

THE DISTRIBUTION AND ESTIMATED ABUNDANCE OF ADELIE PENGUINS BREEDING IN PRYDZ BAY, ANTARCTICA

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Abstract: This paper reports the results of the first aerial photographic survey of Adelie penguin colonies in the Prydz Bay region. The area surveyed extended from the northern Vestfold Hills to the Publications Ice Shelf. More than 325000 pairs of Adelie penguins were estimated to be breeding in this region in 1981/82. The great majority of breeding Adelie penguins occurred in the northern half of the region surveyed, in the Vestfold Hills and Rauer Islands, where most colonies were located. This is probably due to the typical pattern of summer sea-ice dispersal, which usually results in sea-ice leaving the northern areas of coast first.

1. Introduction

Prydz Bay contains a number of regions of ice-free coastline and offshore islands, representing a significant fraction of the ice-free component of coastline of the Australian Antarctic Territory (AAT) (Fig. 1). As such it represents an important area of potential Adelie penguin nesting habitat. Some of this has been surveyed for Adelie penguin occurrence previously, while other areas have never been searched. This bay is an important seabird breeding location, harboring the greatest diversity and concentration of breeding seabirds of any stretch of the coastline within the AAT (WOEHLER and JOHNSTONE, 1990). Though Adelie penguins, *Pygoscelis adeliae*, are a major component of the Prydz Bay avifauna, no complete assessment has yet been made of the size or distribution of their breeding population in this region.

In terms of biomass, Adelie penguins dominate among the species that feed predominantly on euphausiids (MONTAGUE, 1988). An accurate assessment of their population size is necessary before the energy and food requirements of Adelie penguins in this region can be quantified. Baseline information on the status of the population will also enable the determination of any future fluctuations in population size.

JOHNSTONE *et al.* (1973) estimated that 130000 pairs bred in the Vestfold Hills region, based on counts made opportunistically by expeditioners stationed at Davis since the late 1950's. As these counts were never synchronized, and often consisted only of an individual's estimate, based on a count of a very small fraction of any whole colony, this figure must be treated with appropriate caution. WOEHLER *et al.* (1990) provided the most thorough previous assessment of Adelie penguin numbers in the

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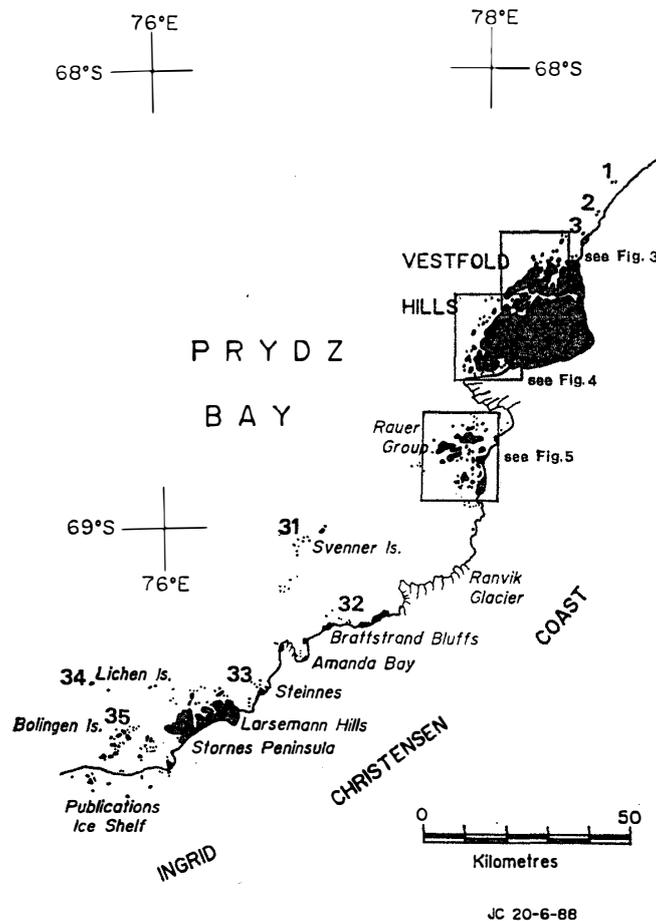


Fig. 1. Ice-free coast and island groups along the Ingrid Christensen Coast of Prydz Bay. Numbers refer to breeding sites listed in Table 1.

Vestfold Hills, based on one of the authors' (TT) extensive ground counts of the Vestfold Hill colonies in November 1974.

The existence of breeding Adelle penguins in the Rauer Island group was reported by KOROTKEVICH (1964), but not in any detail with respect to location and size of colonies. LEWIS and GEORGE (1984) reported some counts made at colonies in the Rauer Islands during the 1983/84 season; however, there were many breeding sites for which they presented no data.

The distribution and abundance of all penguin species breeding in the AAT was reviewed by HORNE (1983). Her treatment of Adelle penguins largely summarized the *ad hoc* counts of previous expeditioners, and in no area of Prydz Bay breeding concentrations was it an exhaustive documentation of all colonies present. Many had never been visited.

WILSON's (1983) synthesis of Antarctic penguin distribution and abundance derived its data for Prydz Bay Adelle penguin numbers largely from HORNE (1983) and thus is also less than a complete record. WOehler and JOHNSTONE's (1990) contribution on the status of seabirds in the AAT presented data estimating the population size of Adelle penguins at general areas, providing little detail on specific localities.

This study is the first to record the abundance of Adelie penguins in the Prydz Bay region with more accuracy than provided by subjective ground counts, and records the distribution of colonies in Prydz Bay in more detail than previously. It also provides the first description of Adelie penguin distribution and abundance for areas of Prydz Bay south of the Svaner Islands.

2. Methods

2.1. Survey method and location

One of us (GWJ) searched the ice-free areas of coastline and offshore islands between the northern Vestfold Hills ($68^{\circ}22'S$, $78^{\circ}32'E$) and the Publications Ice Shelf ($69^{\circ}38'S$, $75^{\circ}20'E$) (Fig. 1), for Adelie penguin colonies between 9 and 22 December 1981. The searches were conducted from a helicopter. Colonies were overflown at an altitude of 300 m and black and white photographs taken vertically with a Nikon 35 mm camera, fitted with a 50 mm lens. At this altitude the penguins did not appear disturbed and were still easy to resolve in the photographs (see Fig. 2).



Fig. 2. Adelie penguin colonies photographed vertically from 300 m altitude. Hop Island, Rauer Islands.

Table 1. Colony sites and estimated breeding population of Adélie penguins at Prydz Bay in 1981/1982. Site numbers refer to locations shown in Figs. 1–5; letters refer to separate island colonies within the same island group.

Site	Estimated number of breeding pairs
Vestfold Hills (Figs. 1, 3, 4)	
1. Murphy Rocks	Present
2. McCallie Rocks	Present
3a. NE Wyatt Earp Island	1147
b. NW Wyatt Earp Island	874
c. S Wyatt Earp Island	783
4a. NW Tryne Island	219
b. Tryne Island	16013
5a. South Tryne Island 1	827
b. South Tryne Island 2	300+55*
6. Long Peninsula Island	6815
7. Organic Lake Coast	175*
8. Albino Rookery Coast	12007
9. North Rookery Coast	6445*
10. Rookery Lake Coast	18883
11. Lucas Island	13663
12. Lugg Island	16964
13. Magnetic Island	17184
14. Turner Island	5553
15. Gardner Island	22180
16. Warriner Island	14782
17. Island west of Redfearn Is.	10522
18a. Hawker Island	4474
b. Island west of Hawker Is.	2133
19a. Mule Island	228
b. Island SW of Mule Is.	1301
20. Zolotov Island	17496
21. Kazak Island	5569
Breeding pairs—estimated sub-total:	196592
	(excluding sites 1 & 2)
Rauer Archipelago (Figs. 1, 5)	
22. Lunnyy Island	7674
23a. Island north of Strelka Is.	1907
b. Strelka Island	4726
24. Kryuchok Island	973
25. Filla Island	15097
26a. Hop Island	43268
b. Island SW of Hop Is.	3259
27. Island west of Varyag Is.	20087
28. Middle island NW of Forpost Is.	351
29. Forpost Island	1789
30. Southern Tangholmane Island	4785
Breeding pairs—estimated sub-total:	103916

Table 1 (continued).

Site	Estimated number of breeding pairs
Svenner Islands (Fig. 1)	
31a. Svenner Island 1	9269
b. Svenner Island 3	2736
c. Svenner Island 4b	1936
d. Svenner Island 6	591
e. Svenner Island 7	487
f. Svenner Island 9	85
g. Svenner Island 12	2961
Breeding pairs—estimated sub-total:	18065
Islands south of Svenner Islands (Fig. 1)	
32. Islands NE of Brattstrand Bluffs	5259
33a. Steinnes Group 1	134
b. Steinnes Group 2	1042
34. Lichen Island	ca. 20**
35. Bolingen Island 1	445
Breeding pairs—estimated sub-total:	6900

* Data not available from this survey. These counts are from a 1973/1974 survey (WOEHLER *et al.*, 1990).

** Site not included in this survey. This count is from a 1978/1979 visit (R.D. SEPPELT, pers. commun.).

During this period prior to chick hatching, the number of adults present in the colony approximates the number of nesting pairs more closely than at other times of the season, making estimates of the breeding population most reliable (TAYLOR and WILSON, 1982).

At three sites within the Vestfold Hills, and at Lichen Island, offshore from the Larsemann Hills, data were obtained from previous visits, as these were places known to be used as Adelie penguin breeding sites, but not included in this survey (see Table 1). These data were from ground counts.

2.2. Analysis of photographs

The photographs of each breeding colony were fitted together, and maps drawn of each location. Each individual breeding group within the colonies was outlined on these maps. The area of each breeding group was calculated by digitizing the mapped outline using a computer and area calculation program.

At colonies containing less than 1000 birds, all individuals were counted directly. At each larger colony, an average density was calculated by counting the number of penguins in selected breeding groups of calculated area. Breeding groups were selected so that the range of nest densities and positions within the colony were represented. Approximately 20% of the breeding groups at each colony were counted. The average density was multiplied by the total breeding area of the colony, giving an estimate of the total number of penguins present.

These counts represented the total number of penguins present in the colonies,

including non-breeding birds as well as pairs or single birds at their nest sites. The number of nesting pairs was estimated by transforming these total counts using calibration factors derived from ground counts of three reference breeding groups at the Magnetic Island colony over the period of the survey.

3. Results

On 8 December, 98% of the total number of penguins within the reference breeding groups at Magnetic Island represented occupied nests; on 13 December this figure was 94% and on 20 December this had fallen to 74%. After reducing the total counts from the photographs by the appropriate factor, the total Adelie penguin breeding population within Prydz Bay was estimated to be 325473 pairs.

The greatest concentration of breeding Adelie penguins was present on the islands offshore from the Vestfold Hills, the Rauer Island archipelago, and the Svenner Islands, in the northern half of the surveyed areas. In the southern half of the area searched, penguins were present in smaller numbers, despite the availability of large numbers of islands offshore from the Larsemann Hills and in the Bolingen Islands (Fig. 1, Table 1).

Estimated population sizes at each breeding site, expressed as numbers of breeding pairs, are presented in Table 1 and Figs. 1 and 3–5 illustrate their position.

4. Discussion

The potential Adelie penguin nesting sites within Prydz Bay not covered by this or any previous survey are those few islands and outcropping areas of coast between the Publications and Amery Ice Shelves. The data presented here therefore include the great majority of Adelie penguin breeding sites within Prydz Bay. For completeness sake, however, these sites must be surveyed in the future.

The global population of Adelie penguins has been varyingly estimated to be between 2 million (WILSON, 1983) and 5 million breeding pairs (CROXALL, 1985). These estimates were made before much of the information from Prydz Bay was available, so are probably underestimates. Whatever the global population of Adelie penguins, Prydz Bay is clearly a region of major importance as a breeding site.

Despite the apparent availability of suitable exposed nesting habitat, the areas south of the Svenner Islands are sparsely populated. The most likely explanation for this is the regular persistence of sea-ice later in the summer in areas south of the Rauer Islands (NORTHERN ICE LIMIT, 1981–1988). YEATES (1975) realized that areas of ice-free coastline and islands were essential as Adelie penguin breeding sites, for this species does not breed on sea or continental ice. For such areas to prove useful as breeding locations, it was necessary that sea-ice break out from them by the time chicks hatched, making colonies readily accessible during the demanding chick-rearing period. Areas of rocky coastline regularly bounded by sea-ice during the summer months are not used as Adelie penguin breeding sites (CAUGHLEY, 1960). The existence of breeding Adelie penguins at the relatively offshore Svenner Islands and the small number breeding on Lichen Island when none breed at the more inshore Larsemann Hills support this suggestion.

WILSON (1983) reported that no data on Adelie penguin distribution was available

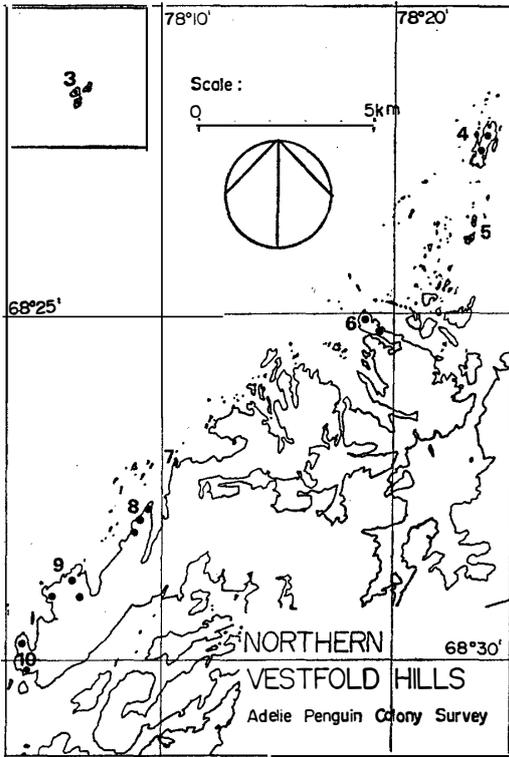


Fig. 3.

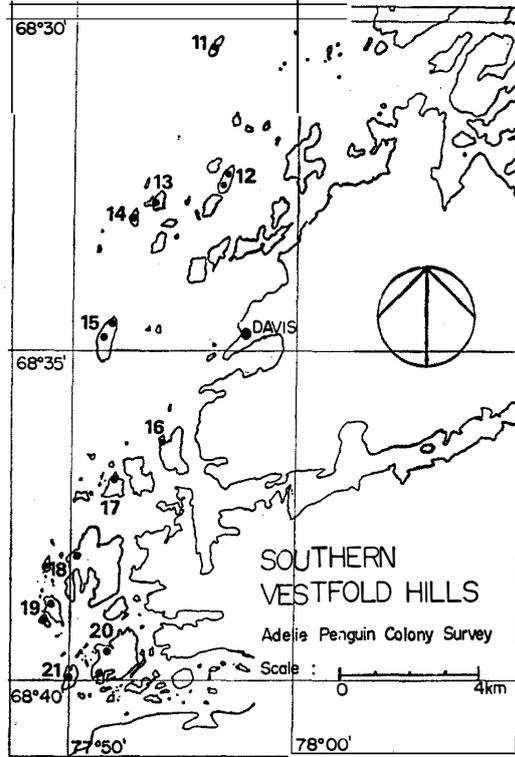


Fig. 4.

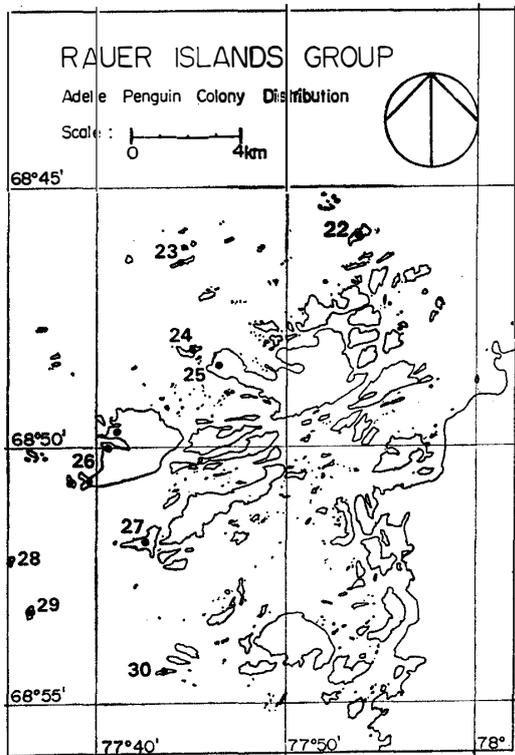


Fig. 5.

Fig. 3. Adelie penguin colony sites in the northern Vestfold Hills. Numbers refer to breeding sites listed in Table 1. See Fig. 1 for location of inset.

Fig. 4. Adelie penguin colony sites in the southern Vestfold Hills. Numbers refer to breeding sites listed in Table 1.

Fig. 5. Adelie penguin colony sites in the Rauer Island group. Numbers refer to breeding sites listed in Table 1.

for the Larsemann Hills area and HORNE's (1983) review of the distribution of penguin breeding colonies in the AAT reported no Adelle penguin colonies between Murray Monolith in Mac.Robertson Land (67°47'S, 66°54'E) and Tangholmane Island in the Rauer Group (68°46'S, 77°50'E), encompassing almost 11 degrees of longitude. This reflected the absence of previous observation rather than recent colonization of these sites. The information reported in the present paper redresses this situation, establishing the existence of almost three times the number of breeding pairs of Adelle penguins in this area as WILSON (1983) found evidence for.

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