A SURVEY OF BURROW-NESTING PETRELS AT MACQUARIE ISLAND BASED UPON REMAINS LEFT BY PREDATORS

By EVAN JONES

SUMMARY

From December 1973 to March 1975, the food of feral cats *(Felis catus)* was studied at Macquarie Island; during the 1974-75 and 1975-76 summers, the food of Great Skuas *(Stercorarius skua lonnbergi)* was also partly studied. Data were obtained on the numbers, species and locations of remains of burrow-nesting petrels left by these two predators. Seven species of burrow-nesting petrels were identified from the remains found. These results when considered with previous records of burrow-nesting petrels at Macquarie Island indicate their status, relative abundance and distribution.

INTRODUCTION

When discovered in 1810, Macquarie Island's original fauna was characterised by large numbers of penguins, surface-nesting seabirds and burrow-nesting petrels in the absence of any land-dwelling mammals. However, cats *(Felis catus)* taken to the island by sealers had become feral by 1820 (Debenham 1945), Stewart Island Wekas *(Gallirallus australis scotti)* were introduced in 1867, and European rabbits *(Oryctolagus cuniculus)* in 1879 (Cumpston 1968). These introductions, together with black rats *(Rattus rattus)* and house mice *(Mus musculus)*, which also became established during the nineteenth century, have had a major impact on the island's avifauna, especially the burrow-nesting petrels.

The first records of the burrow-nesting petrels at Macquarie Island were those of Scott (1882) and Hamilton (1894). However, the first comprehensive account was published by Campbell (1900), based on information and specimens supplied by J. R. Burton, who spent over three years there between 1896 and 1900 (Cumpston 1968). Further information, collected by H. Hamilton and other members of the Australasian Antarctic Expedition (AAE) of 1911-13 and by the British Australian New Zealand Antarctic Research Expedition (BANZARE) of 1929-31 was published by Falla (1937). The burrow-nesting petrels known to have bred at Macquarie Island were White-headed Petrels *(Pterodroma lessonii)*, Blue Petrels *(Halobaena caerulea)*, Antarctic Prions *(Pachyptila desolata)*, Grey Petrels *(Procellaria cinerea)*, Sooty Shearwaters *(Puffinus griseus)* and diving petrels *(Pelecanoides* sp.).

More recently, information on the species of burrow-nesting petrels collected or sighted by members of the Australian National Ant-

arctic Research Expeditions (ANARE) stationed there since March 1948 has been published by Carrick (1956), Law & Burstall (1956), Keith & Hines (1958), Warham (1967, 1969) and Merilees (1971). Included were species not previously recorded from Macquarie Island. However, because no recent comprehensive survey has been published and because of possible continuing population changes, the distribution and abundance of the species present and the present status of some are still poorly known.

During studies of the food of feral cats and Great Skuas *(Stercorarius skua lonnbergi)*, all the remains of burrow-nesting petrels found were recorded. This paper presents these data and discusses their relevance as indicators of the status, relative abundance and distribution of burrow-nesting petrels at Macquarie Island.

METHODS

Macquarie Island has three main physiographic areas: an undulating plateau mainly of subglacial herbfield and feldmark, steep slopes of wet tussock grassland dissected by valleys and areas of scree, and a raised coastal terrace predominantly of herbfield and wet tussock grassland (Taylor 1955). From December 1973 to March 1975 regular searches were made on the plateau, much of the coastal terrace and some areas of the slopes for cat scats. The locations of all scats found were recorded and the cats' diet was investigated by an analysis of 756 scats and the gut contents of 41 adult cats collected; the species of petrels eaten were identified from the bone fragments and feathers found (Jones 1977). In addition, from September 1974 to March 1975 and again in the following (1975/76) summer, the same general areas, particularly where skuas bred, were also searched for casts regurgitated by skuas and for remains of burrow-nesting petrels (Jones & Skira 1979). Petrel bones and feathers were found in casts, and legs, skulls, wings and intact pectoral girdles were also collected; the locations of these remains and minimum numbers of petrels they represented were recorded.

RESULTS

The species of burrow-nesting petrels and the numbers identified in cat scats and guts and collected from skua territories are listed in Table 1. Seven species were identified in the remains left by skuas but only two in cat scats and guts. This discrepancy was probably related to the different ways cats and skuas eat and digest their prey, rather than to selective predation by cats.

The only species eaten frequently by both cats and skuas were Antarctic Prions and White-headed Petrels. For cats, fragments of Antarctic Prions were about twice as numerous as those of White-headed Petrels. Calculations of cat predation rates for these two species based on their relative sizes and the cats' dietary needs indicated that the cats ate about four and a half times as many Antarctic Prions as White-headed Petrels (Jones 1977). During the 1974-75 summer many more remains of Antarctic Prions were found in skua territories than

TABLE 1 — Species and numbers of remains of burrow-nesting petrels recorded from cat and skua kills.

Petrel Species	Remains from cat scats and guts	Numbers from Skua Territories	
		1974/75 Summer	Summer 1975/76
Antarctic Prion	230	442	149
White-headed Petrel	130	219	204
Sooty Shearwater	–	46	34
Blue Petrel	–	7	86
Common Diving Petrel	–	2	–
Short-tailed Shearwater	–	2	–
Soft-plumaged Petrel	–	–	2

during the 1975-76 summer, although White-headed Petrels were in similar numbers. Skuas are able to swallow the wings of Antarctic Prions but not those of the larger White-headed Petrels; failure to examine skua casts during the 1975-76 summer survey probably explains this variation.

The locations of all remains of Antarctic Prions and White-headed Petrels collected to March 1975 are presented in Figures 1 and 2. Remains of Antarctic Prions were found over much of the plateau except for the area north of Bauer Bay, with the major concentrations sited over the middle third of the plateau, particularly south of Bauer Bay, inland from Aurora Point and south of Green Gorge. Further south remains were numerous on the western plateau and in the vicinity of Caroline Cove and Hurd Point. Remains of White-headed Petrels were similarly distributed except for the plateau north of Bauer Bay where they but not prions were found. The distribution of remains of Antarctic Prions and White-headed Petrels found during the 1975-76 summer were identical with those illustrated in Figures 1 and 2. In particular, remains of Antarctic Prions were again most common over the middle third of the plateau and virtually absent north of Bauer Bay. Remains of White-headed Petrels showed a similar distribution, again with a concentration of remains north of Bauer Bay.

No remains of Sooty Shearwaters were identified in the cats' diet. Of those found in skua territories up to March 1975, 20 were on the coastal terrace east of Handspike Point, 14 were at Langdon Point, and four inland from Caroline Cove. During the 1975-76 summer their remains were more dispersed but eight were found at Langdon Point, four on the plateau south of Aurora Point and three inland from Caroline Cove.

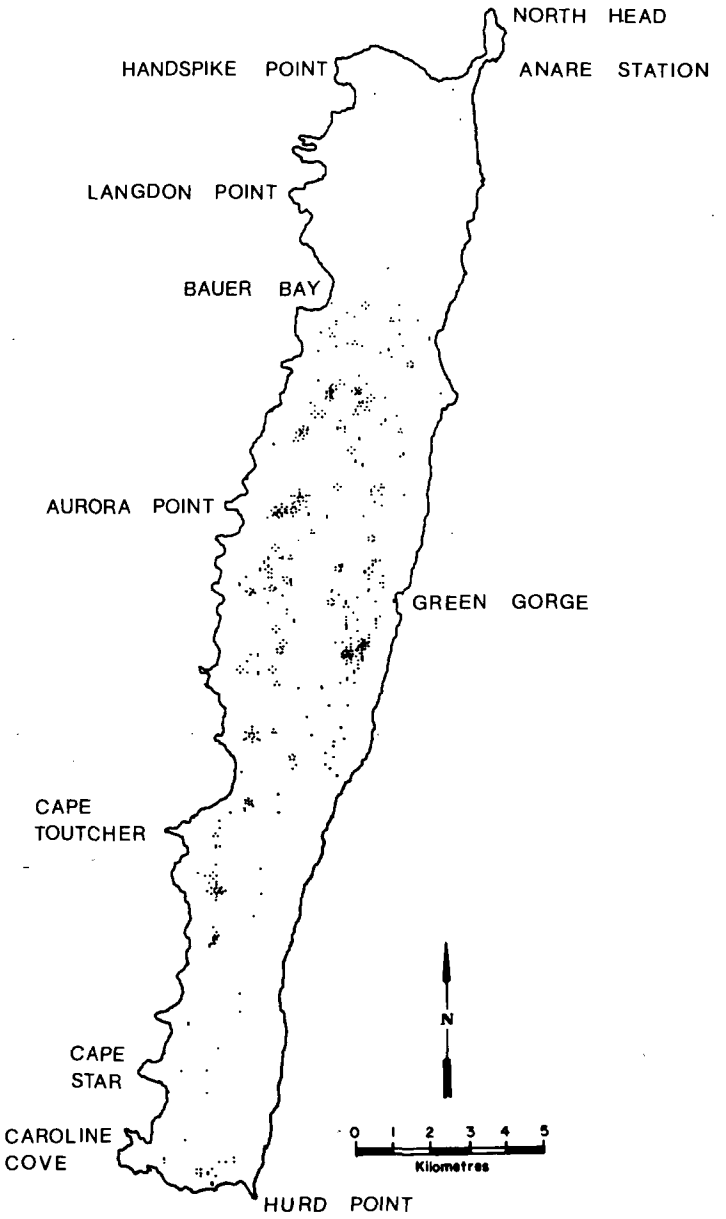

FIGURE 1 — Locations of all remains of Antarctic Prion recorded from cat and skua kills, Dec. 1973 - Mar. 1975.

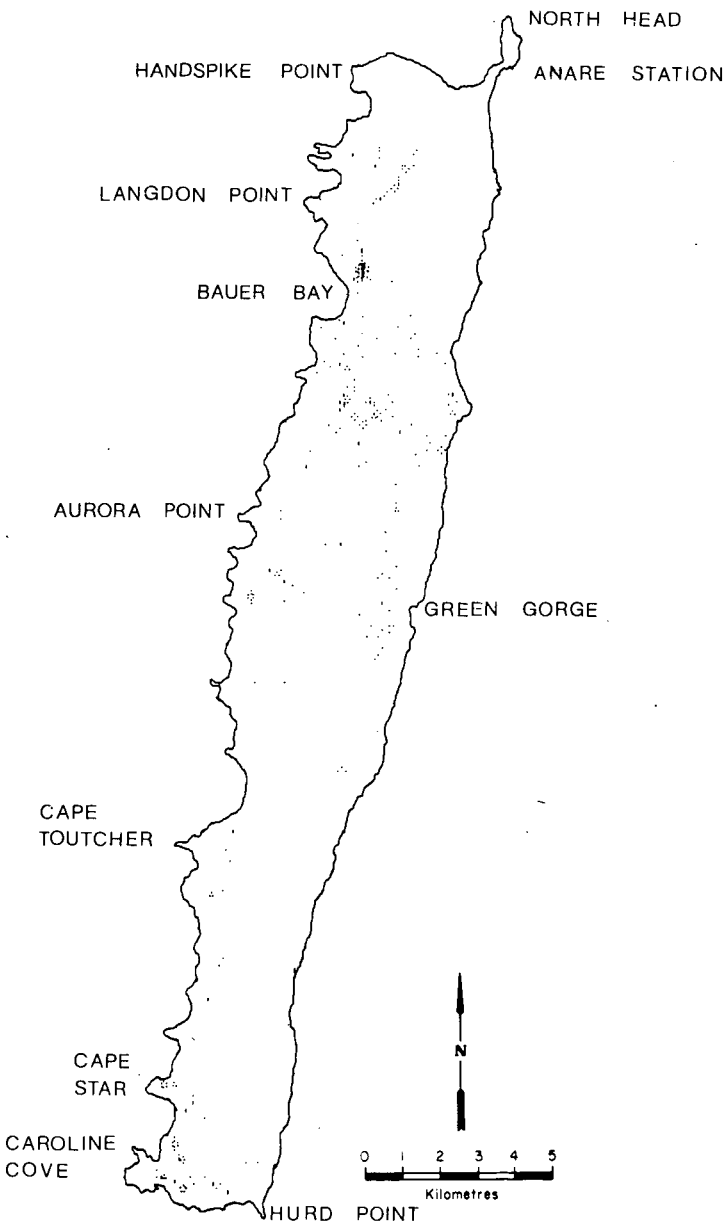

FIGURE 2 — Locations of all remains of White-headed Petrel recorded from cat and skua kills, Dec. 1973 - Mar. 1975.

Blue Petrels were not identified in the cat scats or guts; being similar in size and coloration, any bones or feathers found would have been classified as Antarctic Prion. During the 1974-75 summer the remains of seven were found in a single skua territory inland from Caroline Cove. In the 1975-76 summer many more were found, mainly at two localities, 64 at Langdon Point and 12 inland from Caroline Cove.

Two species were identified during the 1974-75 summer but not in the 1975-76 summer. The skull of a Common Diving Petrel *(Pelecanoides urinatrix)* was found in a skua territory near Caroline Cove and an intact specimen was found dead at the ANARE Station, while two skulls of Short-tailed Shearwaters *(Puffinus tenuirostris)* were found on the coastal terrace north of Langdon Point. Remains of two Soft-plumaged Petrels *(Pterodroma mollis)* were also found during the 1975-76 summer.

DISCUSSION

The conclusions drawn from these data are based on the assumption of a direct relationship between the abundance and distribution of burrow-nesting petrels and the frequency of occurrence and range of position of their remains left by cats and skuas.

This assumption must be qualified. Possible sources of error include different predation rates on different species, the difficulty of identifying the bone fragments and feathers of morphologically similar species, area biased collecting, variable distances between the capture of prey and the deposition of their remains and, in the case of cat predation, the difficulty of deciding the numbers of birds eaten from the fragments collected. Even so, any indirect survey based upon remains of petrels left by predators may give useful information on the relative frequencies and possible distributions of the species present but it does not necessarily establish breeding status, particularly for those species whose remains were found infrequently. However, by relating the results of this survey to previous records, an overall view can be presented.

WHITE-HEADED PETREL

The first record was by H. Hamilton (AAE) who collected a skin and two eggs (Falla 1937), but three eggs collected by J. R. Burton and classified by Campbell (1900) as eggs of Grey Petrels were too small for that species but consistent in size with eggs of White-headed Petrels (Warham 1967). Law & Burstall (1956) noted that "The White-headed Petrels still nest in large numbers around the fringe of the plateau . . . ." Warham (1967) located colonies on the east, west and south sides of the island, with the most extensive colonies on the western plateau stretching from Bauer Bay to the southern end of the island. Colonies now appear to be located on the plateau between Bauer Bay and Green Gorge, on the western plateau north of Bauer Bay, south of Aurora Point, south of Cape Toutcher and in the general vicinity of Cape Star and Caroline Cove.

SOFT-PLUMAGED PETREL

This is the first record of this species at Macquarie Island; an account of the identification of the remains will be published elsewhere (P. J. Fullager & G. F. van Tets, in prep.).

MOTTLED PETREL

A cranium of the Mottled Petrel *(Pterodroma inexpectata)* was found during 1956 (Keith & Hines 1958).

BLUE PETREL

They were first recorded breeding by Campbell (1900) from the evidence of skins and eggs collected by J. R. Burton, who reported them as " exceedingly numerous " (Cumpston 1968). However, the possibility of confusion between Blue Petrels and Antarctic Prions cannot be entirely ignored. There were no further records until one specimen was collected at light in 1950. Eight were collected at light in 1956; females collected between September and October had enlarged ovaries and soil on their feathers (Keith & Hines 1958). Warham (1969) found the remains of two in 1960 and an adult was caught in 1965 after it struck an aerial wire at the Anare Station (unpublished Antarctic Division record). In 1967 Merilees (1971) found the remains of at least 47 in skua territories on the plateau above Langdon Point. Results from this survey suggest colonies near Langdon Point and Caroline Cove; their continued presence as breeding species is thus indicated.

ANTARCTIC PRION

Their occurrence was first recorded by Scott (1882) and the dimensions of six eggs collected by J. R. Burton were published by Campbell (1900). Hamilton (AAE) reported them breeding in thousands and six skins and two eggs were collected by the AAE (Falla 1937). Law & Burstall (1956) stated " The Dove Prion . . . . still nests in many numbers and even these have largely disappeared from the northern half of the Island." This survey indicated that they are probably absent from the northern third of the island but still appear the most numerous and widely distributed of the burrow-nesting petrels. They appear to have a general distribution over the plateau south of Bauer Bay, particularly over the middle third of the island where the groupings of remains suggest the largest colonies are located. Further south they appear more restricted, with possible colonies on the west and south sides of the plateau.

FAIRY PRION

Two female Fairy Prions *(Pachyptila turtur)* with gonads in breeding condition and soil on their feathers were collected at light during 1956 and the remains of two more were found in 1957 (Keith & Hines 1958). There have been no further records but if only few are present they would have been difficult to detect by this survey;

their remains in cat scats could not be distinguished from those of Antarctic Prions.

GREY PETREL

The first breeding record was based on a skin and information supplied by J. R. Burton (Campbell 1900); two further skins were collected by the AAE (Falla 1937). A Grey Petrel was sighted in 1949, two females with well-developed ovaries were collected in 1957 (Keith & Hines 1958), four were regularly seen during 1960, and one reappeared in March 1961 (Warham 1969). Another was seen in 1963 and during 1970 a sighting was made and a beach-washed carcase found (unpublished Antarctic Division records). With their distinctive appearance and habit of coming ashore during daylight, any breeding or killed during 1974 would probably have been seen or their remains identified. It can therefore be reasonably concluded that they no longer breed.

SOOTY SHEARWATER

Hamilton (1894) included the genus *Puffinus* in a list of breeding petrels. Campbell (1900) identified the species from an egg and skin provided by J. R. Burton. H. Hamilton recorded breeding dates and made collections, and during the BANZARE visit in 1930 occupied burrows were located on North Head (Falla 1939). Between 1965 and 1973 chicks were periodically recorded from a colony on North Head (unpublished Antarctic Division records). They appear to be far less numerous than Antarctic Prions or White-headed Petrels. Apart from North Head, colonies are probably sited near Handspike Point, Langdon Point and Caroline Cove.

SHORT-TAILED SHEARWATER

Warham (1969) found a freshly killed specimen in 1960, the only previous record for this species.

GREY-BACKED STORM PETREL

The Grey-backed Storm Petrel *(Oceanites nereis)* was included in a list of breeding species by Hamilton (1894), but no specimens were collected. An adult female with gonads in breeding condition and soil on the feathers collected at light in 1956 (Keith & Hines 1958) is the only record.

COMMON DIVING PETREL

Although reported as breeding by Campbell (1900) (presumably on information supplied by J. R. Burton), two specimens collected in 1899 were identified as South Georgian Diving Petrels *(Pelecanoides georgicus)* by Murphy & Harper (1921); however, Falla (1937) listed the birds breeding at Macquarie Island as *Pelecanoides* sp. Two females with enlarged ovaries collected in 1956 originally classified as *P. georgicus* (Carrick 1956) were reclassified as *P. urinatrix* by R. A.

Falla (Keith & Hines 1958), one collected in 1957 was also identified as *P. urinatrix* by R. A. Falla (Keith & Hines 1958), and three specimens collected during 1949, 1950 and 1953 originally classified as *P. georgicus* were to have been re-examined by R. A. Falla (Keith & Hines 1958) but no results have been published. Warham (1969) found a dead specimen in 1960 which he identified as *P. urinatrix,* and between 1963 and 1970 a further seven, all identified as *P. urinatrix,* have been found dead or injured (unpublished Antarctic Division records). The two found during this survey, together with the earlier records, point to small numbers of *P. urinatrix* still breeding; the earlier identifications of some specimens as *P. georgicus* may have been in error.

In a study during 1970 on the two species of giant petrels *Macronectes giganteus* and *M. halli* breeding at Macquarie Island, Johnstone (1977) analysed the regurgitated stomach contents of both adults and chicks. Of the 651 samples examined, 34 contained petrel bones from the following species: White-headed Petrel, Kerguelen Petrel *(Pterodroma brevirostris),* Antarctic Prion, Fairy Prion or Fulmar Prion *(Pachyptila crassirostris),* Sooty Shearwater, Short-tailed Shearwater, Grey Petrel and Common Diving Petrel. These remains could technically be considered records for Macquarie Island, although it is likely that most, or all, were taken as carrion at sea. Given the mobility of these seabirds, however, it does suggest that they may be more prevalent in the sea adjacent to Macquarie Island than the limited observations carried out to date have indicated.

Before this survey, little was published on the abundance or distribution of the burrow-nesting petrels at Macquarie Island. Even so, Law & Burstall (1956) considered Antarctic Prions and White-headed Petrels common, while Sooty Shearwaters were known from a colony on North Head; Grey Petrels, Blue Petrels and South Georgian Diving Petrels were classified as " species once native, now extinct, or nearly so." Warham (1967) listed White-headed Petrels, Antarctic Prions and Sooty Shearwaters in that order of abundance, but was in doubt regarding the status of Grey Petrels, Common Diving Petrels, Blue Petrels and Grey-backed Storm Petrels. However, the collection in 1956 of two Fairy Prions and a Grey-backed Storm Petrel, all with enlarged gonads, prompted both Carrick (1956) and Keith & Hines (1958) to classify them as breeding species.

This survey indicates that Antarctic Prions and White-headed Petrels are the most numerous and widely distributed species of burrow-nesting petrels now present, with Antarctic Prions probably the more numerous. Sooty Shearwaters seem less abundant and more localised, Blue Petrels and Common Diving Petrels may be present in small numbers and Grey Petrels no longer breed. There has been no evidence presented up to the end of this study to indicate that species other than these have ever had established breeding colonies at Macquarie Island. The present survey together with previous records and the

data from Johnstone (1977) indicate that the other species recorded now occur as occasional stragglers.

ACKNOWLEDGEMENTS

I. J. Skira and H. D. Burton assisted in obtaining and processing data collected to March 1975, P. J. Ormay, N. P. Brothers, R. J. Tomkins and Dr G. W. Johnstone contributed the data of the 1975-76 summer, and Drs P. J. Fullagar and G. F. van Tets identified the remains of petrels collected during the 1975-76 summer. Dr G. W. Johnstone criticised a draft of the paper.

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EVAN JONES, *Antarctic Division, Department of Science and the Environment, 568 St Kilda Road, Melbourne, Victoria 3004. Present address: Keith Turnbull Research Institute, c/o Dept of Agriculture, P.O. Box 125, Bendigo, Victoria 3550.*

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SHORT NOTE

DO OYSTERCATCHERS HAVE A COLOUR BAR?

About three years ago, on Surat Beach, near Pounawea, South Otago, Mr Les Lockerbie noticed a group of 20-30 South Island Pied Oystercatchers *(Haematopus ostralegus finschi)* that had formed a circle around one of their number, an albino. The normally coloured birds screeched and squawked, and jumped up and down in a very excited manner. Then they flew off down the beach, leaving the albino to follow. When it reached them, the ring was again formed around it, and the excited behaviour was repeated. Then the birds flew up the beach with the albino again following, and the ring was formed for a third time and the squawking and jumping repeated. The albino was not molested physically. (Reported by Mr Lockerbie, 27 October 1979).

R. J. SCARLETT, *Canterbury Museum, Christchurch.*