TABLE II *Continued*

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
B. Frugivores and Insectivores												
White-cheeked Honeyeater *Phylidonyris nigra*			X			X	X	X	X	X		
Brown-backed Honeyeater *Ramsayornis modestus*	X									X	X	X
Rufous-throated Honeyeater *Conopophila rufogularis*	X	X	X				X				X	X
Eastern Spinebill *Acanthorhynchus tenuirostris*											X	
Scarlet Honeyeater *Myzomela sanguinolenta*							X	X		X	X	
Yellow-bellied Sunbird *Nectarinia jugularis*	X	X		X				X	X	X	X	X
Spotted Pardalote *Pardalotus punctatus*							X		X		X	
Red-browed Paradalote *P. rubricatus*							X	X	X			
Yellow White-eye *Zosterops lutea*	X	X	X									
Silvereye *Z. lateralis*	X	X	X	X		X	X	X	X	X	X	X
House Sparrow *Passer domesticus*	X								X	X	X	X
Metallic Starling *Aplonis metallica*	X	X						X	X	X	X	X
Yellow Oriole *Oriolus flavocinctus*	X									X	X	X
Figbird *Sphecotheres viridis*	X	X								X	X	X
Great Bowerbird *Chlamydera nuchalis*	X	X								X	X	X
Tooth-billed Catbird *Ailuroedus dentirostris*											X	X
Victoria's Riflebird *Ptiloris victoriae*									X		X	
Australian Magpie-Lark *Grallina cyanoleuca*	X	X	X		X		X	X	X	X	X	X
White-breasted Woodswallow *Artamus leucorhynchus*	X				X					X	X	X
Dusky Woodswallow *A. cyanopterus*	X										X	
Black Butcherbird *Cracticus quoyi*	X									X	X	X
Pied Butcherbird *C. nigrogularis*									X	X	X	X
Pied Currawong *Strepera graculina*									X	X		
Australian Raven *Corvus coronoides*								X				
Torresian Crow *C. orru*	X	X	X	X	X						X	X
Raptors												
Black-shouldered Kite *Elanus notatus*		X		X	X	X	X			X		X
Pacific Baza *Aviceda subcristata*			X					X			X	X
Whistling Kite *Haliastur sphenurus*	X			X		X	X	X	X	X	X	X
Brown Goshawk *Accipiter fasciatus*									X	X		
Grey Goshawk *A. novaehollandiae*									X	X		
White-bellied Sea-eagle *Haliaeetus leucogaster*					X	X	X	X				
Peregrine Falcon *Falco peregrinus*					X	X		X	X			
Rufous Owl *Ninox rufa*							X					
Barking Owl *N. connivens*								X				
Barn Owl *Tyto alba*				X	X	X	X	X				
Eastern Grass Owl *T. longimembris*				X								

H.J. LAVERY, *Queensland National Parks and Wildlife Service, P.O. Box 190, Brisbane North Quay, Qld 4000.*

Received 7 June 1974; accepted 28 August 1985

POPULATION COUNTS AND OBSERVATIONS AT THE EMPEROR PENGUIN *APTENODYTES FORSTERI* COLONY AT AMANDA BAY, ANTARCTICA

INTRODUCTION

There are six Emperor Penguin *Aptenodoytes forsteri* colonies in the Australian Antarctic Territory: Kloa Point (66°38′S, 57°19′E), Fold Island (67°20′S, 59°23′E), Taylor Glacier (67°28′S, 60°53′E) and Auster (67°23′S, 64°02′E), which have been described by Budd (1961, 1962) and Cameron (1969), and Cape Darnley (67°50′S, 69°45′E) and Amanda Bay (69°17′S, 76°46′E) (brief summaries in Budd [1961] and Johnstone *et al.* [1973]).

Among the few published observations of Emperor Penguin colonies in winter are those of the colony at Pointe Géologie, Terre Adélie (66°40′S, 140°01′E), which has been documented in detail over a period of years (Prévost 1959; Jouventin 1971; Mougin 1966), and

0158-4187/86/02113+4 $2.00

the colonies at Dion Islands (67°52′S, 68°43′W) (Stonehouse 1953), at Haswell Island (66°32′S, 93°02′E) (Pryor 1968) and at Cape Crozier (77°27′S, 169°34′E) (Wilson 1907; Caughley 1960; Todd 1980), which have been documented at intervals.

The Emperor Penguin colony at Amanda Bay was viewed from the air on three occasions in 1956–57 (Korotkevich 1964; Willing 1958), once in 1960 (Budd 1961) and was visited in December 1981 (G.W. Johnstone pers. comm.). Estimates of the colony population, which range between 1000 and 5000 birds, were made on these occasions. The only previously recorded ground count was made on a one day visit on 21 May 1960 (Johnstone *et al.* 1973). The Frozen Sea Expedition spent seven days at the colony, 27 September to 3 October and 18 October 1983, and made additional observations on sea ice offshore from the colony.

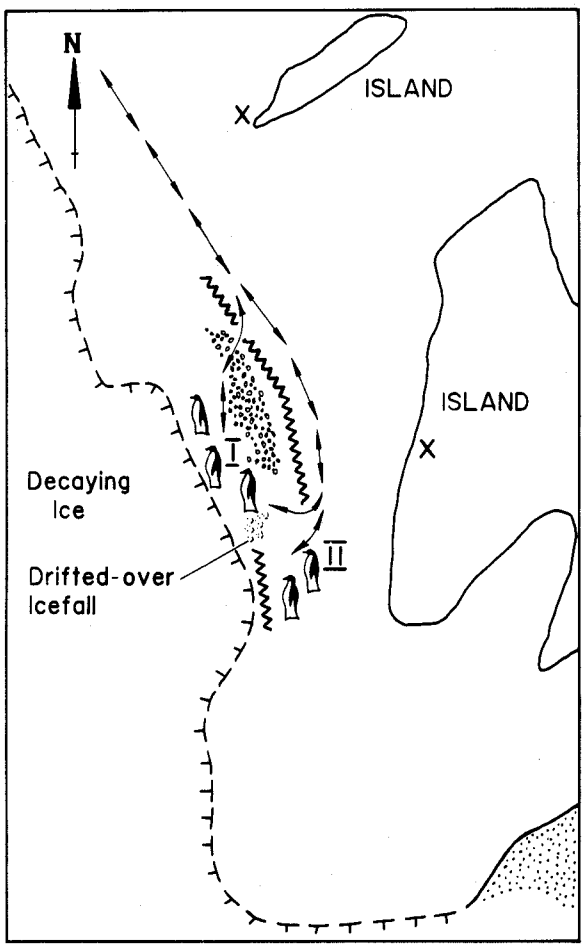
This report details the first count of chicks and the first ground counts of adult Penguins conducted in September–October at the Amanda Bay colony. Information is presented on mortality, on the grouping within the colony, on travel to and from open water and on the first Emperor Penguin vocalization recordings made on the Indian Ocean side of Antarctica. The information presented has been outlined in Lewis & George (1984).

RESULTS

Population and mortality

Methods suitable for counting Emperor Penguins are outlined in Budd (1962).

The penguins at the Amanda Bay colony were in two groups here designated I and II (Fig. 1).



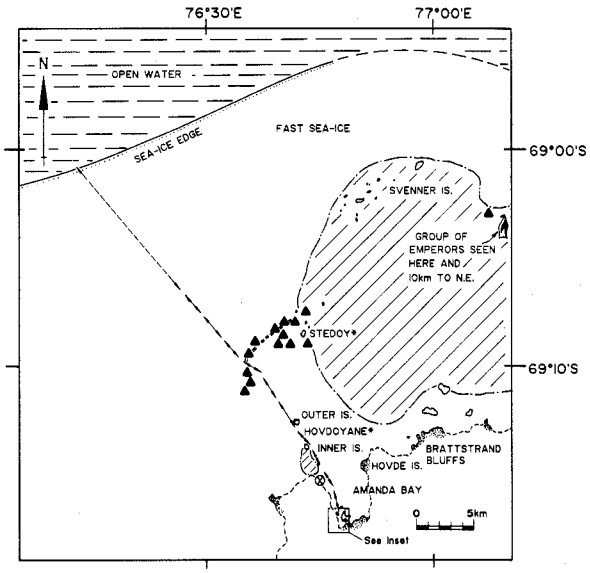


Figure 1. Location of Emperor Penguin Colony (69°17′, 76°46′E) in Amanda Bay, Antarctica, showing access to open water, 20 October 1983. Inset shows grouping within colony.

- Emperor Penguins
- I II Groups of Penguins in colony
- Penguins observed route to and from colony
- Major tidecracks (only shown in vicinity of colony)
- X Observation camps
- Ice cliffs
- Moraine
- Edge of polar cap
- Land
- Icebergs
- Rough Sea-ice
- Major crack in sea-ice between icebergs
- Penguins unobserved probable continuing route to sea
- Location of colony as reported by Budd (1961)
- * Names not approved by Antarctic Names Committee of Australia

Using the method described by Budd as a direct *en masse* ground count, two counts were made of the adult Penguins on separate days (Table I). The number of chicks was calculated by combining a direct *en masse* count of chicks in group I with a count made of chicks in group II using one of the methods described by Budd as indirect, involving the counting of a reference group and estimating by inspection the fraction represented by the group of the total number of birds.

The average figures reported (Table I) were obtained by two persons each making two counts simultaneously and from the same observation point. The arbitrary reference group of chicks was estimated to contain one-third of the total number of chicks in group II.

TABLE I

Adult and chick counts at Amanda Bay Colony, September–October 1983. Summed mean of four counts per-sub group ± mean standard error.

	Group I	Group II	Total Population
CHICKS			
29.9.83	1250 ± 22	1089 ± 65	2339 ± 69
ADULTS			
30.9.83	1195 ± 16	1253 ± 16	2448 ± 23
18.10.83	718 ± 6	1470 ± 21	2188 ± 21

The count showed there to be 2339 ±69 chicks in the colony on 29 September 1983 (Table I). Because each breeding pair produces only one egg, this figure shows the number of breeding pairs successful to this date. The number of adults present on 30 September was 2448 ±23 although an increase of about 350 adults occurred over the following 24 h (see below). The ratio of adults to chicks of approximately 1:1 is consistent with one adult of each pair remaining with its chick whilst the other is away feeding at sea. A surplus of adults might be accounted for by unsuccessful or non-breeding birds and by both members of some breeding pairs being present at change-over. A few chicks may have been hidden from view in the parental pouch. No Penguins in immature plumage were seen in September–October.

The number of adults counted is similar to the ground count made in May 1960 when a breeding population of 2150–3300 pairs was calculated (Johnstone *et al.* 1973) and to Budd's (1961) estimate from aerial photographs of approximately 3000 pairs. It therefore seems that the population of the Amanda Bay colony has changed little between 1960 and 1983. This apparent stability may reflect the favourable conditions at the colony as reported by Budd (1961).

A count on 1 October 1983 of all unhatched eggs (63) and dead chicks (42) indicated a minimum mortality of 105, i.e. 4.3%. This figure is well below the range of 14.8–40.4% reported by Jouventin (1975) for the colony at Pointe Géologie, Terre Adélie. The factors that might lead to error in the mortality figures include loss of material, leading to an under estimate; and carcasses remaining from previous years, leading to an over estimate. Whilst it was impossible to estimate the number of missing eggs and carcasses, no evidence of scavenging was seen. Evidence from summer visits in 1983 and 1984 and from aerial photographs taken in 1959, 1980 and 1981 suggests that sea ice within Amanda Bay does not necessarily clear to open water. This would mean that egg and chick carcasses from previous years may not have been carried away. However, no chick carcasses found had grown beyond the size of the largest chicks at the colony, which seems to indicate that the majority may indeed have died in 1983. Further deaths would be expected before fledging; indeed three more carcasses were found on later visits. One adult Emperor Penguin died overnight on 30 September; no other adult carcasses were found at the colony.

Over one-quarter of chick carcasses were found in tidecracks and one live chick was found wedged in a tidecrack. It seems likely that chicks falling into tidecracks was an important cause of mortality.

It is probably coincidence that the numbers of surplus adults and of unhatched eggs and dead chicks are similar as both figures are subject to error.

Movements

The colony occupied some 100 m × 500 m of fast ice below the ice-cliffs on the south-western side of Amanda Bay (Fig. 1). This is about 3 km south of the colony location as reported by Budd (1961) and shown on Sheet 43–44, Division of National Mapping (1971) but is probably similar to the position reported on 21 May 1960. The colony was divided into two major groups: group I occupied a dark-stained slope of consolidated snow, ice and excreta based on a strip of moraine landward of the tidecracks at the foot of the ice-cliffs; group II was on the flat sea ice itself just seaward of the main tidecrack zone. A continuous flow of individuals and groups comprising both adults and chicks was observed between groups I and II in both directions. However, there was an overall increase in the number of adults and chicks in group II between 4 October and our return visit on 18 October. Observations at the colony in January 1984 (R. Puddicombe pers. comm.) indicated that adult Penguins remain on the sea ice of the Bay whilst moulting.

Penguins leaving the colony to feed at the open sea

took a north-westerly course (Fig. 1). On 20 October, 13 km from the Amanda Bay colony, Penguins were travelling on a bearing of 317°T in groups of 3 to 35 and tracks in the snow deviated less than 250 m. Open water sighted from Stedoy (Fig. 1) was 38 km from the colony. Most returning Penguins followed the same route forming a line of two-way traffic. However, on 13 and 17 September two groups of 8 and approximately 40 Penguins were seen 30 and 40 km respectively north-east of the colony. More than 300 Penguins were seen swimming at Seal holes near Hovdoyane (Fig. 1). In general, Penguins seemed to continue to the sea after swimming at Seal holes. The significance of supplementary feeding *en route* to and from open water is not fully known (Jouventin 1975).

The number of Penguins leaving and returning to the colony each hour over 24 h on 1–2 October was observed from a point 500 m north of the colony. No movement past the observation point occurred in the darkest hours (23:00–03:00 local i.e. GMT plus 7 h). During the remainder of the observation period there was a continuous flow of individuals and groups of Penguins leaving and returning. The number (908) of Penguins returning to the colony within the 24 h was nearly twice the number (553) leaving, resulting in a net increase of some 350 adults. This may have been due to good feeding conditions during the calm fine weather of the previous five days.

A group of three Penguins leaving the colony was observed travelling over a distance of 5.8 km at an average speed of 2.2 km/h to Inner Hovdoy (Fig. 1). At this rate Penguins would cover the 38 km to open water in approximately 17 h. Penguins returning to the colony appeared to travel at a similar speed to those leaving. Jouventin (1975) reported an average travelling speed of 4.5 km/h for Emperor Penguins although he did not state how the figure was obtained.

Calls

Preliminary analysis by Hubbs Seaworld Research Institute, California, U.S.A., of recordings of calls, and comparison with recordings made at Cape Crozier and Dumont D'Urville, led to a statement (Ann Boles, Hubbs Seaworld Research Institute) that no dialectic variations occur between colonies of Emperor Penguins. Underwater recordings of Emperor Penguins at Hovdoyane contained no vocalizations.

CONCLUSIONS

The Emperor Penguin colony at Amanda Bay is apparently stable with a breeding population of some 2500–3000 pairs in both 1960 and 1983. Chick-egg mortality appeared to be low in 1983 with stable sea ice conditions within the Bay and good access to feeding grounds at open water 38 km from the colony on 20 October 1983.

ACKNOWLEDGEMENTS

I appreciate the review of the revised manuscript by the Board of the Oceanic Research Foundation as the fieldwork was carried out during the Foundation's Frozen Sea Expedition 1982–84. I am most grateful to Dr D. Lewis, M. George and J. Schou for allowing me access to their field observations and in particular to J. Schou for assisting me with the counts.

I wish to extend my sincere thanks to Dr G.W. Johnstone, ANARE, for advice and encouragement in preparation of this paper and to all personnel of the Australian Antarctic Division who gave assistance.

REFERENCES

BUDD, G.M. 1961. The biotopes of Emperor Penguin rookeries. Emu 61: 171-189.

———. 1962. Population studies in rookeries of the Emperor Penguin *Aptenodoytes forsteri*. Proc. Zool. Soc. Lond. 139: 265-288.

CAMERON, A.S. 1969. The Auster Emperor Penguin Rookery, 1965. Emu 69: 103-106.

CAUGHLEY, G. 1960. The Cape Crozier Emperor Penguin Rookery. Records of the Dominion Museum Vol. 3 Part 4, August.

DIVISION OF NATIONAL MAPPING. 1971. Australian Antarctic Territory, Sheet 43–44. Scale 1:1 000 000. Department of Resources and Energy: Canberra.

JOHNSTONE, G.W., D.J. LUGG & D.A. BROWN 1973. The Biology of the Vestfold Hills, Antarctica. ANARE Scientific Reports 123: 25.

JOUVENTIN, P. 1971. Comportement et structure sociale chez le manchot empereur. La Terre et la Vie 25: 510-586.

———. 1975. Mortality parameters in Emperor penguins *Aptenodoytes forsteri*. *In* The Biology of Penguins: 435-446. B. Stonehouse (ed.). Macmillan.

KOROTKEVICH, YE. S. 1964. Observations of birds during the first wintering of the Soviet Antarctic Expedition 1956–57. Soviet Antarctic Expedition Information Bulletin 1: 149-152 (English).

MOUGIN, J.L. 1966. Observations écologiques à la colonie de manchots empereurs de Pointe Géologie (Terre Adélie) en 1961. Oiseau et RFO 36, no. 3-4: 167-226.

LEWIS, D. & GEORGE, M. (eds) 1984. The Initial Reports of the Mawson Anniversary and Frozen Sea Expeditions, nos. 4 and 11. Oceanic Research Foundation Occasional Publication no. 1.

PREVOST, J. 1959. Le cycle annuel du Manchot Empereur *Aptenodytes forsteri* a la colonie de Pointe Géologie, Terre Adélie. Expéditions Polaire Françaises. Note ornithologique no. 18.

PRYOR, M.E. 1968. The Avifauna of Haswell Island, Antarctica. *In* Antarctic Bird Studies, Antarctic Research Series, 12: 57-82. O.L. Austin jr., (ed.) Washington, D.C. AGU:

STONEHOUSE, B. 1953. The Emperor Penguin *Aptenodytes forsteri* Gray. Breeding behaviour and development. Falkland Island Dependency Survey Scientific Report No. 6.

TODD, F.S. 1980. Factors influencing Emperor Penguin mortality at Cape Crozier and Beaufort Island, Antarctica. Le Gerfaut 70: 37-49.

WILLING, R.L. 1958. Australian discoveries of emperor penguin rookeries in Antarctica during 1954–57. Nature 182: 1393-1394.

WILSON, E.A. 1907. Aves. British National Antarctic Expedition 1901–4. Zoology, 2: 1-33.

G.S. CRACKNELL, *Oceanic Research Foundation, Box 247, Windsor, N.S.W. 2756;*
Present address: *B.T.O., Beech Grove, Station Rd, Tring, Hertfordshire HP23 5NR, England*

(Final Report No. 4, Frozen Sea Expedition)

Received 7 November 1984; accepted 3 December 1985

INCUBATION PERIOD OF THE AUSTRALIAN GRASS OWL *TYTO CAPENSIS* LONGIMEMBRIS

Of the four or five species of Tytonid owl found in Australia, details of breeding are well known only for two, the Masked Owl, *Tyto novaehollandiae* and the Barn Owl, *Tyto alba* (e.g. Schodde & Mason 1981; Fleay 1949). There are no published accounts of the incubation period for the Australian Grass Owl, *Tyto capensis longimembris* in Australia, although McLachlan & Liversidge (1978) record 42 days for the African Grass Owl (*Tyto capensis*). This is unusually long for Tytonids. We report here some observations on the breeding of the Australian Grass Owl.

The observations were made on a sibling pair of Australian Grass Owls that hatched in captivity at the Cairns Bird Park in June 1983 and bred in Brisbane during April–May 1985. The parents of this pair were also siblings and had been hand-raised at the Cairns Bird Park after being picked up as chicks near Ingham. The female could be distinguished by the darker facial disc and speckles on the ventral plumage. The sex of each bird was confirmed at laparatomy under ketamine (10 mg intramuscular) and xylazine (2 mg intramuscular) anaesthesia at Cairns, in March 1984. At that time the gonads were small in both birds but the female had slight follicular development. On transfer to Brisbane the pair was established in an outdoor aviary (2 × 10 × 3 m) at the University of Queensland's Veterinary Farm at Pinjarra Hills. Diet consisted of fresh mice, frozen mice and chopped frozen rats. Food was supplied *ad libitum*. Each bird ate about 2 mice per day but increased to 3–4 mice per day during March–May 1985 before laying began. 'Courtship song' was first heard on some evenings, after dark, at the end of March 1985 when the male's trilling was heard as it perched on a high point in the aviary while the female was in grass on the ground. This trilling was like that used by courting male Barn Owls in captivity (J. Pettigrew & D. Margoliash unpubl.; Bunn 1977), except that the trills of the Grass Owl were not emitted continuously but in phrases of five to six trills with an interval of 2–3 seconds between each phrase.

The female Grass Owl laid eggs on the nights of the 10th, 12th, 14th, 16th and 19th of April 1985. Young hatched some time in the early morning of the 12th, 14th, 16th, 18th and 21st of May. Incubation began from the laying of the first egg, the female being fed by the male at the nest site on the ground, and she was not seen to leave the nest site until after all the chicks were hatched. The female sat tight in the early morning but could be enticed off the eggs briefly by throwing a freshly-killed mouse to her side. During the warmest part of the afternoon she stood over the eggs. These two opportunities each day allowed the eggs to be counted and showed that laying always occurred during the period between 6 p.m. and 9 a.m.

Assuming that the incubation time is similar for each egg, the mean incubation time is 31 days, counting from the midnight on the night the egg was laid until the midnight before the morning of hatching. We were sufficiently content with this assumption, and sufficiently concerned about disturbing the hen bird during laying, that we made no attempt to check it by marking the eggs for identification as they were laid. The close correspondence between the laying sequence and the hatching sequence also support this assumption.

The Barn Owl has an incubation period of about 31 days (Smith *et al.* 1974; Bunn & Warbuton 1977; Bunn *et al.* 1982) and the Masked Owl, 35 days (Fleay 1949, 1968). Our records therefore confirm that the Australian Grass Owl is like the Barn Owl and the Masked Owl in its incubation time. Like the Barn Owl (Bunn *et al.* 1982), the Australian Grass Owl has a staggered sequence of laying and hatching. Our figure of 31 days for the incubation period of the Australian Grass Owl is hard to reconcile with the previous report of 42 days for the African Grass Owl (McLachlan & Liversidge 1978). The latter figure seems likely to be an error.

We wish to thank the Queensland National Parks and Wildlife Service for their co-operation and the Manage-

0158-4187/86/02117+1 $2.00