

Predation by subantarctic skuas *Catharacta antarctica* on burrowing petrels at Marion Island

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Petrel remains were collected from around 27 subantarctic skua Catharacta antarctica nests at Marion Island. Skuas took seven species of burrowing petrels, with Salvin's prion Pachyptila salvini forming the dominant prey item. The use of skua remains as indicators of petrel was shown for two areas where the density and composition of petrel burrows had been determined. Although the composition of the remains was related mainly to the abundance of the petrels, breeding season and size also determined how well different species were represented.

Stormvoël-oorblyfsels was rondom 27 bruin roofmeeu Catharacta antarctica neste op Marion-eiland versamel. Roofmeeue het op sewe spesies van grawende stormvoëls geprooi, met Salvinse stormvoël Pachyptila salvini die dominante prooi-item. Die verbruik van roofmeeu prooi-oorblyfsels as aanwysers van stormvoël volopheid is bewys vir twee areas waar die digtheid en samestelling van stormvoël nesgate alreeds bepaal was. Alhoewel die samestelling van die oorblyfsels hoofsaaklik aan die relatiewe volopheid van die stormvoëls verwant was, het broeiseisoen en grootte ook bepaal hoe goed verskillende spesies verteenwoordig was.

Introduction

Subantarctic skuas *Catharacta antarctica* are major predators of burrowing petrels (subterranean nesting Procellariiformes from the families Procellariidae, Pelecanoididae and Hydrobatidae, Watson 1975). Skuas are opportunistic feeders, foraging close to their nests and breeding adults are highly territorial (Carrick & Ingham 1970, Sinclair 1980). At Marion Island (46°54'S, 37°45'E) in the Prince Edward group, there are ca 400 pairs of subantarctic skuas (Williams *et al.* 1979), mostly concentrated along the coast (pers. obs.) but some are found inland up to 600 m above sea level (A. Berruti in litt.). Ten species of burrowing petrels have been recorded breeding at Marion Island (Williams *et al.* 1979).

Skua predation on petrels has been described for Macquarie Island (Jones 1980) and for the Antipodes (Moors 1980). Jones (1980) used the prey remains left by skuas and feral house cats *Felis catus* as indicators of the status (distribution and relative abundance) of burrowing petrels at Macquarie Island. At Marion Island, aspects of skua predation on petrels have been documented by Sinclair (1980), Van Aarde (1980) and Grindley (1981). This paper describes the burrowing petrel component of the skuas' diet and assesses the use of skua prey remains for deriving information about the status of petrels.

Study area and methods

Marion Island is volcanic and two lava types can be recognised, viz. an old grey lava eroded by glaciation and a younger post-glacial black lava (Verwoerd 1971). The grey lava and associated glacial deposits form ridges which radiate from the centre of the island. These ridges have steep, well-vegetated slopes with deep, well-drained soils suitable for burrowing by petrels. In contrast, black lava areas generally have poor soil cover and less vegetation. The lava is often very broken with many natural cavities which some petrel species are able to use for nesting.

During February and March 1980, towards the end of the skua breeding season, a strip approximately 2 km wide along the north-east coast of Marion Island, between Macaroni and Blue Petrel Bays, was searched for skua nests. Prey remains, including casts, within a 50 m radius of each nest were collected. The remains of skua prey were distinguished from possible cat prey remains by the lack of tooth marks on the long bones (Van Aarde 1980). Casts were broken apart and examined macroscopically. Petrel species were identified by the size, shape and colour of wings, legs or skulls. The minimum number of birds represented by the remains was recorded. Penguin remains were identified mainly from the heads and feet of adults and chicks but were not counted.

During April 1979 to May 1980 information was collected on the distribution and density of petrels in the north-east part of Marion Island. Transects were positioned at 200 m intervals on the slopes of grey lava ridges, along the black lava coastal plain, and inland. Quadrats 30 × 10 m were laid out at 25-50 m intervals on the transects. Within each quadrat all utilised burrows — those containing eggs, chicks or the remains thereof, or burrows undergoing renovation — were counted and identified. Natural holes used for nesting were also included.

In order to assess the extent to which skua prey remains reflect the status of the surrounding petrel population, prey remains were grouped into those from skua nests in grey lava areas and those from nests in black lava areas. For each group the species composition of the remains was compared to the composition of the petrel burrows found in that area, and the chi-square test was used to test for significant differences.

Results

Prey remains were collected from around 27 skua nests, 15 from grey lava areas and 12 from black lava areas (Fig. 1). The remains of at least 649 petrels of seven species were found (\bar{x} = 24.0; S.D. = 23.38; range = 2-100 petrels per skua nest).

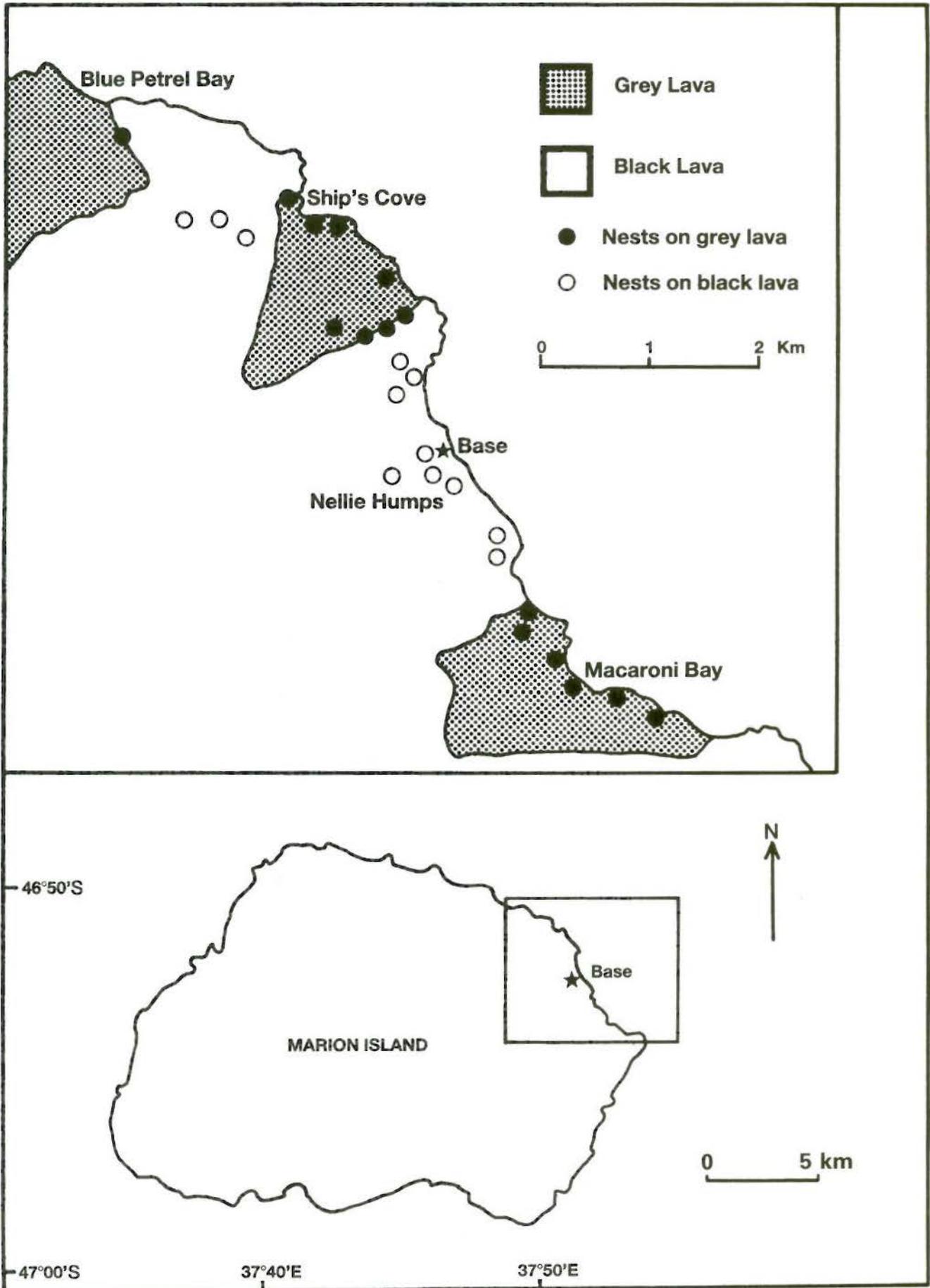


Fig. 1. Marion Island showing the study area and subantarctic skua nest sites.

Table 1
Percentage composition of burrowing petrel remains from subantarctic skua *Catharacta antarctica* nest sites at Marion Island.

	Species	Percentage composition	
		Numbers	Frequency of occurrence
Salvin's prion	<i>Pachyptila salvini</i>	70,1	96,3
Blue petrel	<i>Halobaena caerulea</i>	12,2	37,0
Greatwinged petrel	<i>Pterodroma macroptera</i>	1,1	22,2
Kerguelen petrel	<i>Pterodroma brevirostris</i>	1,1	18,5
Softplumaged petrel	<i>Pterodroma mollis</i>	12,8	63,0
Whitechinned petrel	<i>Procellaria aequinoctialis</i>	1,1	18,5
Diving petrel	<i>Pelecanoides</i> sp.	1,7	7,4
Sample size		649 remains	27 nest sites

Table 2
Percentage composition of burrowing petrel remains from subantarctic skua *Catharacta antarctica* nest sites in grey and black lava areas compared to the percentage composition of petrel burrows found in these two areas.

	Percentage composition					
	Grey lava areas			Black lava areas		
	petrel remains	petrel burrows		petrel remains	petrel burrows	
Salvin's prion	50,9	23,0	**	90,5	71,4	N.S.
Blue petrel	23,1	45,5	**	0,6	0	—
Greatwinged petrel	1,2	10,3	**	1,0	13,4	**
Kerguelen petrel	0,9	4,1	N.S.	1,3	1,8	N.S.
Softplumaged petrel	21,9	8,6	**	3,2	0	—
Whitechinned petrel	2,1	8,6	**	0	12,3	**
Grey petrel	0	0		0	1,1	—
Diving petrel	0	0		3,5	0	**
Sample size	334 remains (15 skua nests)	418 burrows (67 quadrats)		315 remains (12 skua nests)	276 burrows (78 quadrats)	

** differences highly significant ($p < 0,001$)

N.S. differences not significant ($p > 0,01$)

— expected frequencies too small for statistical comparison.

Salvin's prion *Pachyptila salvini* comprised 70,1 per cent of the burrowing petrels taken and this species was found at 96,3 per cent of the skua nests (Table 1).

Penguin remains, mainly eggs and chicks, were found at 70,3 per cent of skua nests. King penguins *Aptenodytes patagonicus* and gentoo penguin *Pygoscelis papua* remains were found at 22,2 and 3,7 per cent of nests respectively. The remains of macaroni penguins *Eudyptes chrysolophus* and rockhopper penguins *E. chrysocome*, which could usually not be separated, were found at 63,0 per cent of skua nests. The remains of a lesser sheathbill *Chionis minor* and an unidentified *Phoebetria* albatross chick were found. Hair from southern elephant seals *Mirounga leonina* was found in two of the 103 casts examined. There was no evidence in any of the remains or casts to suggest that skuas preyed upon the house mouse *Mus musculus*, which is abundant at Marion Island (Anderson & Condry 1974), although A.J. Williams (in litt.) reports finding the remains of a mouse in a skua regurgitation.

There were significant differences ($p < 0,001$; chi-square test) between the frequencies of Salvin's prion, blue petrel *Halobaena caerulea*, softplumaged petrel *Pterodroma mollis* and diving petrel *Pelecanoides* sp. remains from skua nests on grey lava compared to black lava (Table 2). The small sample of remains of greatwinged petrel *Pterodroma macroptera*, Kerguelen petrel *P. brevirostris* and whitechinned petrel *Procellaria aequinoctialis* precluded their statistical analysis.

In black lava areas 276 burrows were found in 78 quadrats (353,8 burrows per hectare), and of these 71,4 per cent belonged to Salvin's prion. This species also dominated (90,5 %) the petrel remains from the 12 skua nests on black

lava (Table 2). Greatwinged and whitechinned petrels were of negligible importance to skuas although they made up 13,4 and 12,3 per cent of burrows found in black lava areas. In grey lava areas petrel burrows were confined to the vegetated slopes of the grey lava ridges, and in 67 quadrats 418 burrows (623,9 burrows per hectare) were found, of which 45,5 per cent were blue petrel and 23,0 per cent Salvin's prion. These were also the two dominant species taken by skuas nesting in grey lava areas.

Discussion

The preponderance of prions in the prey remains is not unexpected as they are the most widely distributed and abundant petrels nesting on Marion Island (Williams *et al.* 1979, pers. obs.). In an earlier study of the remains of 251 burrowing petrels taken by skuas at Marion Island, Grindley (1981) found Salvin's prion formed 71,4 per cent of the total, a figure similar to that obtained during the present study (Table 1).

No comparison has been made between the relative importance of petrels and penguins to skuas, owing to differences in digestibility. Many penguin eggs are swallowed whole and penguin chicks have fewer indigestible components, such as quill feathers and long bones, than the adult birds which make up most of the petrel component of the skuas' diet. Therefore, penguins would tend to be under-represented in the remains.

Since skuas forage close to their nests (Carrick & Ingham 1970), regional differences in subantarctic skua diet have been related to the local availability of food (Jones & Skira 1979). Consequently, Jones (1980) used petrel remains left by

predators as indicators of the status of petrels. This study at Marion Island provided a means of testing the technique used by Jones (1980), as both the density of petrel burrows and the diet of skuas were known for two areas. If prey remains indicate prey status, the petrels should be represented in the same proportions in the remains as in burrows.

While it was found that most of the abundant petrels were well represented in the prey remains, and the remains of both Salvin's prion in black lava areas and Kerguelen petrels were very good indicators of their relative abundance, the remains of many species were poor indicators of their status. For example, whitechinned petrels were not heavily preyed upon, comprising only 1 per cent of the remains, but they nest abundantly in both black lava areas and on the slopes of the grey lava ridges (43,5 and 53,7 burrows per hectare, respectively), making up about 10 per cent of the burrows found. Van Aarde (1980) found that this species comprised only 0,8 per cent of the birds taken by feral cats, which are major predators of the other petrel species at Marion Island. It is likely that the whitechinned petrel's large size (mean mass 1 144 g as compared to 1 638 g for skuas — FitzPatrick Institute unpublished data), and aggressive nature, renders it less vulnerable to predation. However, in the absence of small more suitable prey such as prions, skuas will regularly take whitechinned petrels (Despin *et al.* 1972). On the Antipodes, where there are few small petrels, whitechinned petrels form up to 21 per cent of the petrels taken by skuas (Moors 1980).

Most skuas arrive at Marion Island during August, breed during mid-summer and depart again in April (Williams 1980). Therefore, only petrels nesting during this time would be vulnerable to predation. Greatwinged petrels breed during winter (Schramm in press) and this would explain why so few remains of this abundant species were found.

The time at which the prey remains are collected appears to influence how well different species are represented. In the remains from grey lavas, blue petrels were significantly under-represented (Table 2). Since blue petrels nest in early summer, with chicks fledging from late January to early February (pers. obs.), most birds would have left the island by the time the remains were collected in February and March. This might explain why, in relation to the number of blue petrel burrows in grey lava areas (45,5 % — 283,8 burrows per hectare), only 23,1 per cent of the remains belonged to this species. Salvin's prions and softplumaged petrels, which breed during mid- and late summer respectively (Schramm in press), would therefore tend to be over-represented in remains collected at this time of year (Table 2).

A few diving petrels (probably South Georgian diving petrels *Pelecanoides georgicus*) which were not found breeding in the study area, appeared in the prey remains from two skua nests in Nellie Humps. This area is used as a flyway by petrels *en route* to inland nest sites (pers. obs.), and the birds were probably taken as they flew over the skuas' territories.

The composition of skua prey remains reflects the relative abundance of petrels occurring around the time of collection of the remains. However, skuas tend to undersample larger species (e.g. whitechinned petrels) and winter breeding species (e.g. greatwinged petrels). Nevertheless, analysis of skua prey remains could be useful during short visits to Prince Edward Island and to the remote parts of Marion Island.

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