AUSTRALIAN NATIONAL ANTARCTIC RESEARCH EXPEDITIONS

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THE DISTRIBUTION AND ABUNDANCE OF ADÉLIE PENGUINS, *PYGOSCELIS ADELIAE*, IN THE MAWSON AREA AND AT THE ROOKERY ISLANDS (SPECIALLY PROTECTED AREA 2), 1981 AND 1988

by

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*Deceased

ABSTRACT

Aerial photographic surveys of Adélie penguins, *Pygoscelis adeliae,* were undertaken in January 1982 and December 1988 at Mawson and the Rookery Islands group (Specially Protected Area (SPA) 2), Mac.Robertson Land. Twenty-three islands were photographed. Comparisons with census data collected in 1972-73 indicate a 15% increase in the number of Adélie penguins breeding in the area, from approximately 71 500 ± 7620 pairs in 1972-73 to at least 82 500 ± 8250 pairs in 1988-89. The population on Rookery Island, within the SPA, increased by 46% between 1972-73 and 1988-89, representing almost 85% of the total increase recorded for the entire SPA. The populations on islands near Mawson appear to have remained stable. These results highlight the value of long-term, annual monitoring efforts to explicate population changes.

1. INTRODUCTION

Little has been published on the avifauna of the Mawson and Rookery Islands Specially Protected Area (SPA) region. Early studies investigated Emperor penguins, *Aptenodytes forsteri*, (Budd 1961, 1962; Willing 1958a, 1958b) and Snow petrels, *Pagodroma nivea* (Brown 1966). Bonner and Lewis Smith (1985) reviewed all known data for the Rookery Islands SPA.

Early census data of Adélie penguins, *Pygoscelis adeliae*, were collected in the Mawson region, including the Rookery Islands, in the 1971-72 summer (Horne 1983). Opportunistic counts of Adélie Penguins were made on islands offshore from Mawson until 1977 (Horne 1983). The 1971-72 survey provided the first estimate of Adélie penguin populations in the region; 52 000 breeding pairs (Horne 1983).

This study reports on aerial photographic surveys of Adélie penguins in the Mawson region and Rookery Islands SPA from the 1981-82 and 1988-89 seasons. These have provided the first estimates of population sizes using a method that is more precise than ground counts.

2. METHODS

In 1981-82 the photographs were taken by Johnstone on 14 January 1982, using Kodak Tri-X 400 ASA black and white film in a bulk-loaded 35 mm Nikon camera, from a helicopter flying at 300 m. Gibbney Island (67°33'S 62°19'E) was photographed in 1981-82, but was not covered in the 1972-73 or 1988-89 surveys.

The 1988-89 photographs were taken as part of an on-going aerial survey of Adélie penguin colonies in the region. Photographs were taken on 20 December 1988, using a Linhoff Aerotronica 70 mm camera with a 120 mm lens, from a helicopter flying at 500 m. One 30 m roll of Kodak Tri-X was used. It is intended that the survey be repeated every 3-5 years.

From the photographs exact counts were made of adults present. Counts included non-breeders and partners of incubating and brooding birds. The counts were transformed from counts of adults in mid-December 1988 and in mid-January 1982 to an estimate of the nests established at the start of each season, using weekly census data from monitored colonies (M.D. Whitehead, personal communication, 1989). The accuracy of these transformed data are ± 5 to 10%.

3. RESULTS

Maps 1, 2 and 3 show the location of islands photographed in the survey. Maps 4 to 24 present the results of the survey. These maps show the distribution of Adélie penguin colonies on each island, and the results of any previous census. Map 25 shows the distribution of Adélie penguin colonies from the 1981-82 survey. Except for Rookery Islands 10 and 11[1], the coastline and

[1] In the Rookery Islands group, only Rookery and Giganteus Islands are officially named. The use of numbers to designate islands is unofficial, but has been in effect since the first survey in 1972.

islands shown in Map 25 were over-flown; the figure shows the complete distribution of Adélie penguin colonies.

The results for all islands are summarised in Table 1. A total of 88 375 breeding pairs was counted from the 1981-82 photographs, including Gibbney Island and the un-named island west of Forbes Glacier, and 60 570 breeding pairs from the 1988-89 photographs. On the thirteen islands completely counted in 1972-73 and 1988-89, the population of Adélie penguins had increased by 13.37%. However, this increase is not statistically significant (two-tailed paired-sample t test, $t_{0.05\ (2),\ 12} = 0.233$, $p > 0.5$, Not Significant) (Zar 1984), as the upper limit of the 1972-73 count (48 111) exceeds the lower limit of the 1988-89 count (45 565).

A brief description of the results from each island follows:

Rookery Island 1 (Map 4)
No survey was made in 1972-73, presumably because there were no Adélie penguins nesting on the island. There was no nesting in 1981-82 or 1988-89.

Rookery Island 2 (Map 5)
The breeding population increased between 1972-73 and 1981-82, and then decreased to less than that of 1972-73 in 1988-89.

Rookery Island 3 (Map 6)
There are no census data available from 1972-73, and the photographs from 1981-82 are incomplete. However, it appears that the breeding population has decreased on this island between 1981-82 and 1988-89.

Rookery Island 3A (Map 7)
There are no census data from 1972-73 and there was no nesting in 1981-82 or 1988-89.

Rookery Island 4 (Map 8)
There are no census data from 1972-73 or 1981-82, and there was no nesting in 1988-89.

Rookery Island 5 (Map 9)
The data indicate a relatively stable population between 1972-73 and 1981-82, and a slight decrease to 1988-89.

Rookery Island 6 (Map 10)
As with Rookery Island 2, the population increased between 1972-73 and 1981-82, and has since declined. The photographic coverage in 1981-82 is incomplete, with only 90% of the island photographed. Colonies were larger in 1981-82 than 1988-89.

Rookery Island 7 (Map 11)
The population increased between 1972-73 and 1981-82, and remained stable between 1981-82 and 1988-89.

Rookery Island 8 (Map 12)
Data from 1972-73 and an incomplete count in 1981-82 indicate that the population increased between counts. The island was not photographed in 1988-89.

Rookery Island 9 (Map 13)
The population increased between 1972-73 and 1981-82, and remained stable between 1981-82 and 1988-89.

Rookery Island 10 (Map 14)
The breeding population appears to have remained stable between 1972-73 and 1988-89. No data from 1981-82 are available.

Rookery Island 11 (Map 14)
The population increased between 1972-73 and 1988-89. No data from 1981-82 are available.

Rookery Island 12
There are no data from 1972-73 or 1981-82. There was no nesting in 1988-89.

Giganteus Island (Map 15)
The population increased between 1972-73 and 1981-82, and then decreased between 1981-82 and 1988-89.

Rookery Island (Map 16)
The population increased between 1972-73 and 1981-82, and remained stable between 1981-82 and 1988-89.

Béchervaise Island (Map 17)
The population appears to have remained stable between 1972-73 and 1988-89, although the coverage in 1981-82 was incomplete as only half the island was photographed.

Verner Island (Map 18)
The breeding population declined between 1972-73 and 1988-89.

Petersen Island (Map 19)
The population increased between 1972-73 and 1981-82, and decreased between 1981-82 and 1988-89.

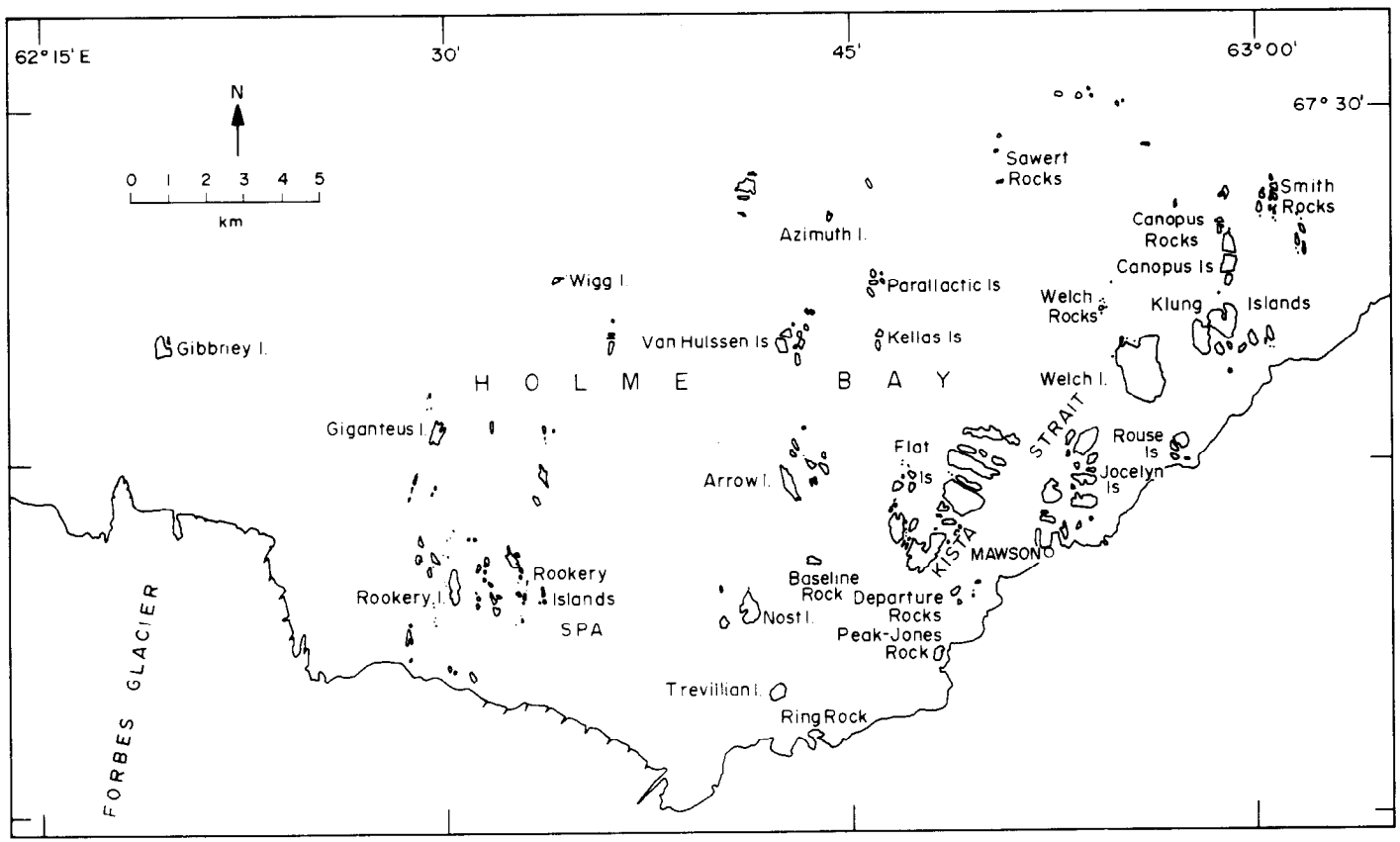
Welch Island (Map 20)
The population increased steadily between 1972-73 and 1988-89, although only 80% of colonies were photographed in 1981-82; numbers in colonies were higher than in 1972-73.

Klung Island (Map 21)
The population declined between 1972-73 and 1981-82, although the full extent of the decline cannot be determined as only 90% of the island was photographed. The population appears to have declined further between 1981-82 and 1988-89.

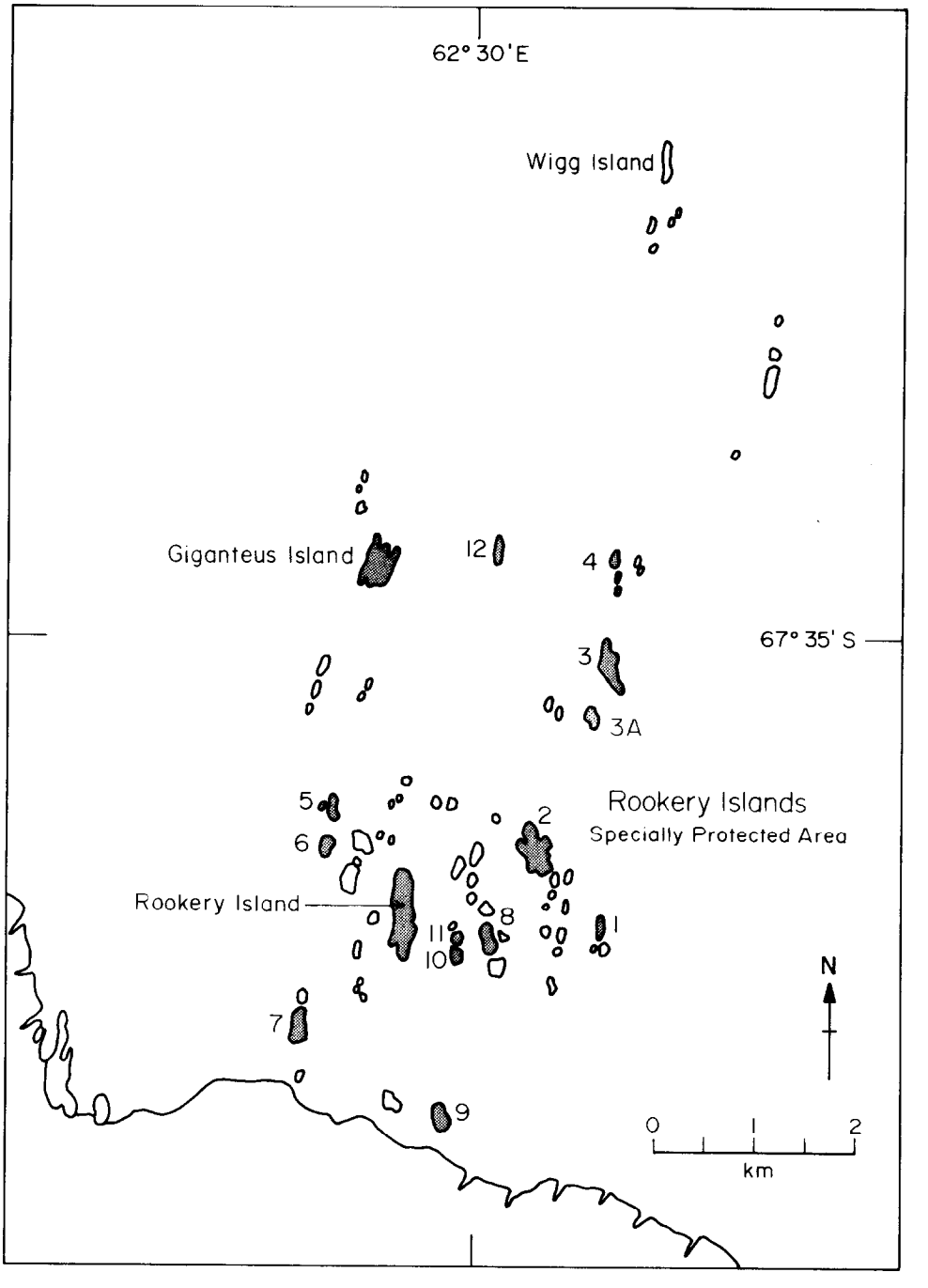
Un-named island west of Klung Island (Map 22)
The population was not counted in 1972-73, but increased between 1981-82 and 1988-89.

Gibbney Island (Map 23)
Sixty per cent of the island was surveyed in 1981-82. It is not known if there are Adélie penguin colonies on the areas not photographed.

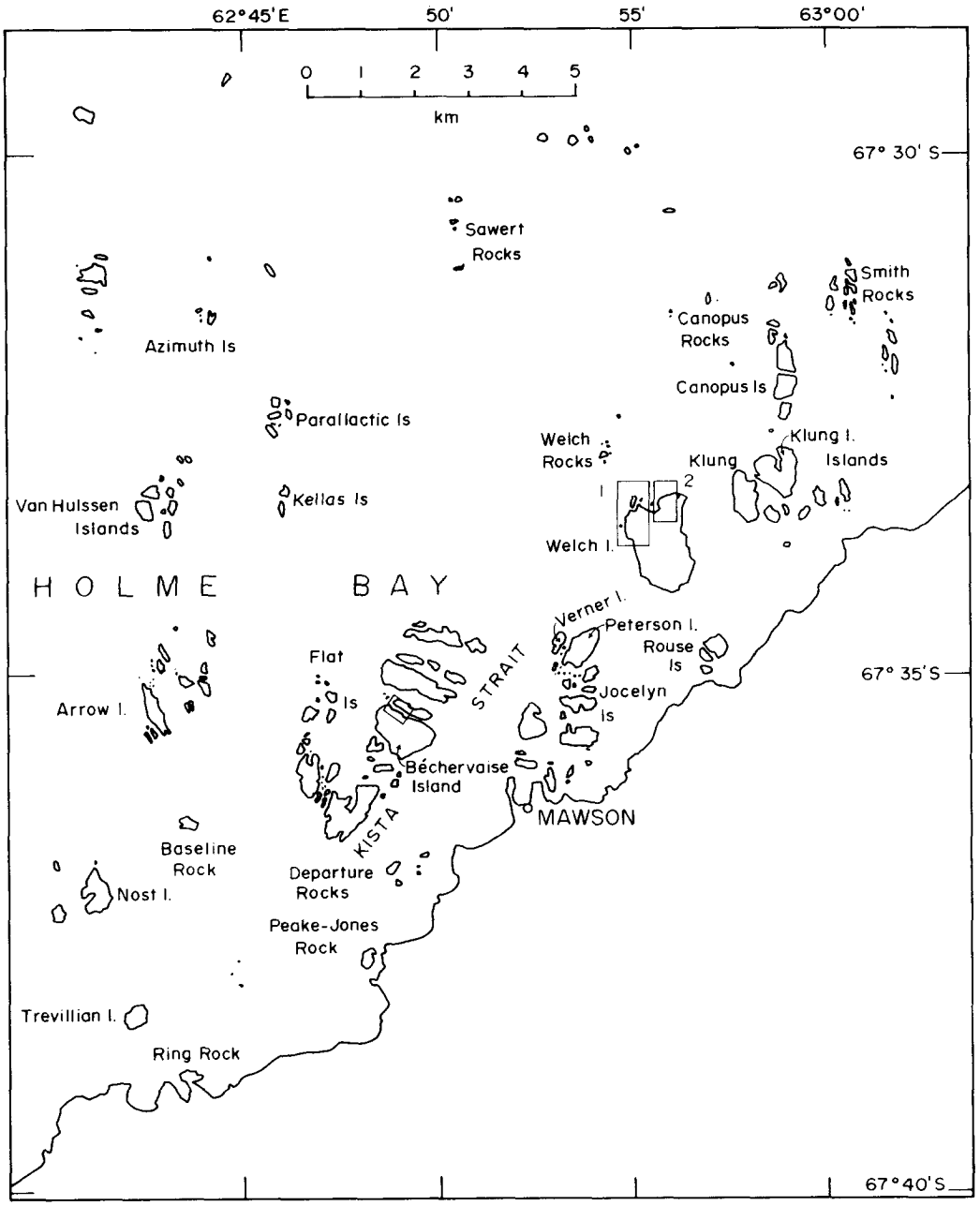
Un-named island west of Forbes Glacier (Map 24)
The population was surveyed in 1981-82.



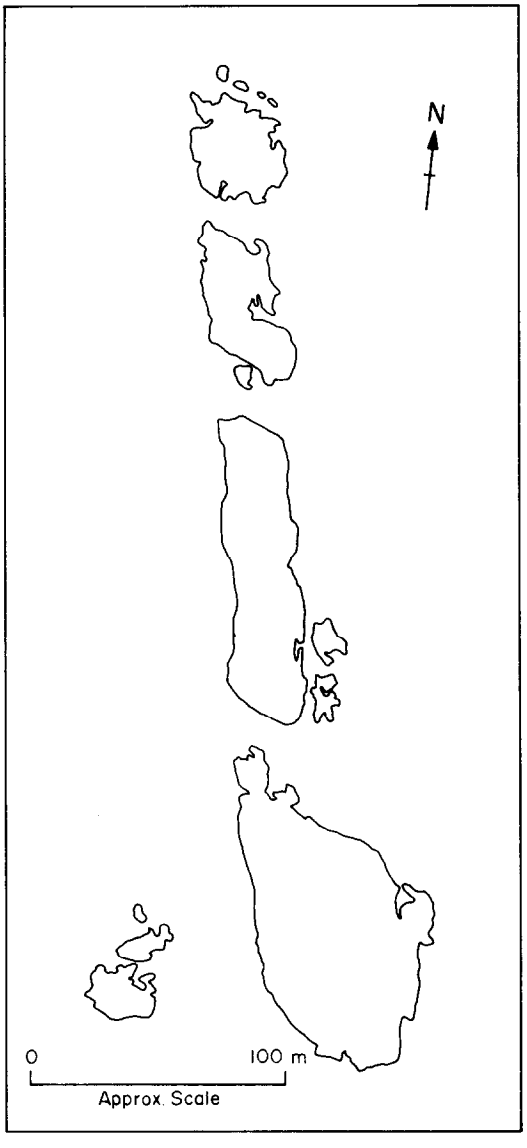
Map 1. Mawson area, including the Rookery Islands SPA .



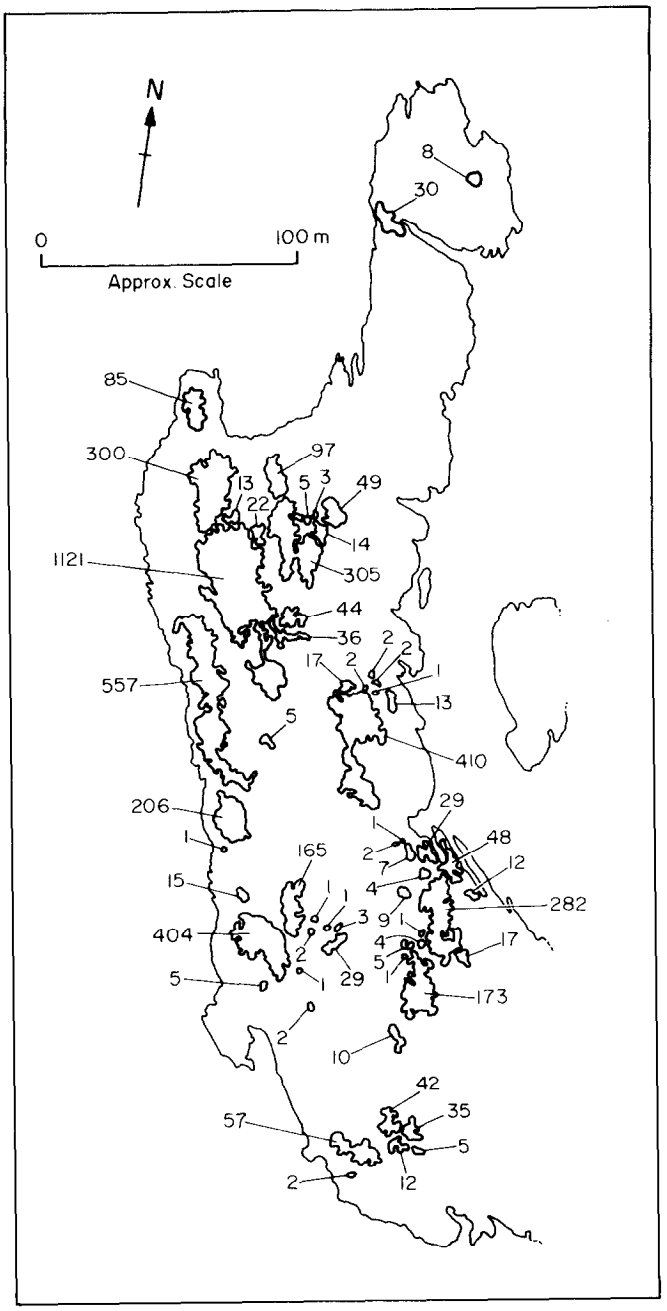
Map 2. Rookery Islands SPA. Shaded islands are those with Adélie penguin colonies. Islands are numbered according to E. Jones (ANARE Mawson 1972).



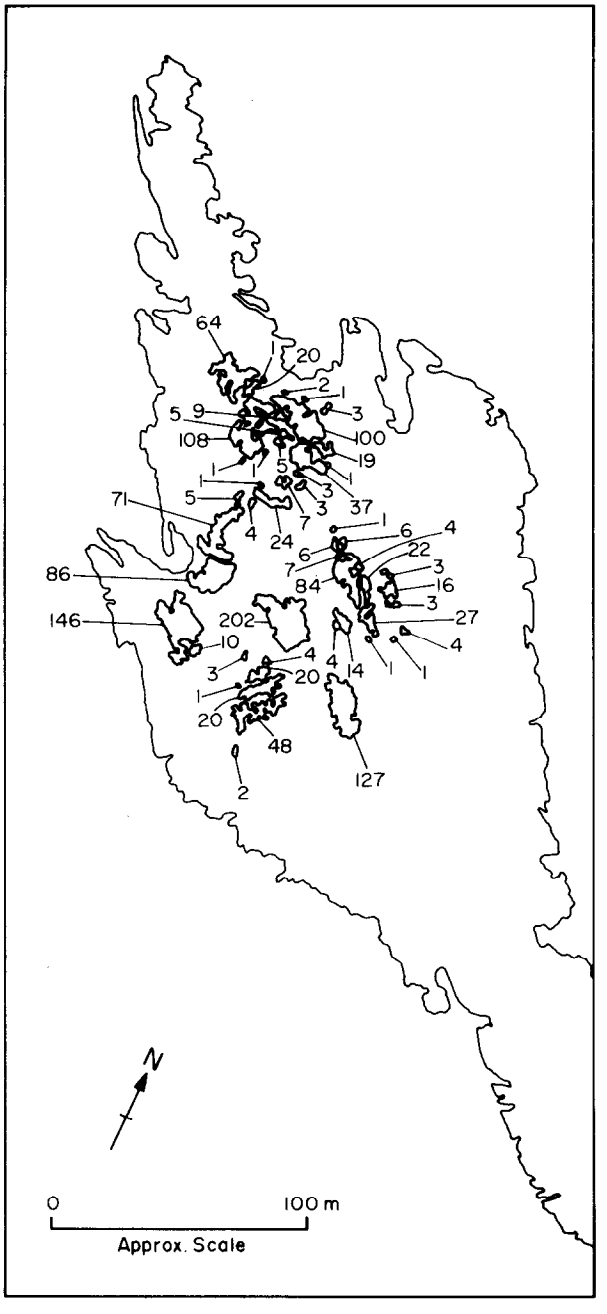
Map 3. Islands near Mawson station. The locations of detailed maps for Béchervaise and Welsh Islands are indicated.



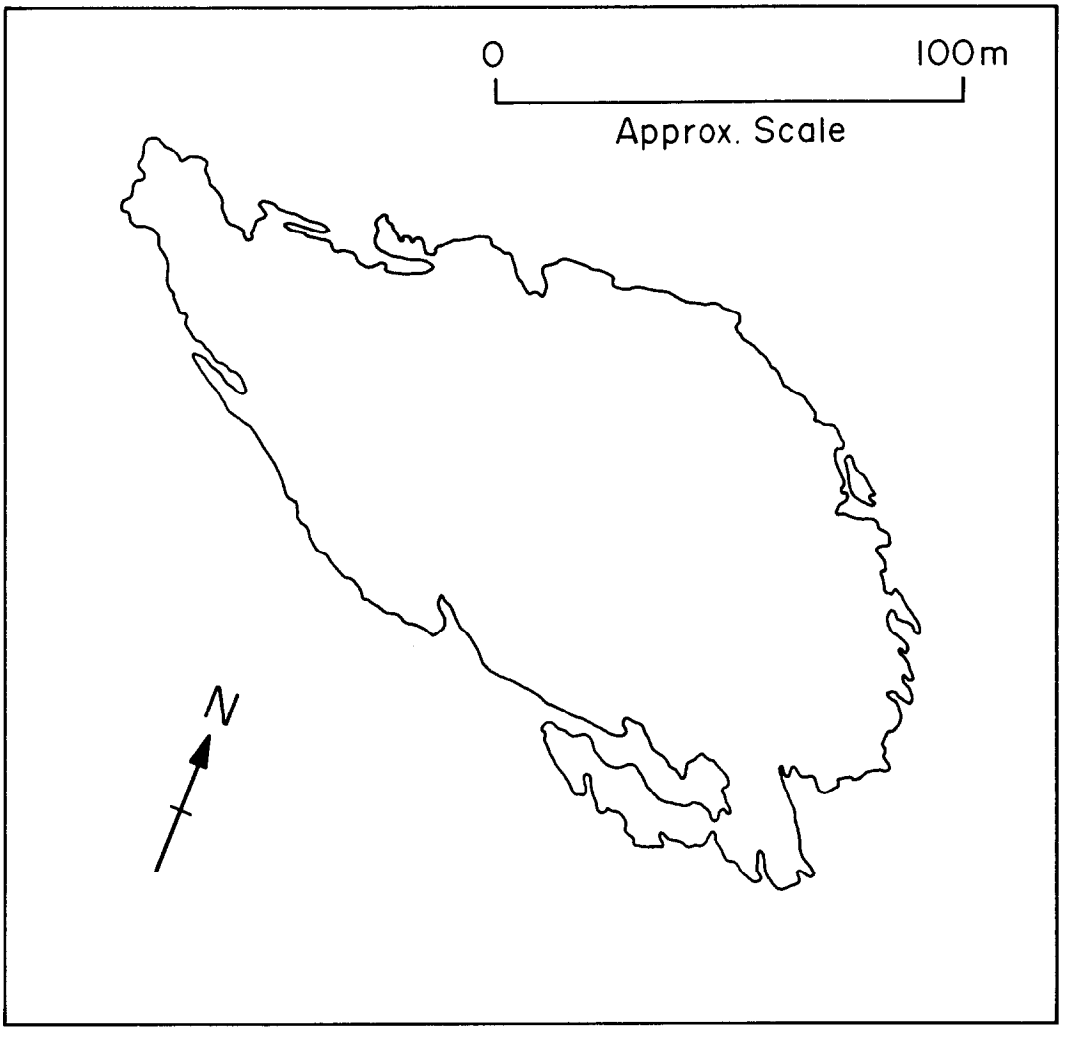
Map 4.
Rookery Island 1
Date censused: 20 December 1988
Total count: Nil nests
Previous Count: Nil nests on 14 January 1982



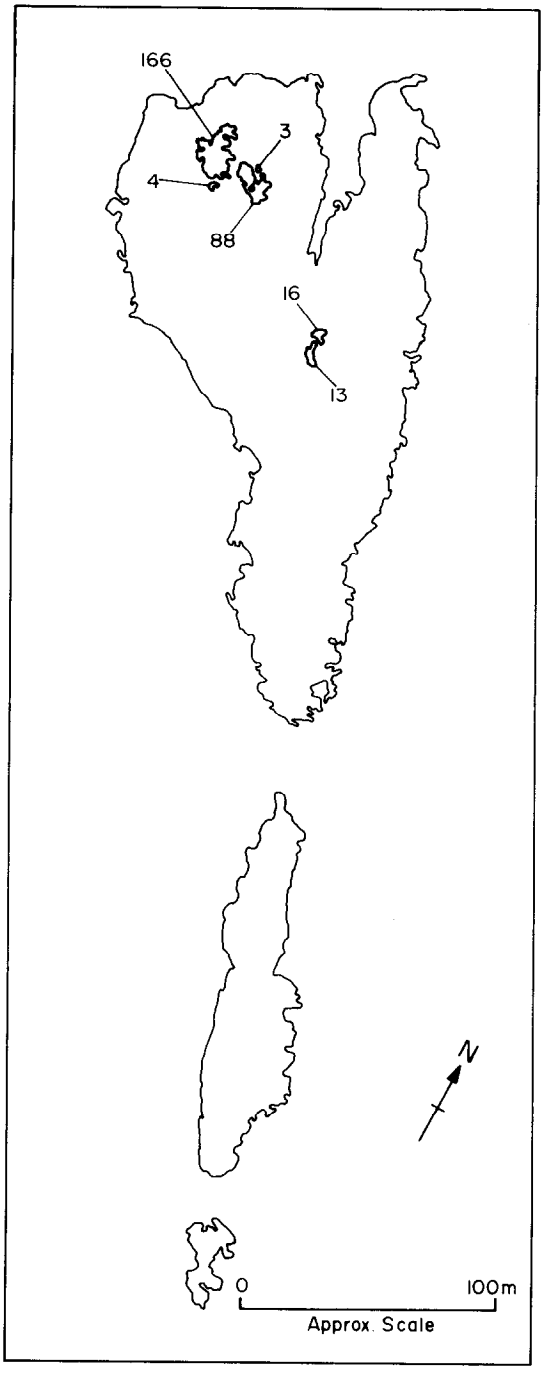
Map 5.
Rookery Island 2
Date censused: 20 December 1988
Total count: 4117 nests
Previous Count: 6994 nests on 14 January 1982
Previous Count: 4765 adults on 17 November 1972



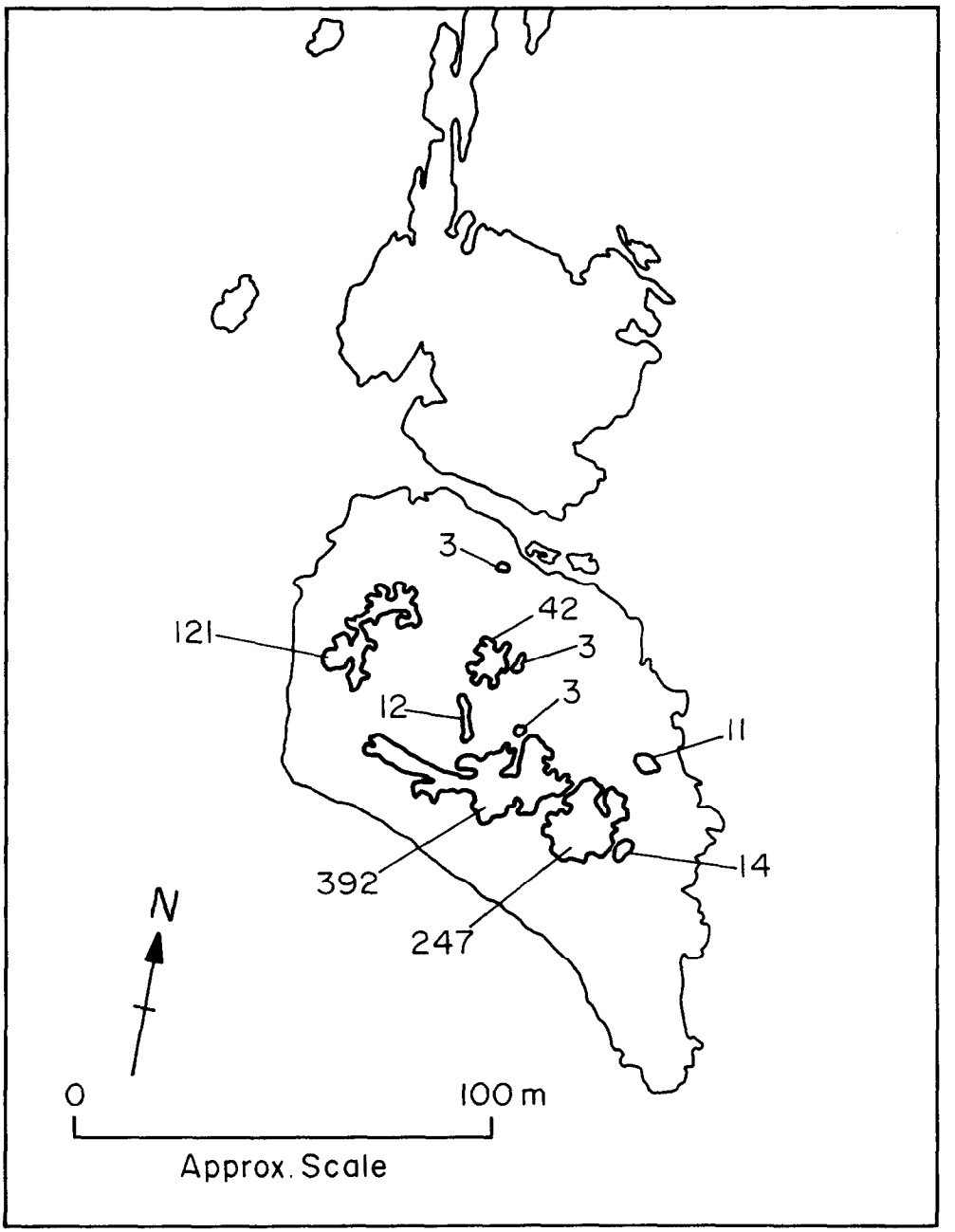
Map 6.
Rookery Island 3
Date censused: 20 December 1988
Total count: 1200 nests
Previous Count: 1441 nests on 14 January 1982 (incomplete)



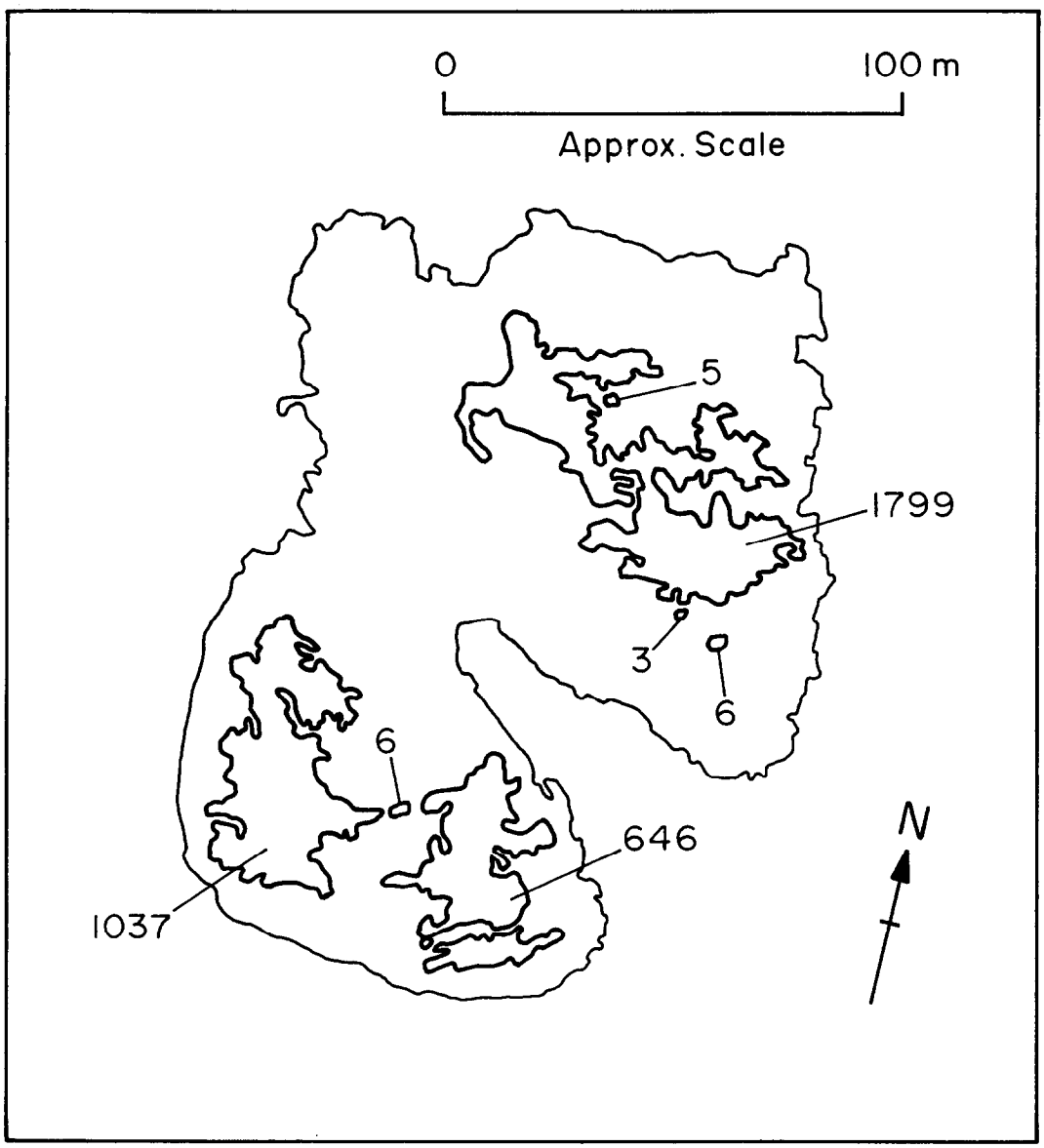
Map 7.
Rookery Island 3A
Date censused: 20 December 1988
Total count: Nil nests
Previous Count: Nil nests on 14 January 1982



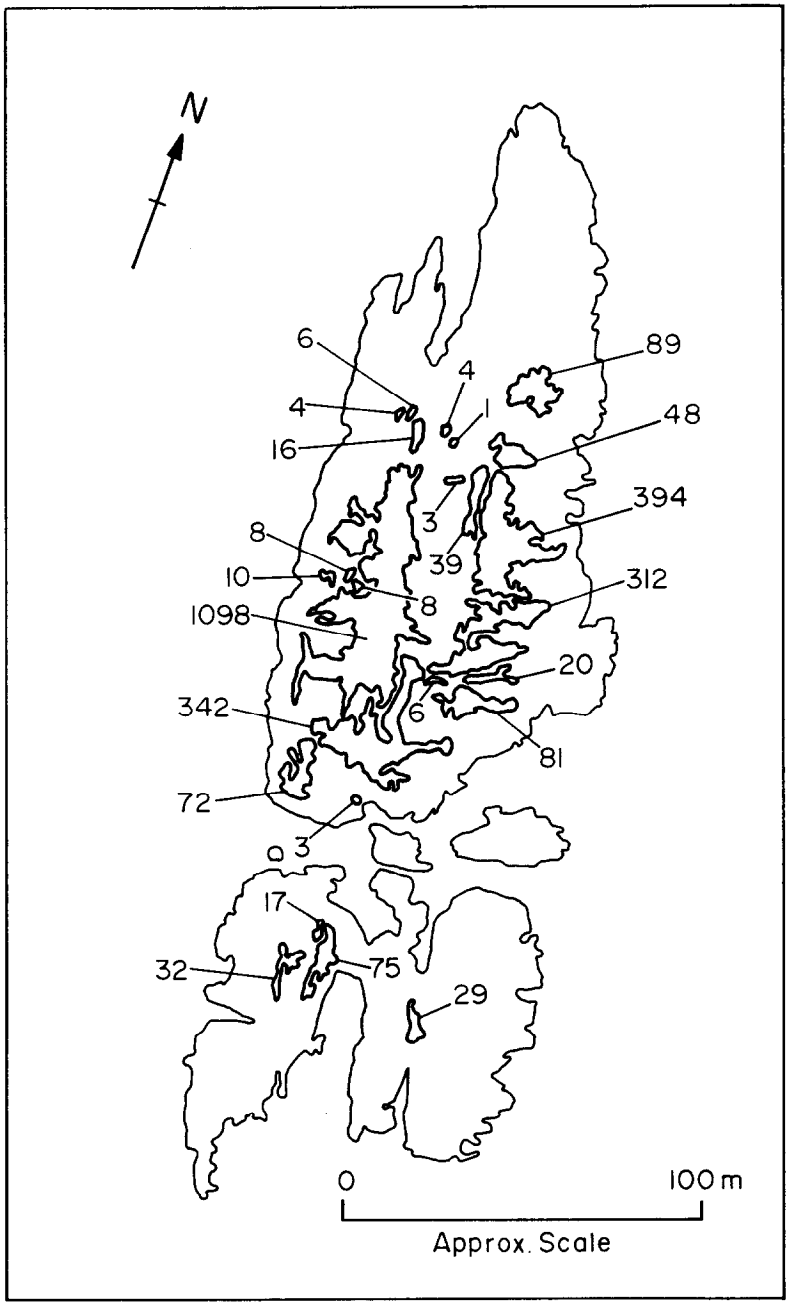
Map 8.
Rookery Island 4
Date censused: 20 December 1988
Total count: Nil nests
Previous Count: Not held



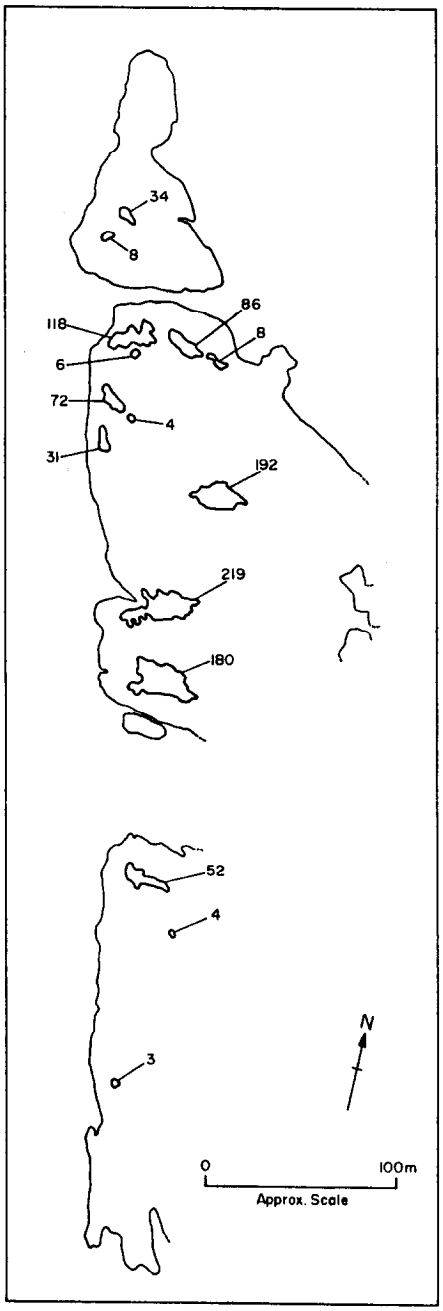
Map 9.
Rookery Island 5
Date censused: 20 December 1988
Total count: 738 nests
Previous Count: 916 nests on 14 January 1982
Previous Count: 807 adults on 17 November 1972



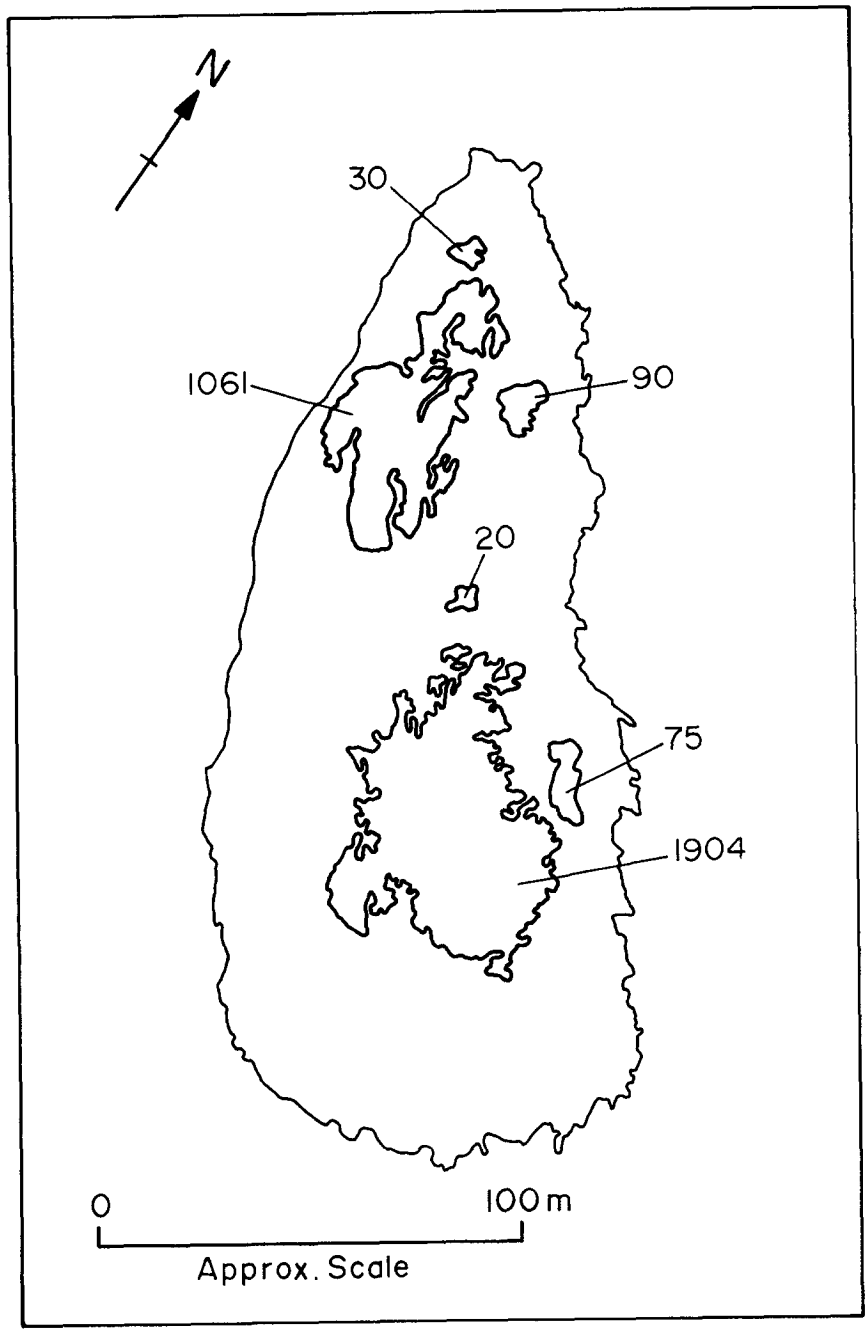
Map 10.
Rookery Island 6
Date censused: 20 December 1988
Total count: 3047 nests
Previous Count: 4097 nests on 14 January 1982 (incomplete)
Previous Count: 2934 adults on 17 November 1972



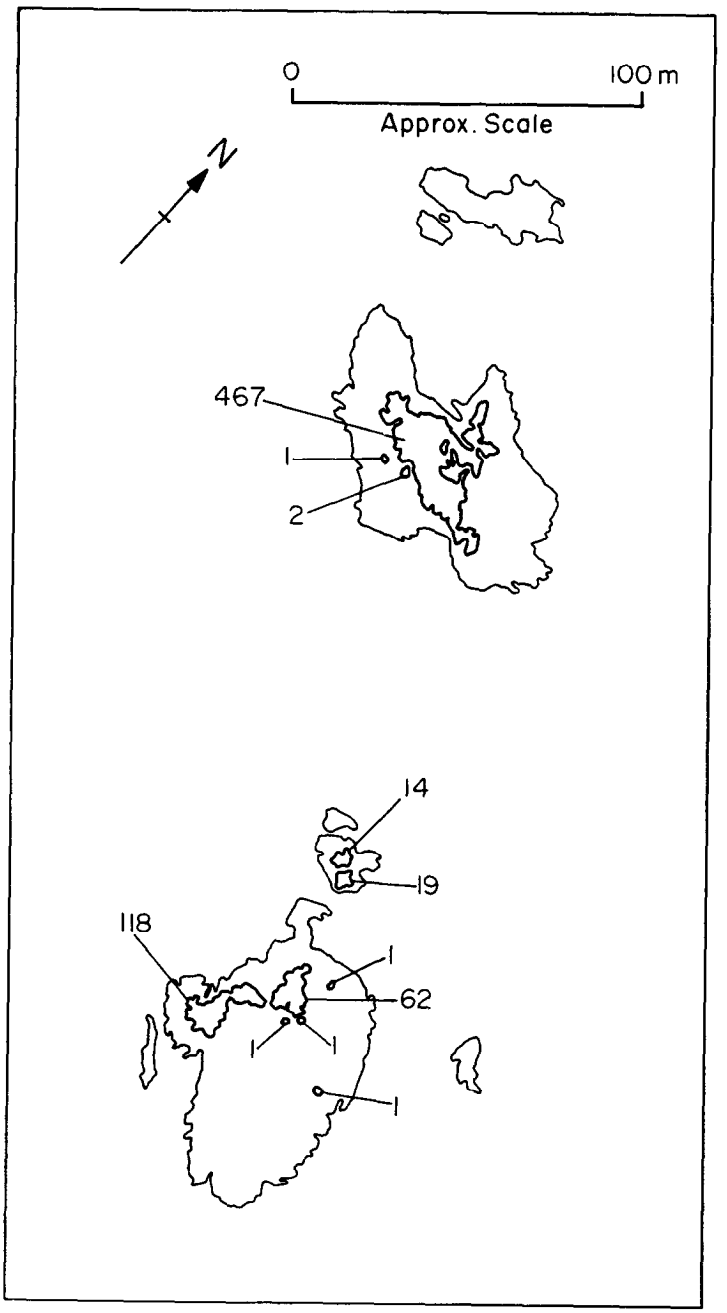
Map 11.
Rookery Island 7
Date censused: 20 December 1988
Total count: 2364 nests
Previous Count: 2494 nests on 14 January 1982
Previous Count: 1492 adults on 17 November 1972



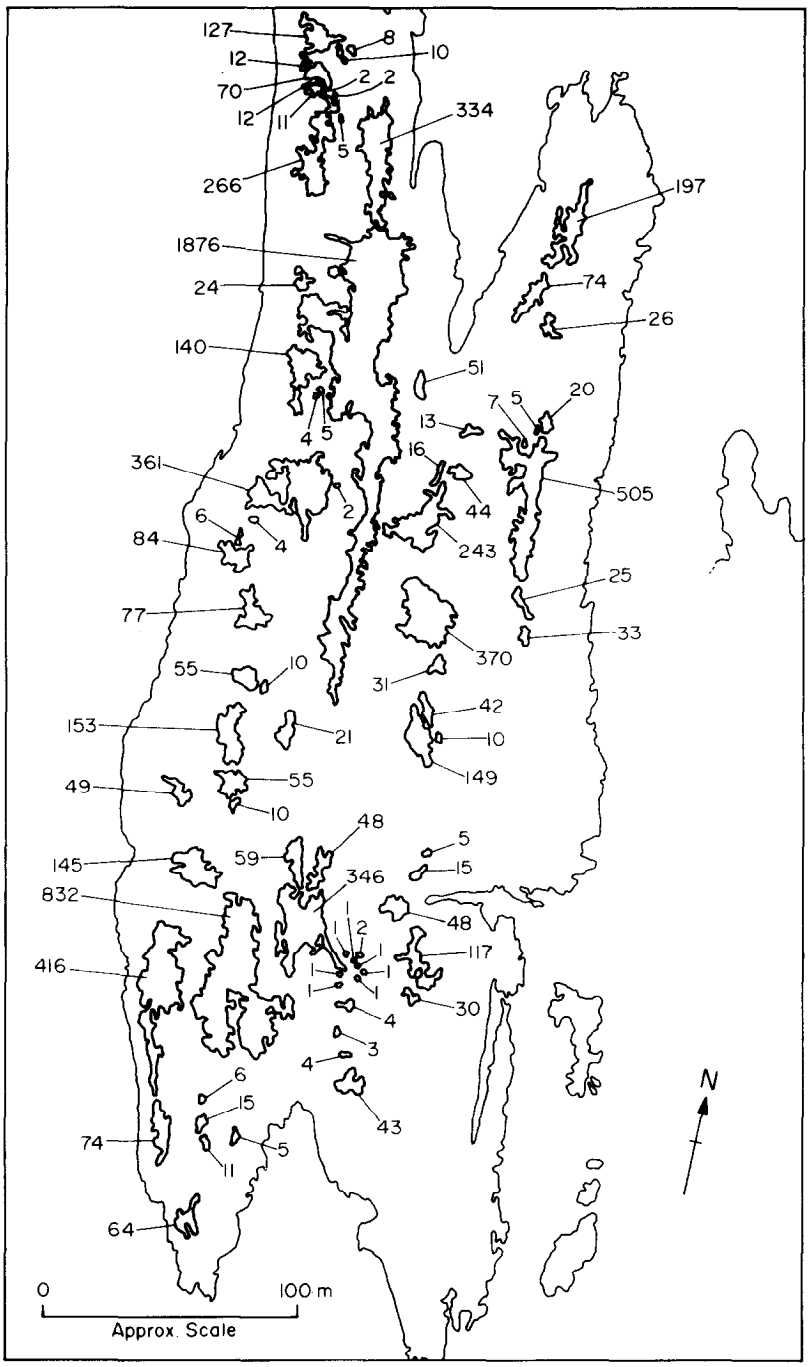
Map 12.
Rookery Island 8
Date censused: 14 January 1982
Total count: Not held (missed)
Previous Count: 1180 nests (incomplete)
Previous Count: 698 adults on 17 November 1972



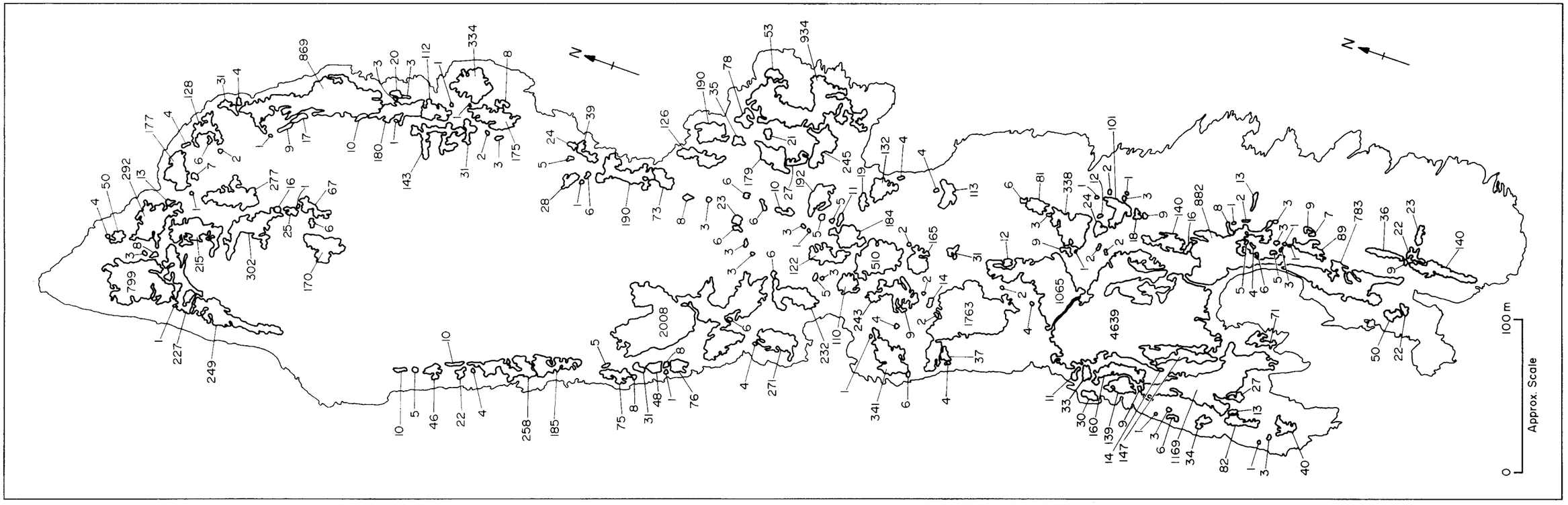
Map 13.
Rookery Island 9
Date censused: 20 December 1988
Total count: 2767 nests
Previous Count: 3061 nests on 14 January 1982 (incomplete)
Previous Count: 2031 adults on 17 November 1972



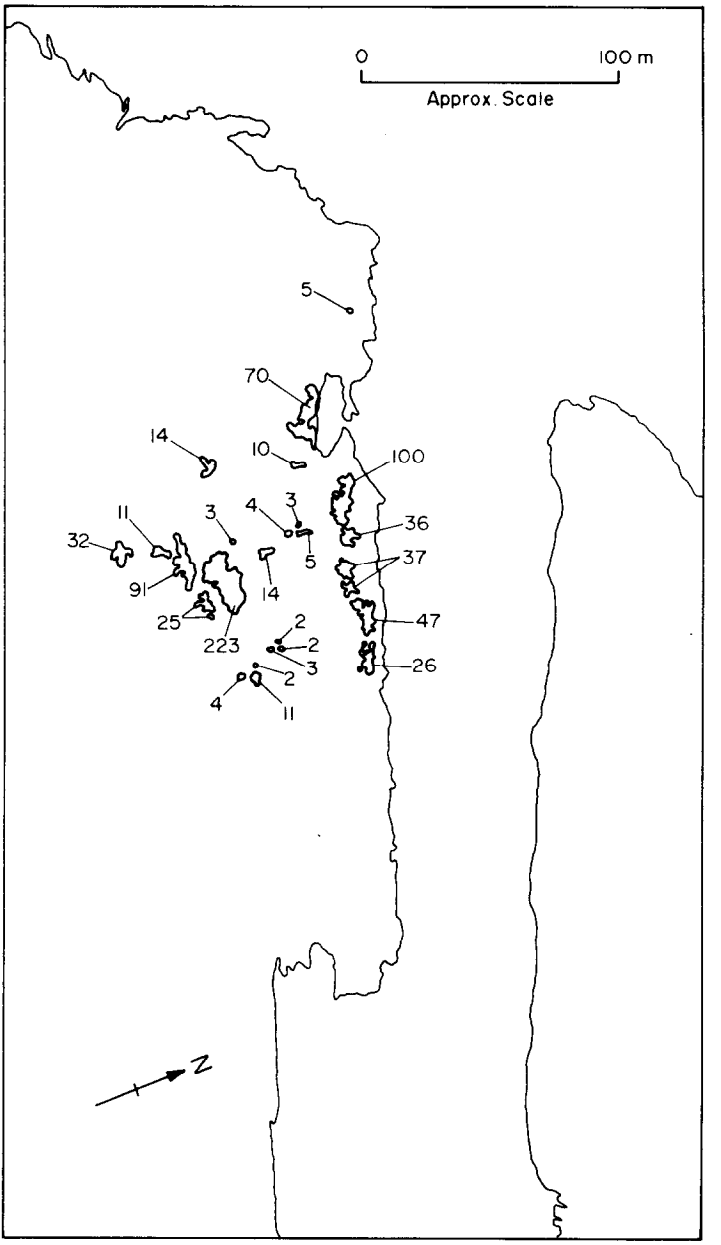
Map 14.
Rookery Islands 10 and 11
Date censused: 20 December 1988
Total count: 189 (Island 10) and 409 (Island 11) nests
Previous Count: 223 adults (Island 10) on 17 November 1972
Previous Count: 326 adults (Island 11) on 17 November 1972



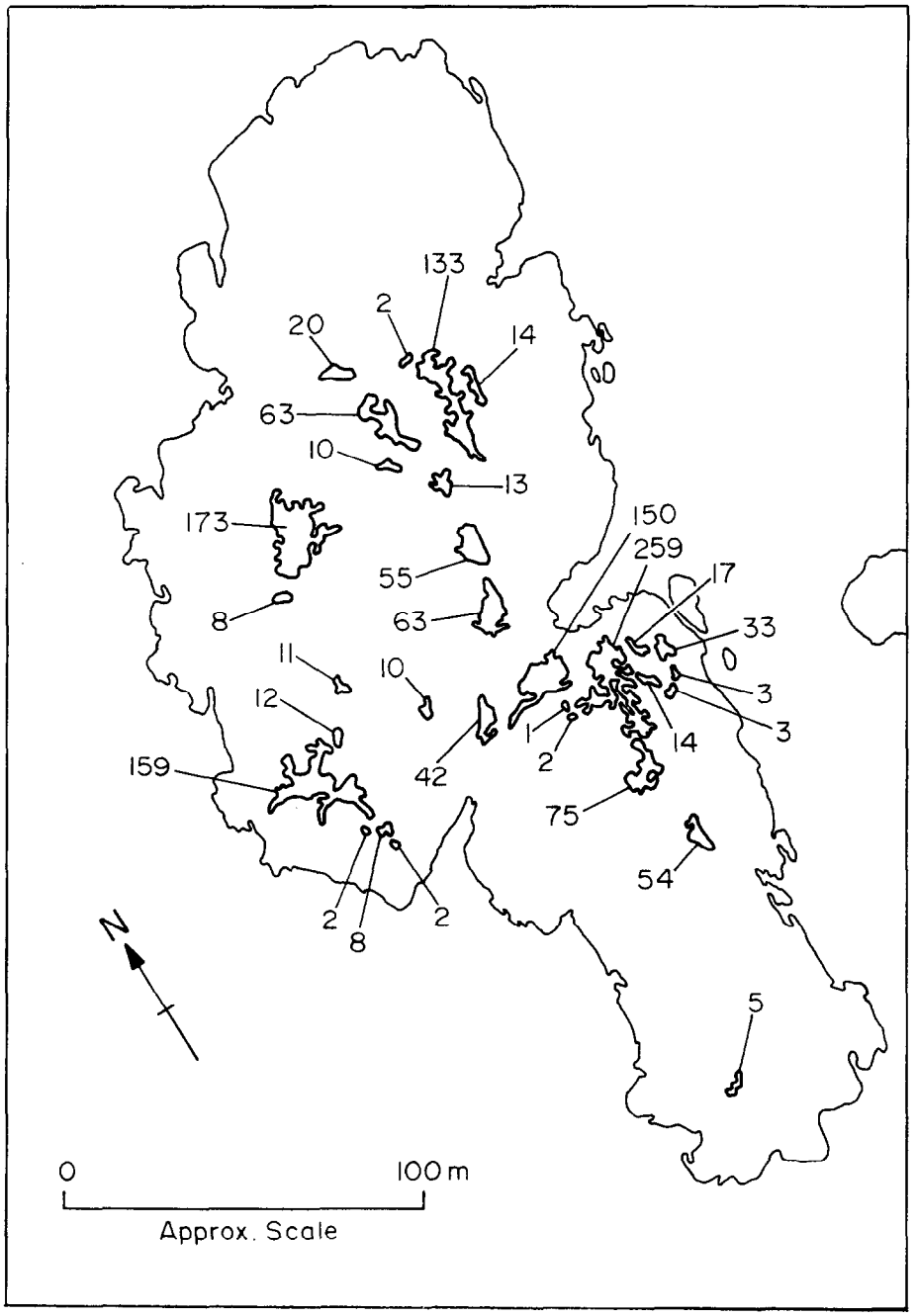
Map 15.
Giganteus Island
Date censused: 20 December 1988
Total count: 6795 nests
Previous Count: 8534 nests on 14 January 1982
Previous Count: 7080 adults on 17 November 1972



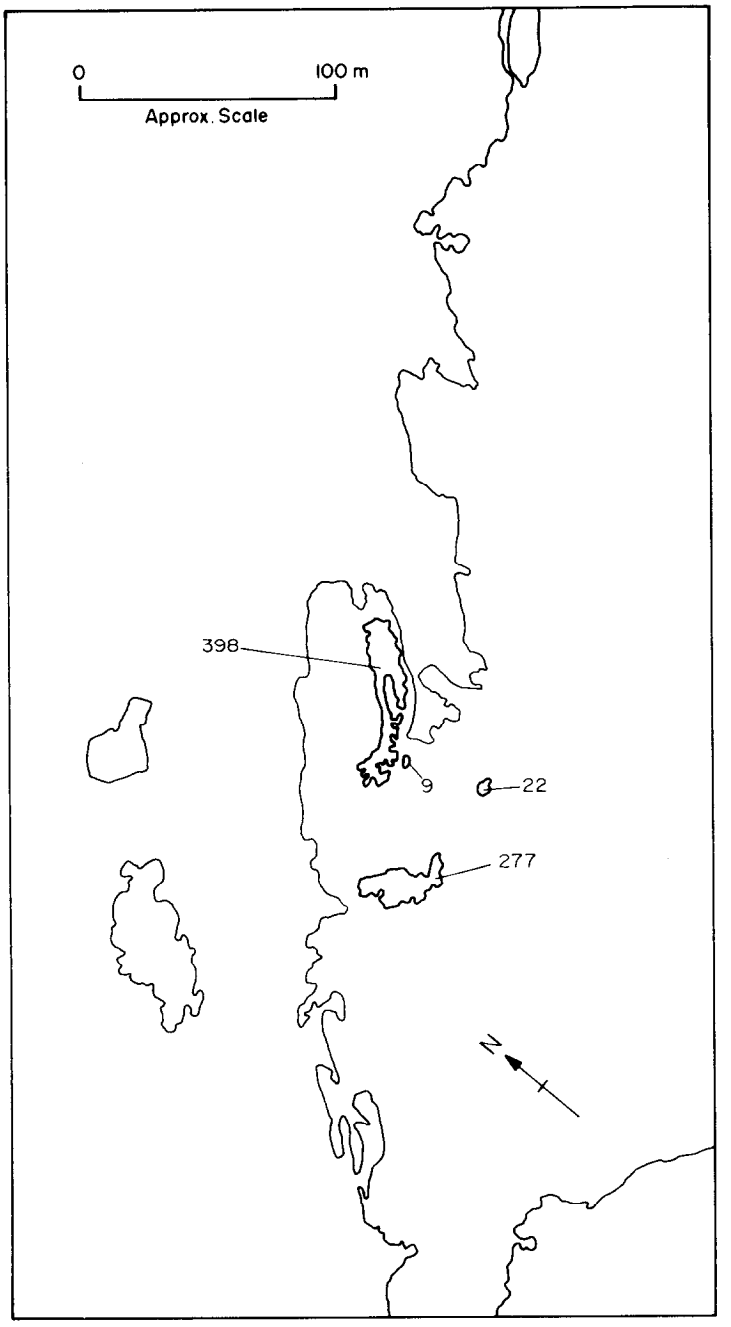
Map 16.
Rookery Island
Date censused: 20 December 1988
Total count: 21 994 nests
Previous Count: 21 489 nests on 14 January 1982
Previous Count: 15 020 adults on 17 November 1972



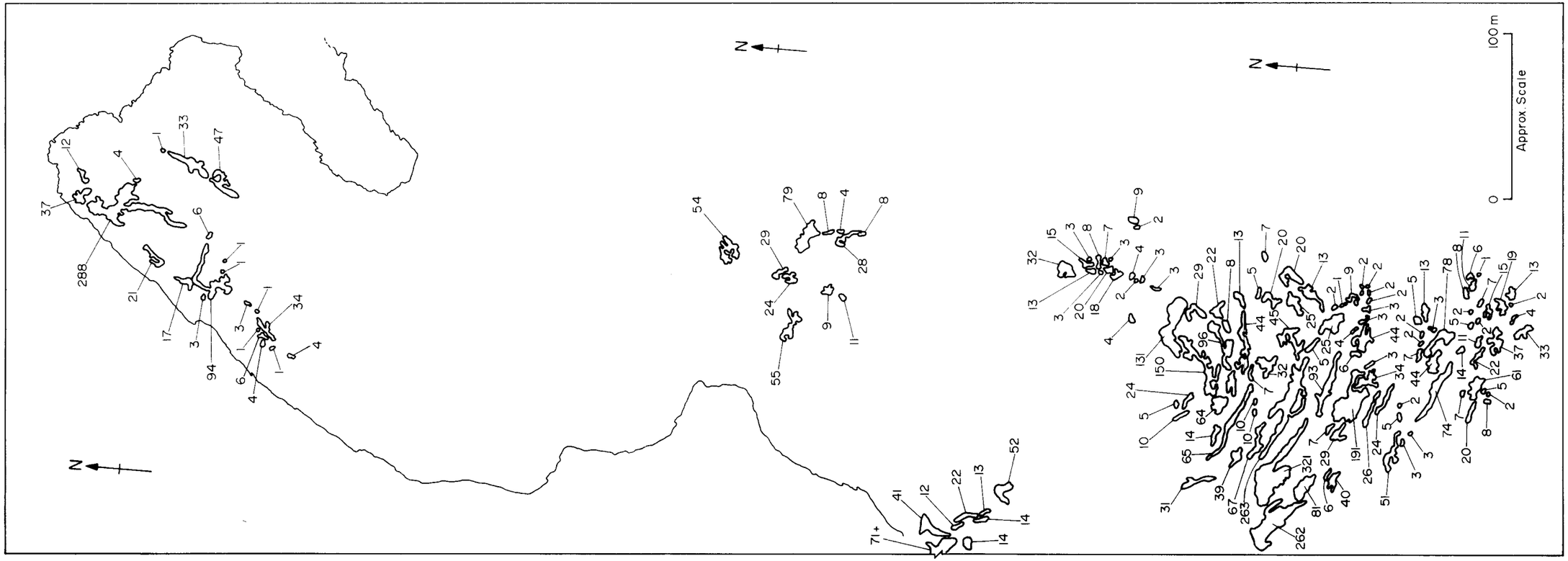
Map 17.
Béchervaise Island
Date censused: 20 December 1988
Total count: 679 nests
Previous Count: 684 nests on 14 January 1982 (incomplete)
Previous Count: 744 adults on 17 November 1972



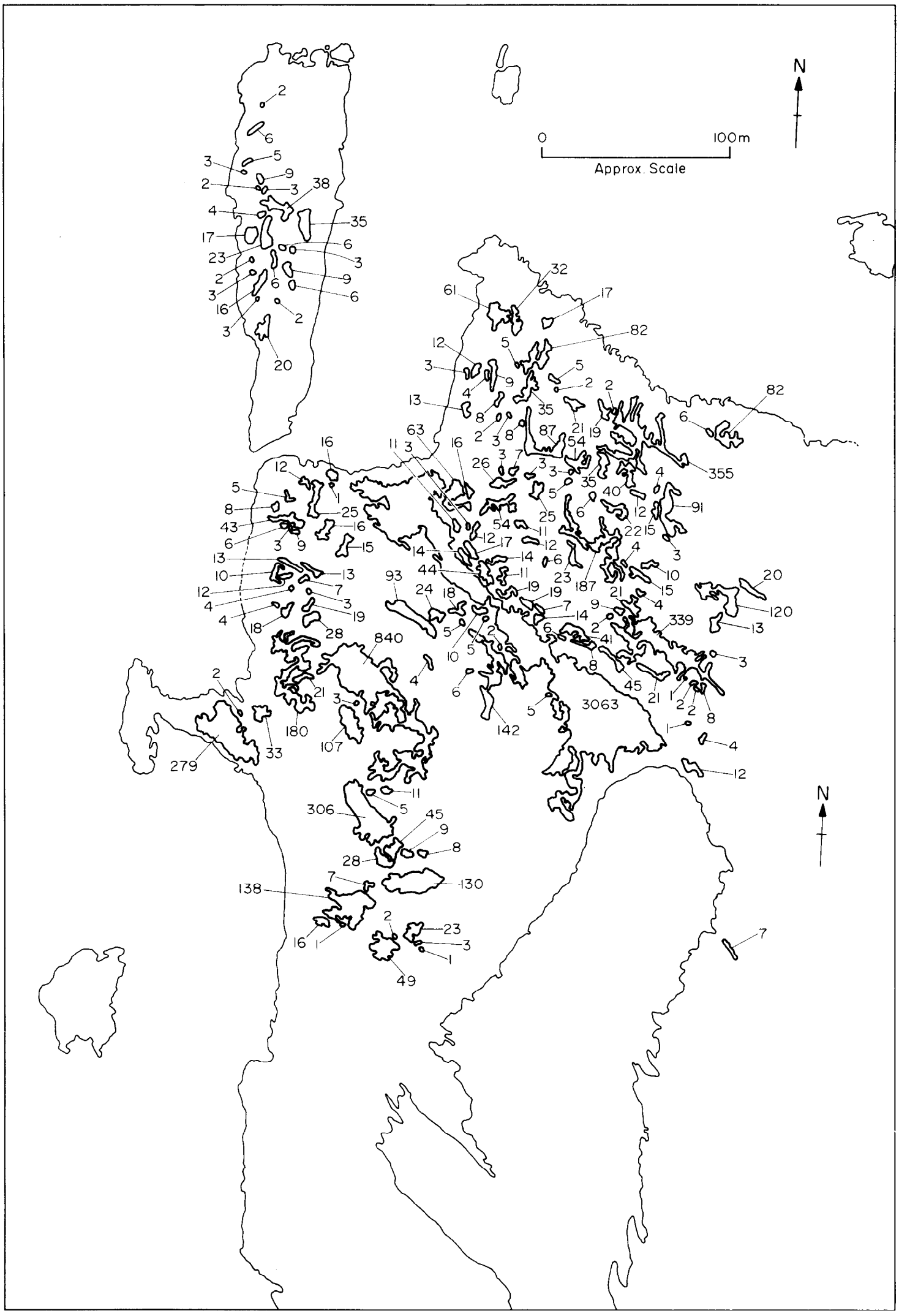
Map 18.
Verner Island
Date censused: 20 December 1988
Total count: 1232 nests
Previous Count: 1517 nests on 14 January 1982
Previous Count: 1966 adults on 8 December 1972



Map 19.
Petersen Island
Date censused: 20 December 1988
Total count: 614 nests
Previous Count: 684 nests on 14 January 1982
Previous Count: 500 adults on 9 December 1972



Map 20.
Welch Island (1) and (2)
Date censused: 20 December 1988
Total count: 11 328 nests (incomplete)
Previous Count: 10 137 nests on 14 January 1982 (incomplete)
Previous Count: 9445 adults on 8 December 1972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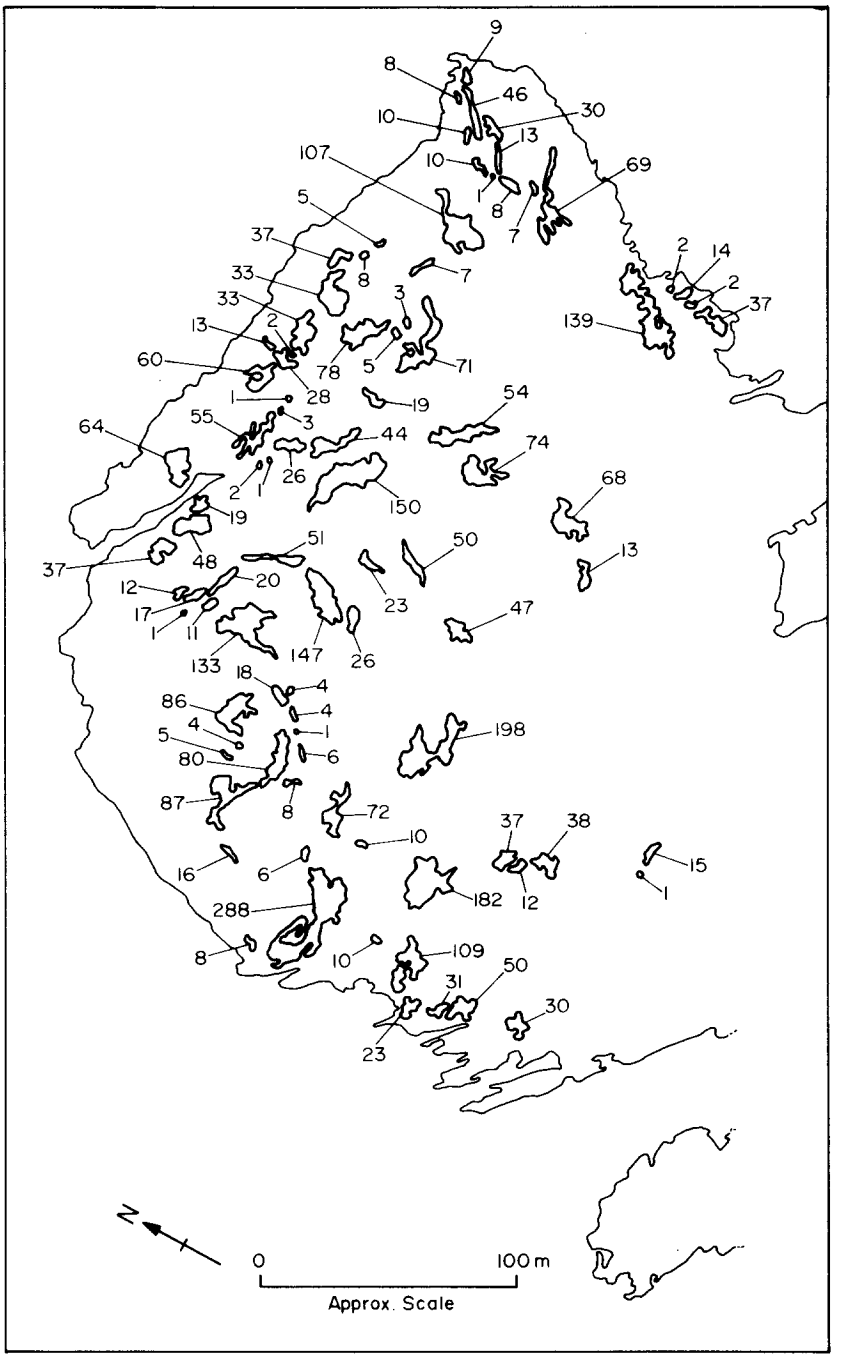
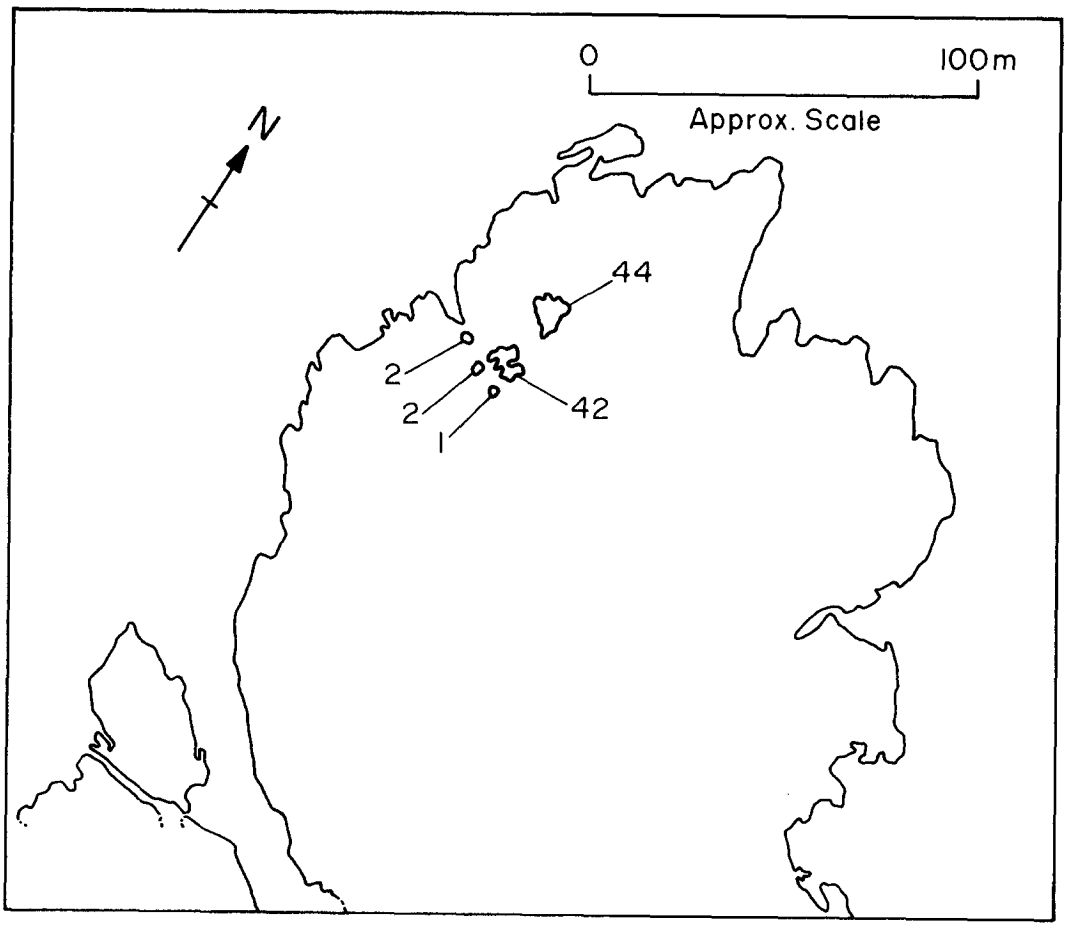
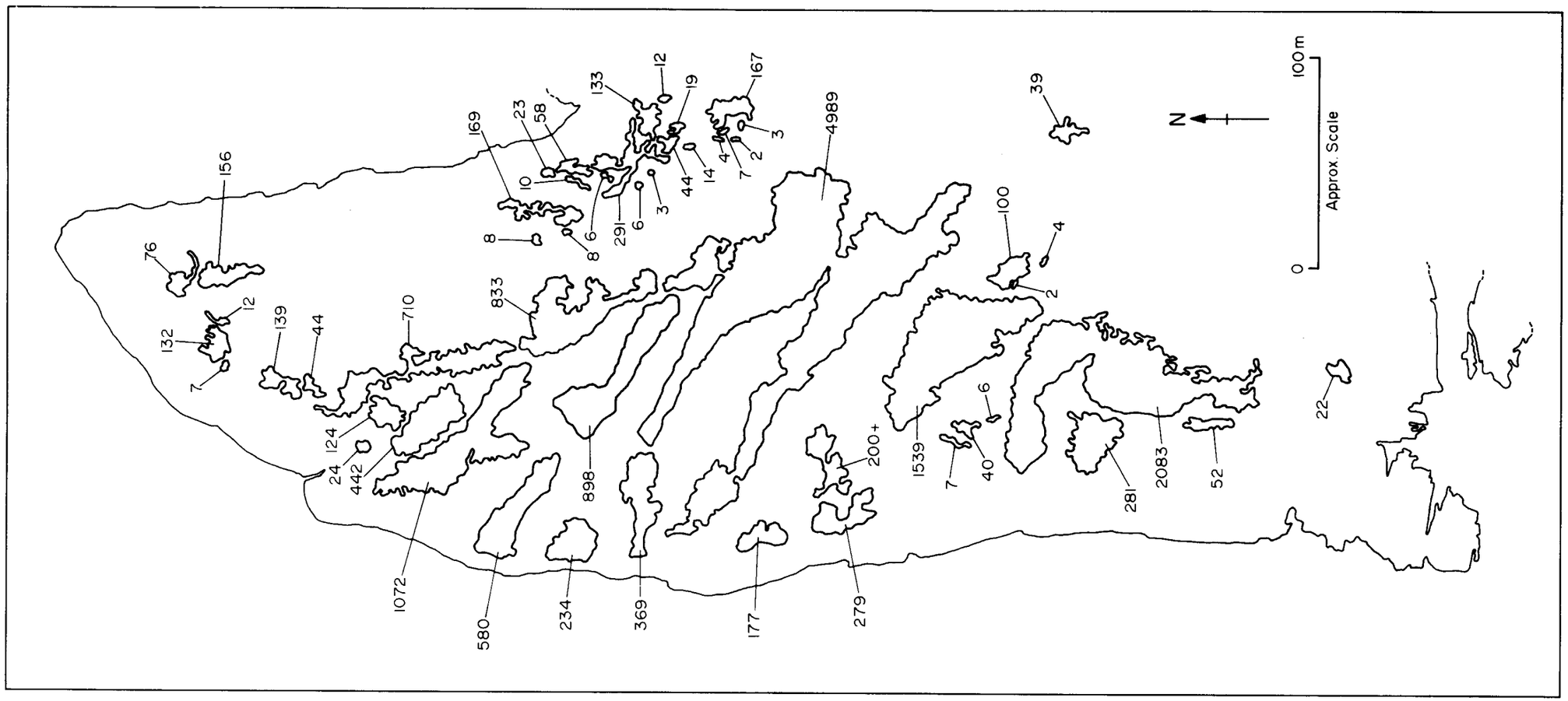


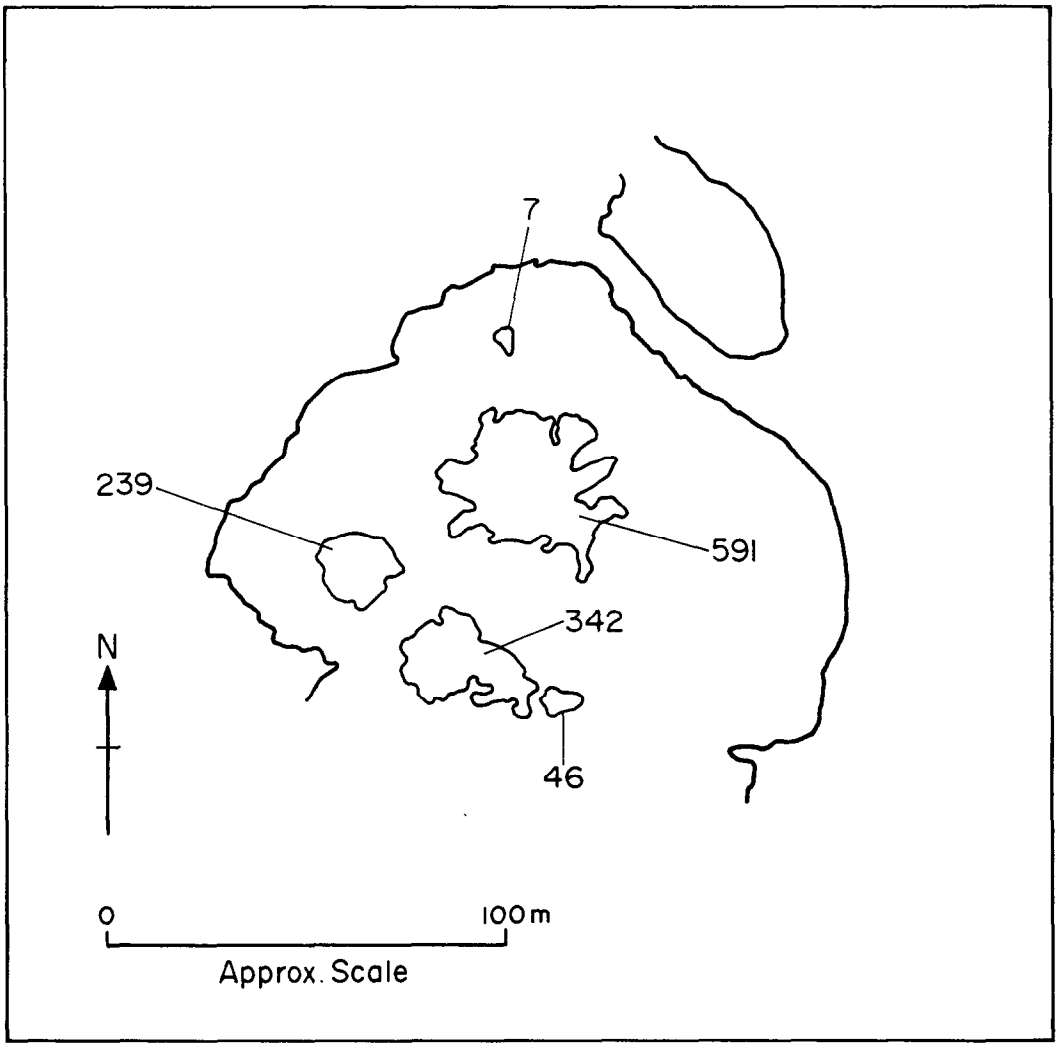
Map 21.
Klung Island
Date censused: 20 December 1988
Total count: 3018 nests
Previous Count: 4345 nests on 14 January 1982 (incomplete)
Previous Count: 4419 adults on 8 December 1972



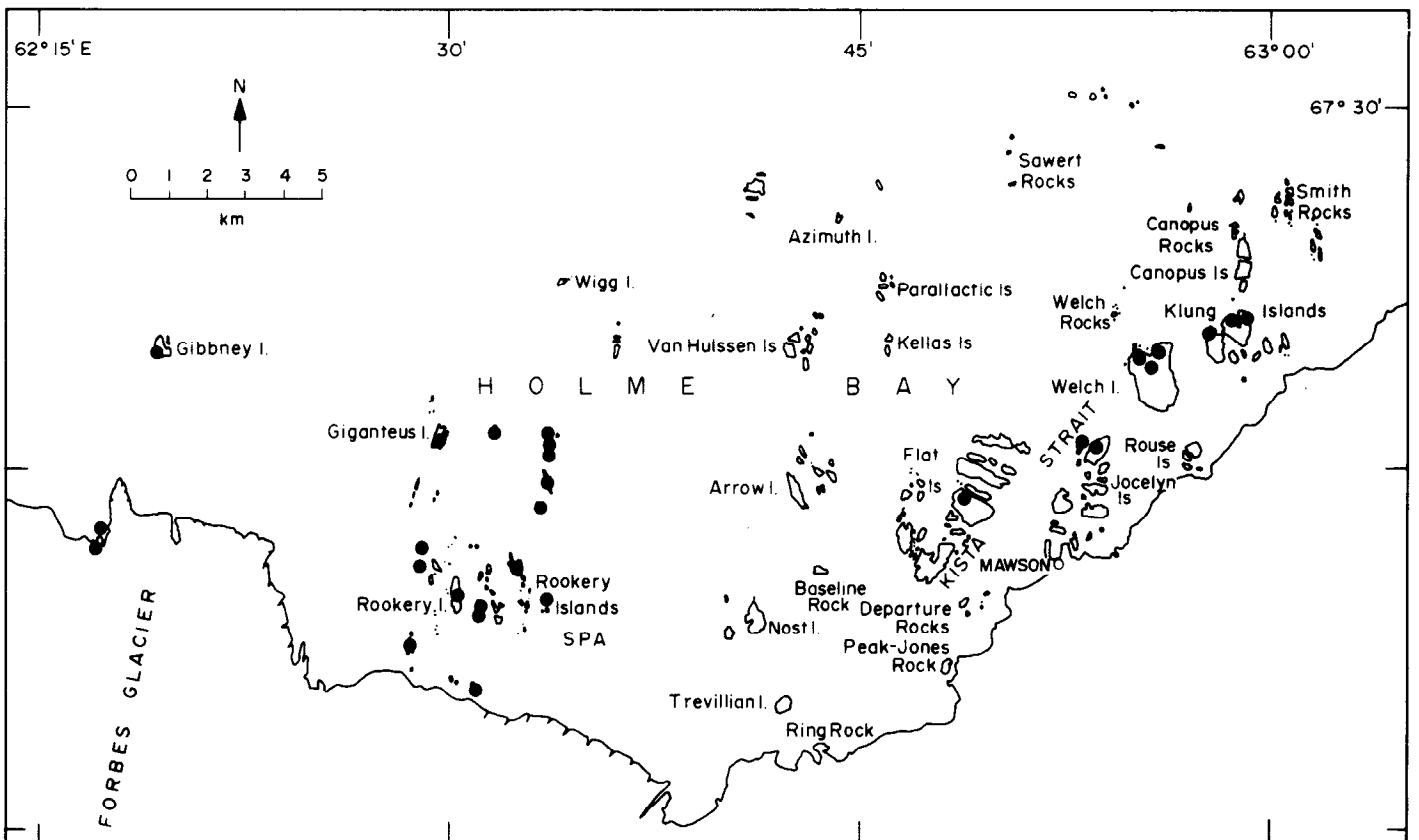
Map 22.
Un-named island west of Klung Island
Date censused: 20 December 1988
Total count: 79 nests
Previous Count: 57 nests on 14 January 1982



Map 23.
Gibbney Island
Date censused: 14 January 1982
Total count: 19 324 nests (incomplete)
Previous Count: Not held



Map 24.
Un-named island west of Forbes Glacier
Date censused: 14 January 1982
Total count: 1421 nests
Previous Count: Not held



Map 25. Islands surveyed in 1981-82 where Adélie penguin colonies were located are marked •. Apart from Rookery Islands 10 and 11, all islands on the map were over-flown and surveyed.

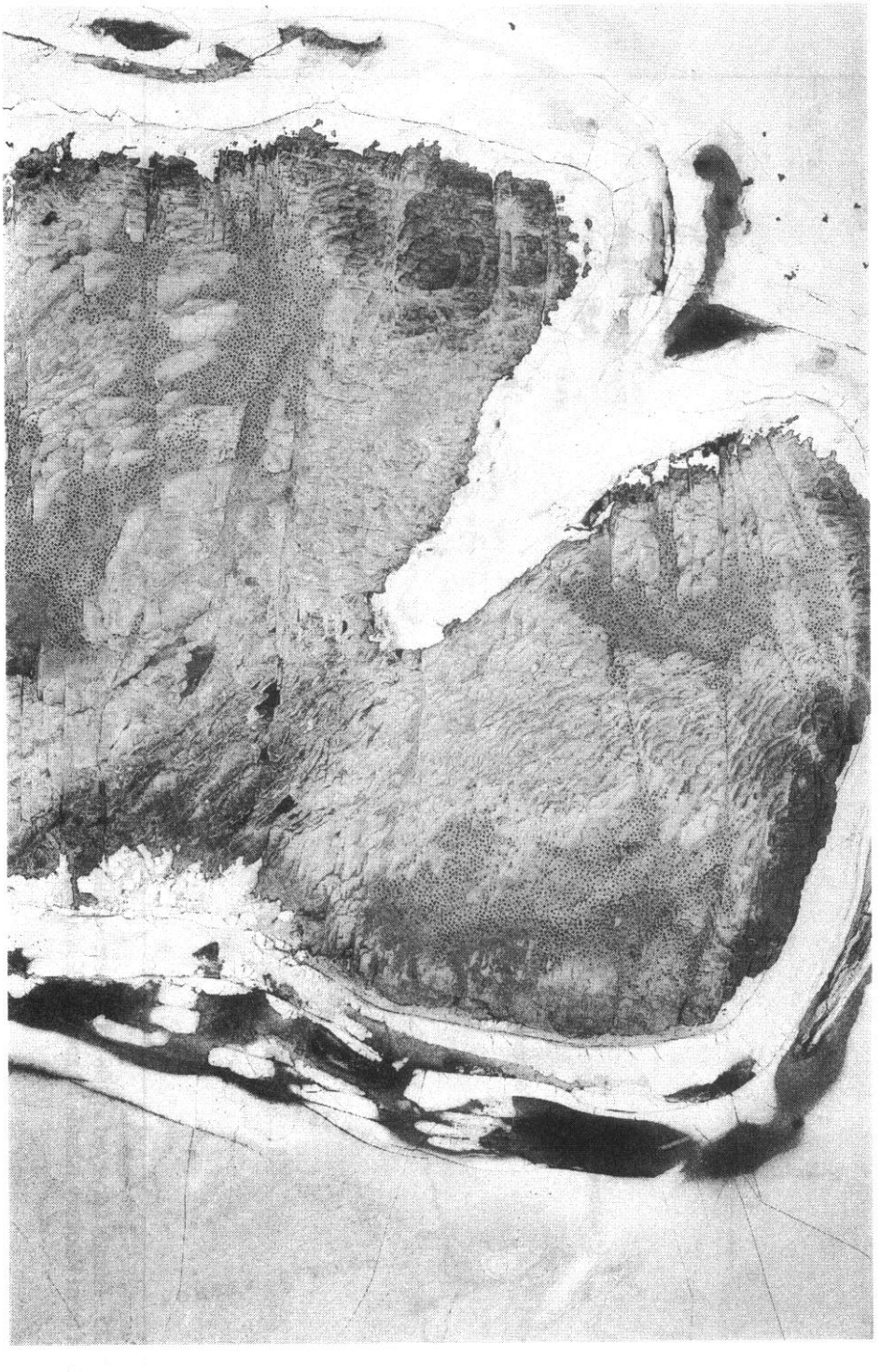


Plate 1. Part of the Adélie penguin colony on Rookery Island 6, 20 December 1988.

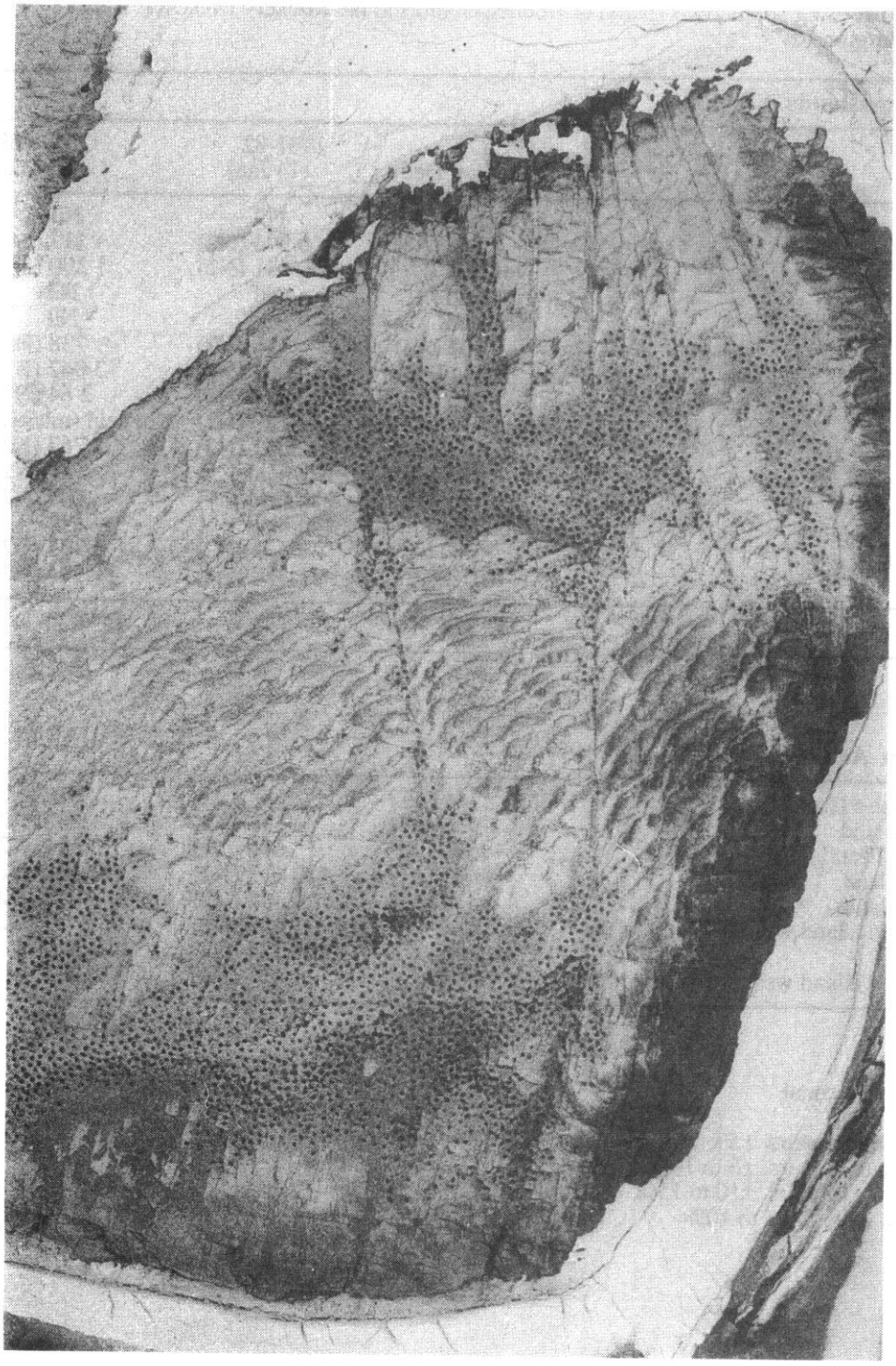


Plate 2. Enlargement, Plate 1.

Table 1. Breeding populations (pairs) of Adélie penguins in the Rookery Islands SPA and Mawson region.

Rookery Islands SPA

Island	1972-73 (17 Nov + 8, 9 Dec)	1981-82 (14 Jan)	1988-89 (20 Dec)
1	Not held	Nil	Nil
2	4 765 (A3)	6 994 (N2)	4 117 (N2)
3	Not held	*1441 (N2)	1 200 (N2)
3A	Not held	Nil	Nil
4	Not held	Not held	Nil
5	807 (A3)	916 (N2)	738 (N2)
6	2 934 (A3)	*4 097 (N2)	3 047 (N2)
7	1 492 (A3)	2 494 (N2)	2 64 (N2)
8	698 (A3)	*1 180 (N2)	Not held (missed)
9	2 031 (A3)	3061 (N2)	2 767 (N2)
10	223 (A3)	Not held 1	89 (N2)
11	326 (A3)	Not held 4	09 (N2)
12	Not held	Not held	Nil
Giganteus	7 080 (A3)	8 534 (N2)	6 795 (N2)
Rookery	15 020 (A3)	21 489 (N2)	21 994 (N2)
Total	**35 376**		**43 620**

Mawson Area

Béchervaise Island	744 (A1)	*684 (N2)	679 (N2)
Verner Island	1 966 (A1)	1 517 (N2)	1 232 (N2)
Petersen Island	500 (A1)	684 (N2)	614 (N2)
Welch Island	9 445 (A1)	*10 137 (N2)	*11 328 (N2)
Klung Island	4 419 (A2)	*4 345 (N2)	3 018 (N2)
Un-named island west of Klung Island	Not held	57 (N2)	79 (N2)
Gibbney	Not held	*19 324 (N2)	Not held
Un-named island west of Forbes Glacier	Not held	1 421 (N2)	Not held
Total	**16 780**		***16 950**

* incomplete count

A1 Counts of pairs, ±5%
A2 Counts of pairs, ±5 to 10%
A3 Counts of pairs, ±10 to 15%
N2 Nest counts, ±5 to 10%

4. DISCUSSION

Although the 1981-82 35 mm photography did allow population counts to be made, the 70 mm photography undertaken in 1988-89 was markedly superior in definition and clarity, resulting in less time spent in counting from photographs (Plates 1 and 2).

The number of Adélie penguins breeding in the Rookery Island SPA increased between 1972-73 and 1981-82, and has remained stable since then. The population on Rookery Island increased by 46%, although the census in 1972-73 could have under-estimated the population, given the difficulties in counting large colonies. The increase on Rookery Island represents almost 85% of the total population increase in the SPA between 1972-73 and 1988-89, but there are no indications why the breeding population on Rookery Island should have increased while the other islands' populations have not. The breeding population on the islands in the Mawson area has not changed between 1972-73 and 1988-89.

Increases in the numbers of breeding pairs of Adélie penguins have been reported at Casey by M.R. Martin (personal communication, 1989) and at the Vestfold Hills by M.D. Whitehead, (personal communication, 1989). Reports of increases from other sites around the Antarctic continent include Dumont d'Urville between 1958 and 1984 (Thomas 1986). The increase in population of Adélie penguins at most localities in East Antarctica implies an increasing demand for marine resources by these birds.

Population changes may be attributable to overall changes in colony densities as the areas occupied by the colonies did not appear to have changed. Rather, the same areas now (1988-89) contain a greater number of nests than in 1981-82. These data seem to indicate that the preferred nesting habitats for Adélie penguins are areas already colonised, and new colonies are only established when existing colonies are over-crowded. This conclusion is supported by the observation that no new colonies were observed, except on the small un-named island west of Klung Island. The high number of islands without Adélie penguin breeding colonies is further evidence for such a preference. The islands not colonised by Adélie penguins may also not be suitable for nesting. Although the counts were made at times during the breeding season which include both parents being present at the nest (17 November) and only one parent present (December and January), the data are comparable in that they refer to the numbers of breeding pairs or occupied nests. The best dates for a census are approximately 25 November to 10 December when only one bird is present at the nest.

An estimate of the total number of Adélie penguins in the Rookery Islands SPA for 1988-89 can be derived from the 1981-82 count for Island 8 (minimum of 1180 nests) and the total for the fourteen other islands with Adélie penguin colonies (43 620 nests in 1988-89), giving a minimum total of 44 800 pairs. Similarly, the number of Adélie penguins on the islands offshore from Mawson (minimum of 16 950 nests) and the 1981-82 data from Gibbney Island (minimum of 19 324 nests) and the un-named island west of Forbes Glacier (minimum of 1421 nests) gives a figure of 37 695 nests. The estimate for the population in 1988-89 is therefore 82 495.

As the closest known Adélie penguin colonies east of Mawson are at Scullin (67°47'S 66°42'E) and Murray (67°47'S 66°53'E) Monoliths (Woehler and Johnstone in press), and there are only small, scattered colonies along the coast west of the Forbes Glacier to the Taylor Glacier (67°26'S 60°50'E), the estimate of 82 500 pairs is applicable to the coast between Scullin Monolith and Cape Batterbee (65°51'S 53°48'E) (Woehler and Johnstone in press).

The data set collected in the early 1970s, when compared with data collected in 1982 and 1988, extends the time frame in which population trends in the Mawson area can be assessed.

The irregular nature of the population increases and decreases, reported here from the Mawson region and the Rookery Islands SPA, highlight the value of annual, long-term monitoring of Adélie penguin colonies such as those undertaken at Magnetic Island near Davis (Whitehead *et al.* in press). A limitation of this study is that the authors are only dealing with 'snap-shots' of colony numbers at infrequent intervals, without knowing the degree of annual variation in population size. However, the data are of sufficient quality to confirm that the Adélie penguin populations in the Mawson region have remained stable and those in the Rookery Islands SPA have increased by 15.4% between 1972-73 and 1988-89.

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