hills, Antarctica. Melbourne. Department of Science, Antarctic Division, *ANARE Scientific Reports, Series B (1) Zoology* No 123.

Kirkwood, R. and Robertson, G. (1997). Seasonal change in the foraging ecology of emperor penguins on the Mawson Coast, Antarctica. *Marine Ecology Progress Series* 156:205-223.

Kirkwood, R. and Robertson, G. (1997). The energy assimilation efficiency of emperor penguins, *Aptenodytes forsteri*, fed a diet of Antarctic krill, *Euphausia superba*. *Physiological Zoology* 70:27-32.

Kirkwood, R. and Robertson, G. (1997). The foraging ecology of female emperor penguins in winter. *Ecological Monographs* 67:155-176.

Kirkwood, R. and Robertson, G. (1999). The occurrence and purpose of huddling by Emperor penguins during foraging trips. *Emu* 99:40-45.

Korotkevich, E.S. (1964). Observations on birds during the first wintering of the Soviet Antarctic Expedition in 1956-1957. *Soviet Antarctic Expedition Information Bulletin*, Elsevier Publishing Company, Amsterdam. Pp. 149-152.

Lewis, D. (1984). Icebound in Antarctica. *National Geographic* 166(5):634-663.

Lewis, D. (1987). *Icebound in Antarctica.* William Heinemann Australia, Richmond, Victoria.

Lewis, D. and George, M., eds. (1984). The Initial Reports of the Mawson Anniversary and Frozen Sea Expeditions, nos. 4 and 11. *Oceanic Research Foundation Occasional Publication* 1.

Robertson, G. (1990). Huddles. *Australian Geographic* 20:76-94.

Robertson, G. (1992). Population size and breeding success of Emperor penguins *Aptenodytes forsteri* at the Auster and Amanda Glacier Colonies, Mawson Coast, Antarctica. *Emu* 92:62-71.

Robertson, G. and Newgrain, K. (1992). Efficacy of the tritiated water and 22Na turnover methods in estimating food and energy intake by Emperor penguins *Aptenodytes forsteri*. *Physiological Zoology*. 65:933-951.

Robertson, G. (1994). *The Foraging Ecology of Emperor Penguins* (Aptenodytes forsteri) *at two Mawson Coast Colonies, Antarctica*. PhD Thesis, University of Tasmania.

Robertson, G., Williams, R., Green, K. and Robertson, L. (1994). Diet composition of Emperor penguin chicks *Aptenodytes forsteri* at two Mawson Coast colonies, Antarctica. *Ibis* 136:19-31.

Robertson, G. (1995). The foraging ecology of Emperor penguins *Aptenodytes forsteri* at two Mawson Coast colonies, Antarctica. *ANARE Reports* No 138.

Schwerdtfeger, W. (1970). The climate of the Antarctic. In: Orvig, S. (Ed). *Climates of the Polar Regions.* Pp. 253-355.

Schwerdtfeger, W. (1984). Weather and climate of the Antarctic. In: Orvig, S. (Ed). *Climates of the Polar Regions.* P. 261.

Todd, F.S., Splettstosser, J.F., Ledingham, R. and Gavrilo, M. (1999). Observations in some emperor penguin *Aptenodytes forsteri* colonies in East Antarctica. *Emu* 99:142-145.

Trathan, P.N., Fretwell, P.T. and Stonehouse, B. (2011). First recorded loss of an emperor penguin colony in the recent period of Antarctic regional warming: implications for other colonies. *PLoS ONE* 6(2): e14738. doi:10.1371/journal.pone.0014738.

Wienecke, B.C. and Pedersen, P. (2009). Population estimates of emperor penguins at Amanda Bay, Ingrid Christensen Coast, Antarctica. *Polar Record* 45:207-214.

Wienecke, B., Kirkwood, R. and Robertson, G. (2004). Pre-moult foraging trips and moult locations of Emperor penguins at the Mawson Coast. *Polar Biology* 27:83-91.

Wienecke, B.C. and Robertson, G. (1997). Foraging space of emperor penguins *Aptenodytes forsteri* in Antarctic shelf waters in winter. *Marine Ecology Progress* Series 159:249-263.

Willing, R.L. (1958). Feeding habits of emperor penguins. *Nature* 182:194-195.

Willing, R.L. (1958). Australian discoveries of emperor penguin rookeries in Antarctica during 1954-57. *Nature*, London 182:1393-1394.

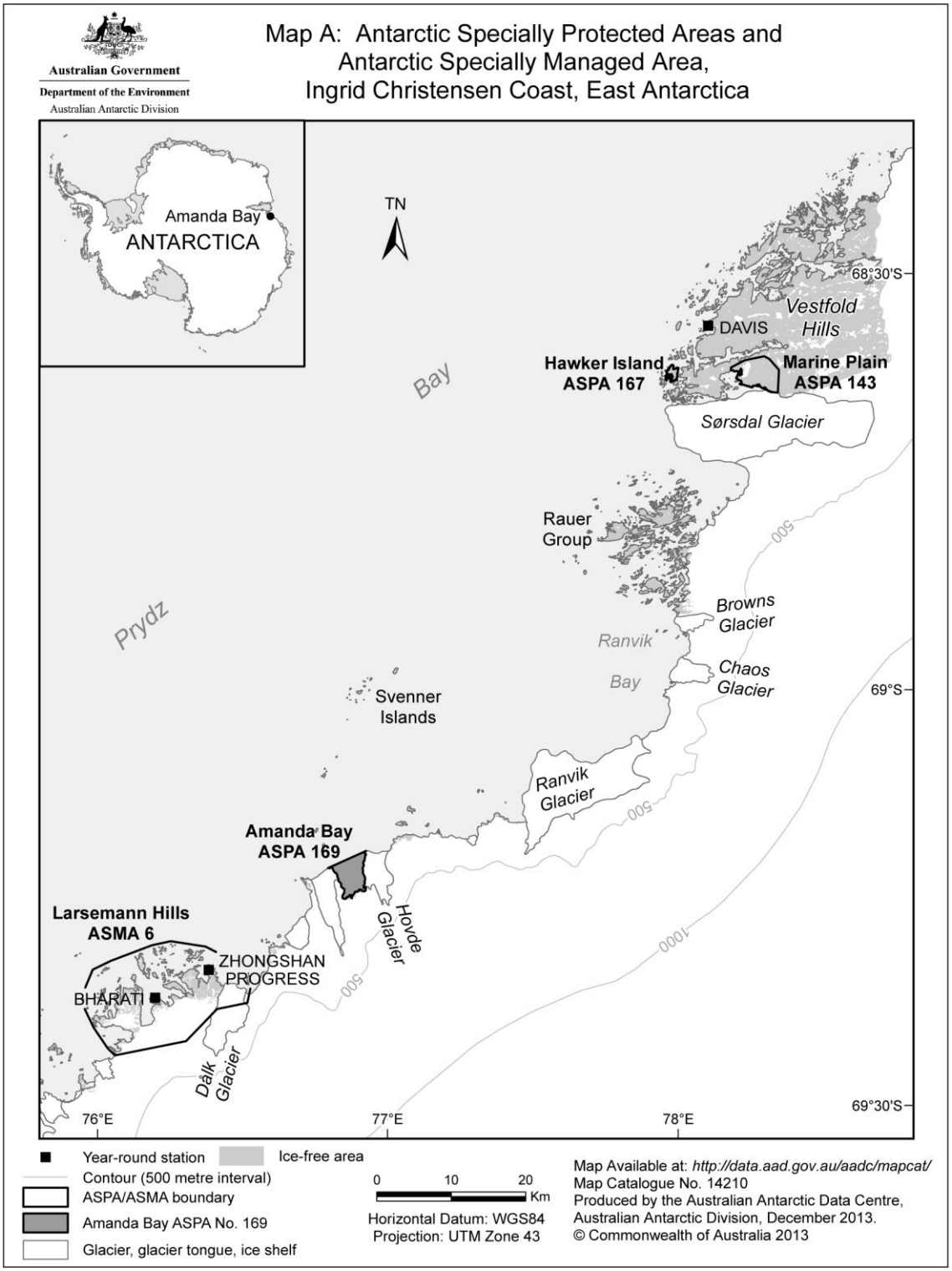
Woehler, E.J. [compiler], Poncet, S. and International Council of Scientific Unions. Scientific Committee on Antarctic Research. Bird Biology Subcommittee, Scott Polar Research Institute. (1993). *The distribution and abundance of Antarctic and subantarctic penguins.* Scientific Committee on Antarctic Research (SCAR), Cambridge.

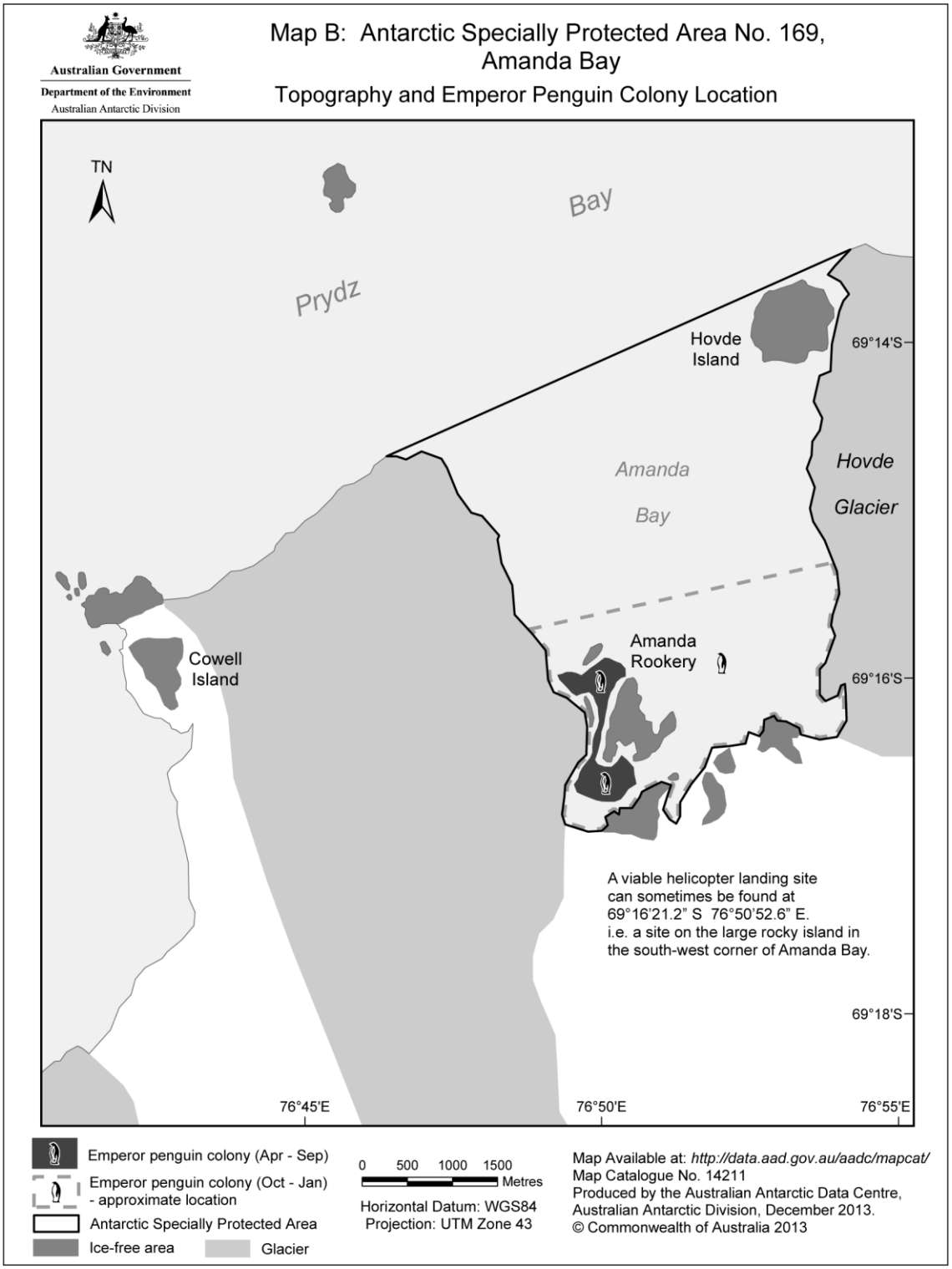
Woehler, E.J. *et. al*. and International Council of Scientific Unions. Scientific Committee on Antarctic Research, Bird Biology Subcommittee, Commission for the Conservation of Antarctic Marine Living Resources, National Science Foundation [U.S.]. (2001). *A statistical assessment of the status and trends of Antarctic and sub-Antarctic seabirds.* Scientific Committee on Antarctic Research (SCAR).

Woehler, E.J. and Johnstone, G.W. (1991). Status and conservation of the seabirds of the Australian Antarctic Territory Islands. In: *Seabird - status and conservation: a supplement*. International Council for Bird Preservation, Cambridge. Pp. 279-297.

Appendix 1. History of emperor penguin population observations at Amanda Bay 1956-1997

Date	**Estimated number of penguins present in colony**	**Comments**	**Reference**
1956/57	5000 birds along Ingrid Christensen Coast	General reference, no systematic census	Korotkevich (1964)
September 1957	1000-2000 birds	No systematic count, no distinction between adults and chicks	Willing (1958)
1961	1500 adults	Unspecified reference, no date given, no systematic count conducted	ANARE in Horne (1983)
29-30 September 1983	2339 ± 69 chicks, 2448 ± 23 adults	Adults: en masse count after Budd (1961), chicks: combined en masse count group I and indirect count of group II (see Budd 1961)	Cracknell (1986)
1987	9000?	Unspecified reference, no date, no specification of unit, no systematic census	ANARE in Woehler and Johnstone (1991)
13 December 1992	5500 – 6000 chicks	Chicks in five groups, estimate based on grid counts	Todd (1999)
21 December 1996	1000 – 5000 total birds	Rough estimate from over flight	Todd (1999)
November 1997	8000 chicks	No systematic count, rough estimate	J. Gallagher, pers. comm., in Giese and Riddle (1999)


Map A: Antarctic Specially Protected Areas and
Antarctic Specially Managed Area,
Ingrid Christensen Coast, East Antarctica
Australian Government
Department of the Environment
Australian Antarctic Division
Amanda Bay
ANTARCTICA
TN
68°30'S
Vestfold
Hills
DAVIS
Hawker Island
ASPA 167
Marine Plain
ASPA 143
Bay
Sørsdal Glacier
Rauer
Group
500
Prydz
Browns
Glacier
Ranvik
Bay
Chaos
Glacier
69°S
Svenner
Islands
Ranvik
Glacier
500
Amanda Bay
ASPA 169
Larsemann Hills
ASMA 6
Hovde
Glacier
ZHONGSHAN
PROGRESS
BHARATI
500
1000
Dålk
Glacier
69°30'S
76°E
77°E
78°E
Year-round station
Ice-free area
Contour (500 metre interval)
ASPA/ASMA boundary
Amanda Bay ASPA No. 169
Glacier, glacier tongue, ice shelf
0
10
20
Km
Horizontal Datum: WGS84
Projection: UTM Zone 43
Map Available at: http://data.aad.gov.au/aadc/mapcat/
Map Catalogue No. 14210
Produced by the Australian Antarctic Data Centre,
Australian Antarctic Division, December 2013.
© Commonwealth of Australia 2013


Australian Government
Department of the Environment
Australian Antarctic Division
Map B: Antarctic Specially Protected Area No. 169, Amanda Bay
Topography and Emperor Penguin Colony Location
TN
Bay
Prydz
Hovde Island
69°14'S
Amanda Bay
Hovde Glacier
Cowell Island
Amanda Rookery
69°16'S
A viable helicopter landing site can sometimes be found at 69°16'21.2" S 76°50'52.6" E. i.e. a site on the large rocky island in the south-west corner of Amanda Bay.
69°18'S
76°45'E
76°50'E
76°55'E
Emperor penguin colony (Apr - Sep)
Emperor penguin colony (Oct - Jan) - approximate location
Antarctic Specially Protected Area
Ice-free area
Glacier
0 500 1000 1500
Metres
Horizontal Datum: WGS84
Projection: UTM Zone 43
Map Available at: http://data.aad.gov.au/aadc/mapcat/
Map Catalogue No. 14211
Produced by the Australian Antarctic Data Centre, Australian Antarctic Division, December 2013.
© Commonwealth of Australia 2013