

SOUTHERN GREAT SKUAS ON ANTIPODES ISLAND, NEW ZEALAND: OBSERVATIONS ON FOODS, BREEDING, AND GROWTH OF CHICKS

By P. J. MOORS

ABSTRACT

Between 8 November and 4 December 1978 observations were made on Southern Great Skuas (*Stercorarius skua lonnbergi*) at Antipodes Island in the Southern Ocean. Their food habits were determined by observing birds and identifying prey remains. Penguin eggs and chicks were the dominant prey of coastal skuas, whereas those with inland territories relied on petrels and shearwaters. Clutch size in 11 nests averaged 1.8 eggs; most eggs in nine study nests hatched during the first fortnight of November. Hatching success was 54%, but only 3 of 10 chicks survived until 4 December. At that stage of the breeding season, and allowing for unnatural losses of eggs and chicks, productivity was 0.50 chicks per breeding pair.

Six chicks were weighed and measured for 5-20 days. Hatching weight averaged 74.3 g. Initial weight gains were small, but after day 4 the average growth rate was 31.6 g/day. Chicks which were heavier at hatching remained so subsequently. Mean bill length at hatching was 17.8 mm and mean depth 9.9 mm. Little growth occurred for the first five days, but afterwards the average growth rate was 1.0 mm/day for bill length and 0.4 mm/day for bill depth. The ratio of bill length to depth changed during growth, and attained the adult condition by age 17-20 days. There were no consistent differences between chicks from coastal and inland nests in their weight gains, or in the growth of their bills.

INTRODUCTION

Southern Great Skuas (*Stercorarius skua lonnbergi*) have a circumpolar distribution in the southern hemisphere. They breed on most islands at higher latitudes and on parts of the Antarctic Peninsula and disperse northwards to about 33°S during the winter. In the New Zealand region they nest on Stewart Island, the Chatham Islands, and their outliers, and on all the subantarctic islands. Information on the breeding biology and food habits of populations from this region has been given by Stead (1932), Oliver (1955), Young (1978) and Warham & Bell (1979), among others. These aspects of the Southern Great Skua's biology have also been studied on South American subantarctic islands, notably by Murphy (1936) and Stonehouse (1956) on South Georgia and by Burton (1968) on Signy Island.

Little has been published about the growth of Southern Great Skua chicks, apart from the few measurements made by Stonehouse (1956). However, Young (1963a) and Reid (1966) measured the growth of chicks in two populations of the closely related Antarctic Skua (*S. maccormicki*). Reid provided a detailed description of growth in body weight and in bill, wing and foot measurements.

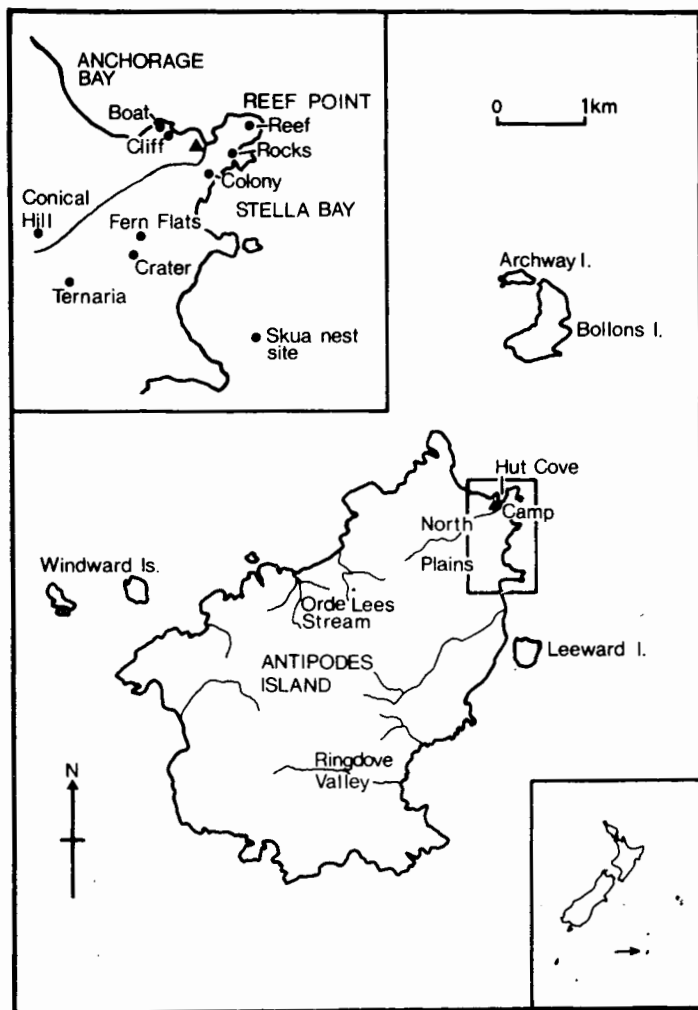


FIGURE 1 — Map of the Antipodes Islands. The upper inset shows the locations of the nine study nests.

Young (1963b) also studied the foraging habits of Antarctic Skuas at Cape Royds, Antarctica. He observed that whereas most fed entirely at sea, a few consistently obtained at least part of their food at a nearby colony of several thousand Adelie Penguins (*Pygoscelis adeliae*). Skuas feeding in the colony had a higher breeding success than those foraging at sea, but Young (1963a) found no differences between the growth rates of chicks reared by each group.

In November 1978 the New Zealand Wildlife Service mounted a short expedition to the Antipodes Islands (49° 42' S, 178° 48' E) in the Southern Ocean. Southern Great Skuas are reasonably common there in summer, and breeding pairs are distributed widely over the islands (Warham & Bell 1979). On the main Antipodes Island some skuas nest along the coasts near mixed colonies of Erect-crested and Rockhopper Penguins (*Eudyptes sclateri* and *E. crestatus*) and feed predominantly on penguin eggs and nestlings. Other skuas nest inland where, judging from regurgitated pellets and the remains of prey, they subsist on petrels and shearwaters. Thus, each pair of skuas apparently depended on either concentrated or dispersed supplies of food, in a similar way to the Antarctic Skuas studied by Young (1963b). This paper reports observations of the food habits and breeding of Southern Great Skuas on Antipodes Island and compares the early growth rates of chicks reared in coastal and inland nests.

METHODS

The expedition was on Antipodes Island only from 8 November until 6 December 1978, which limited the extent of my investigations. The skuas had begun laying before our arrival, and none had fledged chicks before our departure. Therefore my data do not encompass a complete breeding season, and I could measure only the early growth rate of chicks.

Most data were collected from nine study nests. All were within 1.5 km of the expedition's camp near Reef Point on the north-east coast (Fig. 1): five nests (hereafter called "coastal nests") were close to penguin colonies in Stella and Anchorage Bays and on Reef Point, and four ("inland nests") were inland on the North Plains. When first located seven nests contained eggs and two contained chicks.

Eggs were measured with vernier calipers to the nearest 0.1 mm. Volumes and shape indices were calculated using Coulson's (1963) formulae:

$$\text{Volume (ml)} = 4.78 \times 10^{-4} (\text{length} \times \text{breadth}^2);$$

$$\text{Shape index} = 100 (\text{breadth} \div \text{length})$$

Nests with eggs were visited irregularly until the eggs were pipping, and thereafter daily to determine the hatching date. Nests with chicks were visited usually daily to weigh and measure the nestlings. Chicks were weighed with Pesola scales accurate to 1 g

for weights up to 300 g, and to 5 g for weights above 300 g. The upper bill length (from tip to edge of downy area at base) and the bill depth at base were measured using vernier calipers accurate to 0.1 mm.

Information on clutch size and egg dimensions was also obtained from four other inland nests, three being on North Plains. Notes were also taken of the contents of all skua nests encountered during brief visits to Bollons and Archway Islands (approximately 2 km north of Antipodes) on 29 November and 2 December.

Both species of penguin were incubating when the expedition arrived on Antipodes. The Erect-crested Penguins began hatching about 14 November, and the Rockhopper Penguins about 1 December. The colonies in the study area were composed predominantly of Erect-crested Penguins, and so the hatching of Rockhopper chicks did not add greatly to the potential food supply of skuas.

The numbers of petrels visiting the island nightly varied with the weather and the stage of each species' breeding cycle. Both White-headed Petrels (*Pterodroma lessonii*) and White-chinned Petrels (*Procellaria aequinoctialis*) had begun laying by late November, but most Soft-plumaged Petrels (*Pterodroma mollis*) were away before laying; fledglings of Grey Petrels (*Procellaria cinerea*) were leaving throughout November.

RESULTS AND DISCUSSION

Food habits

All the skuas from coastal study nests were individually colour-banded so that their foraging areas could be determined. Each pair patrolled part or all of one of the penguin colonies near their nest-site (Fig. 1). The pair actively defended its area against intruding skuas, and was rarely seen elsewhere. Hunting was concentrated within the territory, apart from occasional scavenging forays to places such as the boulder beach in Hut Cove or the areas on Reef Point frequented by the non-breeding skua flock. Colour-banded birds were regularly observed preying on penguin chicks and eggs; and, when handled, skua chicks sometimes regurgitated meals containing these items. These observations, together with the many remains of skua meals found in the colonies, leave little doubt that these skuas were obtaining almost all their food from penguin colonies. Skuas were not seen foraging at sea, nor did they harry other seabirds to make them disgorge food, behaviour reported by Warham & Bell (1979) to occur later in the season.

The extent of skua depredations was illustrated by the large numbers of broken eggs littering the colonies and the many empty penguin nests. For example, between 14 November and 4 December, 41 of 43 Rockhopper Penguin nests were plundered in one section of the Stella Bay colony. During the same period I collected 101 penguin eggs eaten there by skuas, and about 70% of these were Rockhopper eggs. Predation occurred even though both species of penguin vigorously

defended their eggs and chicks and many skua attacks were unsuccessful. However, the speed, manoeuvrability and persistence of the skuas enabled them eventually to snatch an egg or chick left unguarded. The skuas usually swooped on their prey from a vantage point in the colony or flew low over the penguins until, in the resulting disturbance, they could grab an unprotected egg or chick. Similar behaviour has been described for Southern Great Skuas elsewhere (e.g. Oliver 1955, Stonehouse 1956). Nevertheless, the penguin colonies on Antipodes did not provide the skuas with an abundance of easy prey, and it is likely that as the penguin chicks grew older and formed creches they would have become increasingly difficult to capture. This pattern has been observed by Young (1963b) for Antarctic Skuas hunting in an Adelie Penguin colony.

Petrels and shearwaters were the most important foods of inland skuas. Partly dismembered carcasses of these prey and regurgitated pellets containing their feathers and bones littered the skua territories. White-headed Petrels were by far the most frequent prey, forming 73.4% of all remains collected from inland areas (Table 1), a preponderance already noted by Oliver (1955) and Warham & Bell (1979). Grey Petrels (9.4%) and White-chinned Petrels (7.0%) were also taken. The scarcity of small petrels such as prions in the diet reflects both their exceptionally low breeding numbers on the island (Imber, pers. comm.) and the greater difficulty in finding their remains. The only sample of which they formed a large part (number 5, Table 1) came from a nest near where Fairy Prions (*Pachyptila turtur*) were breeding.

Remains of penguin eggs or chicks were not found on any inland territories.

White-chinned Petrels do not usually fall prey to skuas (Murphy 1936), presumably because they are large enough to repel most skua attacks. However, on Antipodes these petrels occurred in two samples of prey remains and formed 20% of the sample (number 1, Table 1) collected from the territories of the Fern Flats and Crater skua pairs on the North Plains (Fig. 1). Several fresh carcasses of White-chinned Petrels were also found on nearby areas of the Plains. Many White-chinned Petrels arrived back from sea late in the afternoon and spent the few remaining daylight hours circling the island. Expedition members witnessed several half-hearted attacks by skuas on these birds, but the petrels escaped easily. However, I once saw a pair of skuas bring down a White-chinned Petrel on the North Plains. One of the skuas pursued and caught the petrel from behind, and both birds tumbled downwards from an altitude of about 15 metres before the petrel disengaged itself and hurriedly landed. Both skuas landed and tried to attack the petrel, which lunged at them and succeeded in keeping them at bay. The stalemate continued at least until I left 20 minutes later, with the skuas slowly circling the petrel just out of its pecking range. Next morning a trail of feathers led about 2

TABLE 1 — Bird remains identified by M. J. Imber in collections of Southern Great Skua prey from various localities on Antipodes Island, and from Bollons and Archway Islands.

Prey Species	Antipodes Island*					5	Bollons Island	Archway Island	Offshore Island Total	Grand Total
	1	2	3	4	Inland Total					
<u>Pterodroma lessoni</u>	27	127	23	2	179			1	1	180
<u>P. mollis</u>	4				4					4
<u>Pterodroma</u> sp.	1				1					1
<u>Procellaria aequinoctialis</u>	13	4			17					17
<u>P. cinerea**</u>	8	2	7	6	23		11		11	34
<u>Puffinus griseus**</u>	2				2					2
<u>P. assimilis</u>	4	4			8		149	41	190	198
<u>Pelecanoides urinatrix</u>	2	2			4	1				5
<u>Pachyptila turtur</u>			1		1	6				7
<u>Garrodia nereis</u>			1	1	2					2
<u>Fregetta tropica</u>				2	2		2		2	4
<u>Sterna vittata**</u>			1		1					1
<u>Budyptes cretatus</u>								1	1	1
<u>Cyanoramphus</u> sp.								1	1	1
Total	61	142	32	9	244	7	162	44	206	457

* Sample numbers indicate locality of collection: 1 = Territories of Fern Flats and Crater pairs of skuas (Fig. 1); 2 = North Plains generally; 3 = Ringdove Valley; 4 = Orde Lees Stream; 5 = Coastal skua nest away from penguin colonies.

** Approximately half the P. cinerea remains were from fledglings; all the remains of P. griseus and S. vittata were from fledglings.

metres from where the birds had landed to the recently plucked and eaten carcass of the White-chinned Petrel. The carcass was cold, and apparently had been killed during the night. Warham & Bell (1979) reported similar incidents, but none ended with the death of the petrel.

White-chinned Petrels may be exploited on Antipodes because of the relatively small breeding populations of smaller petrels, a staple prey of Southern Great Skuas elsewhere (e.g. Oliver 1955, Burton 1968, Young 1978). A similar situation has been described in two valleys on Ile de l'Est in the Crozet Archipelago where penguins and small

TABLE 2 — Average measurements of Southern Great Skua eggs from Antipodes Island.

Nest locality	Egg type*	n	Length (mm)	Breadth (mm)	Volume (ml)	Shape index
Coastal	Larger	4	77.0	53.0	103.7	68.9
	Smaller	4	74.2	52.7	98.7	71.0
Inland	Larger	7	75.7	53.5	103.6	70.8
	Smaller	5	73.3	52.6	95.6	72.8
Overall mean		20	74.8	53.0	100.6	71.0
± SD			(2.55)	(1.57)	(6.93)	(3.21)

*Larger or smaller eggs in two-egg clutches; measurements from one-egg clutches included with larger eggs.

petrels are relatively few, and Southern Great Skuas take White-chinned Petrels instead (Despin *et al.* 1972).

The situation on Antipodes contrasts with that on Bollons and Archway Islands just to the north, where White-headed and White-chinned Petrels are few but Little Shearwaters (*Puffinus assimilis*) are abundant. The shearwaters are preyed on heavily by skuas, and their remains comprised 92.2% of samples collected (Table 1). The large colony of Erect-crested Penguins on Archway and the mixed colonies on Bollons are presumably also exploited by skuas, but we saw little debris from such meals.

Hatching and breeding success

The clutch size in four coastal and seven inland nests averaged 1.8 eggs. Nine nests contained two eggs, and two inland nests contained only one; no nests had three eggs. Table 2 gives the average dimensions and shape indices of these 20 eggs. Eggs from coastal nests tended to be bigger overall than those from inland nests, but larger samples are needed to confirm the significance of this difference. Mean egg size calculated from the combined data was 74.8 x 53.0 mm, slightly smaller than the average of 75.5 x 53.2 mm (n = 20) for eggs from South Georgia (Stonehouse 1956). The mean shape index of Antipodes eggs varied only slightly but tended to be higher for smaller eggs in two-egg clutches, and also for eggs from inland nests. The higher index indicates that these eggs were relatively broad for their length.

Table 3 records the contents and subsequent fate of each of the nine study nests. Of the seven found with eggs, four hatched between

TABLE 3 — Description of the Southern Great Skua nests studied on Antipodes Island in 1978, and the fates of their eggs and chicks.

Nest	Type*	Date found	Contents	Hatching date**	No. eggs hatched	Fate of chicks
Colony	C	8 Nov	2 eggs	-	0	Nest destroyed 28 Nov by skuas
Reef	C	9 Nov	2 eggs	12 Nov	2	1 died 13 Nov, other died 1 Dec
Rocks	C	9 Nov	2 eggs	-	0	Deserted 15 Nov
Crater	I	9 Nov	1 egg	16 Nov	1	Disappeared 4 Dec
Fern Flats	I	9 Nov	2 eggs	30 Nov	1	Alive 4 Dec
Ternaria	I	12 Nov	2 eggs	14 Nov	2	1 died 18 Nov, 1 alive 4 Dec
Boat	C	13 Nov	2 eggs	15 Nov	1	Alive 4 Dec
Cliff	C	14 Nov	1 chick	?	?	Died 21 Nov
Conical Hill	I	17 Nov	2 chicks	?	?	Smaller disappeared 21 Nov, larger 28 Nov

* C = coastal nest near penguin colony; I = inland nest.

** Hatching date of first chick when two-egg clutch.

12 and 16 November and one on 30 November. Judging from the size of the nestlings, the two nests with chicks had hatched about 5 and 10 days before they were discovered. Thus, six of the seven nests hatched during the first fortnight of November. This timing is similar to that of Southern Great Skuas breeding on Rangatira Island (44°S) in the Chathams Group (Young 1978) but is about a fortnight earlier than on Macquarie Island (54°S) (Jones & Skira 1979) and 4-6 weeks earlier than on both South Georgia (54°S) and Signy Island (61°S) (Burton 1968). There is a trend towards later breeding in higher latitudes, but it may reflect availability of food more than climate.

Of 13 eggs laid in the study nests, seven (54%) hatched, three (37%) from coastal nests and four (80%) from inland nests. The large difference in hatching success was due to the failure of the Colony and Rocks nests, probably as a result of human disturbance. One egg in the Fern Flats nest was infertile, and a chick in the Boat nest died while hatching. When both eggs in a two-egg clutch hatched, the larger egg hatched first.

Initially, 10 chicks were present in seven nests, but only three (30%) were still alive when last visited on 4 December; one was

in a coastal nest and two in inland nests. Conical Hill nest contained two chicks when discovered, but the smaller disappeared shortly afterwards, possibly expelled by the larger (see Procter 1975), and the remaining one lost weight and disappeared after two days of stormy weather. Another chick (*Ternaria* 1) died after storms, one fell over a cliff (Cliff), two died of unknown causes (Crater, Reef 2) and one was accidentally killed (Reef 1). The low overall productivity at 4 December of 0.33 chicks per breeding pair was caused partly by human activities, but if only the six unaffected pairs are included, productivity is increased to 0.50 chicks per breeding pair.

Expedition members found 11 skua nests during visits to Bollons and Archway Islands. Two nests held only eggs, two held a hatchling together with an egg, and seven held chicks. Three nests held pairs of chicks, the largest pair being about three-quarters adult size. The oldest chick found was a singleton of adult size with its primaries fully developed. The presence of several nests containing two chicks contrasted with the situation on Antipodes and suggests that skuas may be more productive on these two offshore islands, presumably as a result of the abundance there of Little Shearwaters.

Although the sample is small and does not cover a complete breeding season, the hatching success and productivity of Antipodes skuas appear to be lower than those known elsewhere. For example, Burton (1968) observed an average hatching success of 66% over three seasons for Southern Great Skuas on Signy Island, and Young (1963a) and Spellerberg (1971) reported successes of 80.5% and 58.3-81.1% respectively for Antarctic Skuas. Productivity on Antipodes was much less than the range of 0.74-1.55 chicks per pair (mean 1.13 chicks per pair) reported for five other populations of Southern Great Skuas (Downes *et al.* 1959, Wood 1971, Young 1978, Jones & Skira 1979). None of my study pairs successfully reared a two-chick brood, in contrast to the abilities of Southern Great Skuas elsewhere (e.g. Burton 1968, Young 1978), and apparently on Bollons and Archway Islands. This appeared to be the major cause of low productivity on Antipodes, possibly due to a shortage of food. The productivity was similar to those summarised by Wood (1971) for Antarctic Skuas breeding along the Antarctic coast, where the average was 0.42 chicks per pair; successful two-chick broods were also rare in these populations.

Weight gains of chicks

The weight at hatching of seven chicks averaged 74.3 g (range 65-87 g). The two eggs in Reef nest hatched about 48 hours apart, the first chick weighing 70 g and the second 65 g; in *Ternaria* nest the eggs hatched about 72 hours apart and the chicks weighed 81 g and 67 g. Reid (1966) reported that eight Antarctic Skua chicks weighed 61-76 g (mean 69.2 g) within 15 minutes of hatching.

Four chicks, two from coastal and two from inland nests, were weighed and measured for 17-20 days, and two others for five days

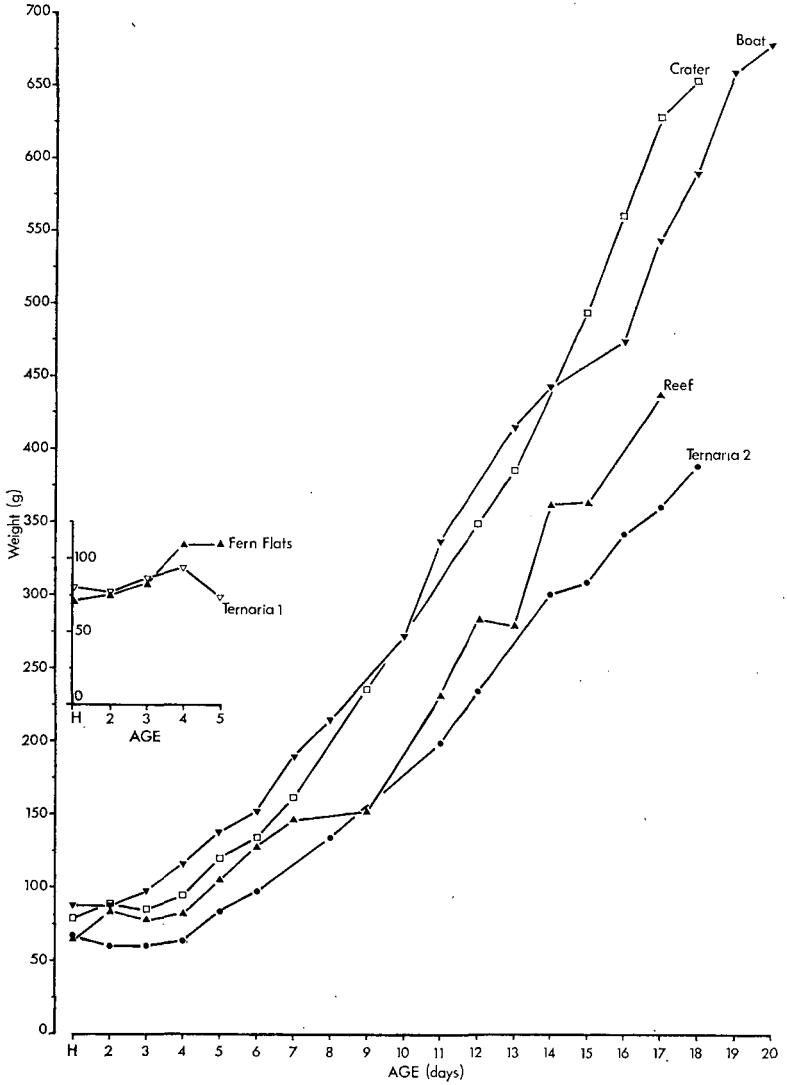


FIGURE 2 — Growth in weight after hatching (H) of Southern Great Skua chicks.

(Fig. 2). The initial weight gains, particularly during the first four days, were small. Five actually lost weight at some stage during this period, the greatest 24-hour reduction being 7 g (10.4% hatching weight) on day 2 for Ternaria chick 2. Ternaria chick 1 lost 20 g (21.3% initial weight) between days 4 and 5 during wet windy weather and was found dead in the morning. The other weight changes were probably due to the opposing effects of the absorption of the remnants of the yolk sac and the food brought by parents. Reid (1966) stated that at hatching the yolk reserve in Antarctic Skuas averaged 11.1% of chick body weight and lasted about 72 hours. He also observed slow growth rates for several days after hatching.

The four surviving chicks doubled their hatching weight in an average of 6.9 days. The two chicks in coastal nests required only six days each, whereas the two inland chicks took seven and eight days. These periods are all appreciably longer than the 4-5 days noted for Antarctic Skuas by Reid (1966).

After day 4, the body weights of Antipodes chicks increased rapidly (Fig. 2). Crater chick had the greatest daily increase in weight (40.4 g/day) and Ternaria chick 2 the least (23.1 g/day); the average of the four chicks was 31.6 g/day. Two other chicks, one from the inland Conical Hill nest and the other from the coastal Cliff nest, put on 15.0 g/day over 10 days and 30.3 g/day over seven days, respectively.

There were no consistent differences between the growth rates of chicks fed from penguin colonies and those fed petrels, but by day 17 there were large individual differences in weight. At that age, Crater chick was heaviest (630 g) and Ternaria chick 2 lightest (362 g), a difference of 74%, even though both were being fed petrels. The chicks which were heavier at hatching remained so subsequently, even though each of the lighter ones was the only chick being fed by its parents. Crater chick (hatching weight 78 g) came from a one-egg clutch and Boat chick (87 g) was the first hatched and larger of a two-egg clutch; in contrast, both Reef chick (65 g) and Ternaria chick 2 (67 g) were from second eggs. The differences in growth rates are clearly evident in Figure 2. More data are required to determine if Southern Great Skua chicks from one-egg clutches and first hatched chicks from two-egg clutches always grow faster than second-hatched chicks. Neither Young (1963a) nor Reid (1966) found such differences for Antarctic Skuas, although the pairs of chicks they compared were from the same nests. However, it is possible that the growth rates of siblings and differences between nests may depend more on the hunting experience and abilities of the parents than on intrinsic factors.

Changes in bill measurements of chicks

The average bill length at hatching was 17.8 mm ($n = 4$; range 17.3-18.2 mm) and the average depth was 9.9 mm ($n = 4$; range

9.3-10.4 mm). The rates of increase in bill length and depth (Fig. 3) did not vary as widely between chicks as did weight. Both bill measurements increased little in the first 4-5 days but increased steadily thereafter. As with weight, Ternaria chick 2 lagged behind the others in both initial and later bill dimensions. The average daily growth rate after day 4 was 1.0 mm ($n = 6$; range 0.7-1.2 mm) for bill length, and 0.4 mm ($n = 6$; range 0.3-0.7 mm) for bill depth. The bills of chicks from coastal and inland nests did not differ consistently in either size or growth.

Boat chick showed the largest overall increase in bill size: between days 2 and 20 length increased from 17.8 mm to 35.3 mm, and depth from 9.7 mm to 16.0 mm. These final measurements were 65% and 64% of the corresponding averages from eight breeding adult skuas caught near camp.

The ratio of bill length to depth changed during growth. Within three days of hatching, bill length was, on average, 1.79 times bill

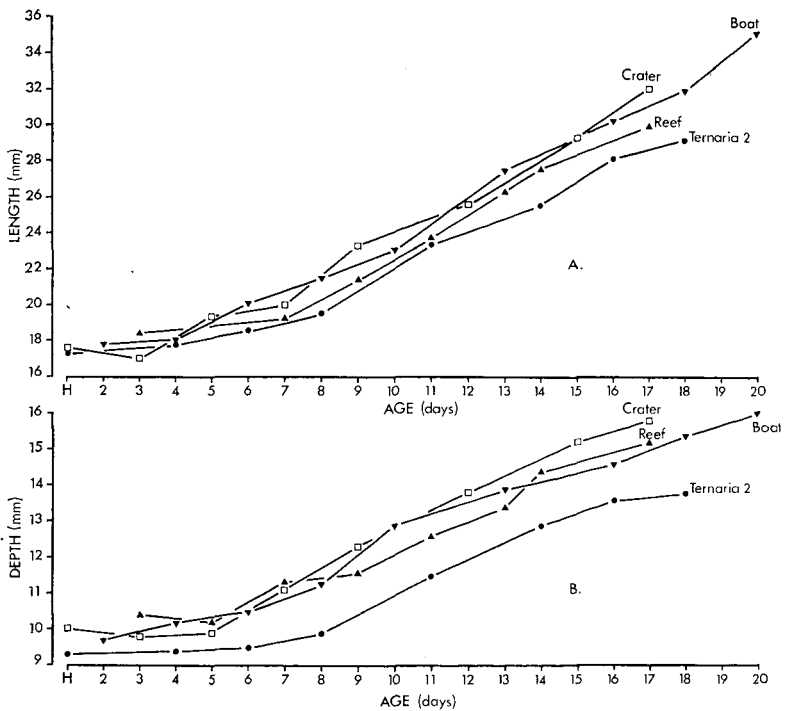


FIGURE 3 — Growth in the length (A) and depth (B) of the bills of Southern Great Skua chicks.

depth ($n = 7$; range 1.72-1.86), whereas by day 17-20 the multiplication factor had increased to 2.10 ($n = 4$; range 1.97-2.21), a highly significant difference ($t = 6.13$; $p < 0.001$). This higher factor was similar to, and not significantly different from, the average of 2.20 (range 1.92-2.47) from eight unsexed adults. It is clear that at hatching the proportions of the bill differ from the adult condition, which is achieved by a faster gain in length than in depth.

CONCLUSION

The data presented here show that on Antipodes Island penguin colonies do not provide Southern Great Skuas with a better food supply for their chicks than do petrels. Chicks grow just as fast or slowly when being fed penguins or petrels, and the foraging skill of the parents is at least as important as the overall abundance of food. Weather and the relative timing of breeding in skuas, penguins and petrels are also likely to be influential. Similar conclusions were reached by Young (1963a, b) after his investigation of the breeding success and growth of Antarctic Skuas at Cape Royds. Both there and on Antipodes Island, penguin colonies were not especially favourable food sources for skuas, despite appearances to the contrary. Skuas apparently fare much better in areas where there are dense breeding populations of the smaller petrels and shearwaters.

ACKNOWLEDGEMENTS

This study was carried out during the 1978 New Zealand Wildlife Service Expedition to the Antipodes Islands. Transport was kindly provided by the Royal New Zealand Navy aboard HMNZS *Waikato*. Several expedition members assisted me with fieldwork and gave me egg measurements or other information, for which I am most grateful. I particularly appreciate permission from M. J. Imber to present his identifications of birds in the several collections of skua prey gathered by himself and others. He also provided some general information on the breeding and abundance of petrels on the islands and made useful comments on a draft manuscript. I also wish to thank J. A. Mills and H. A. Best for commenting on an earlier draft.

LITERATURE CITED

- BURTON, R. W. 1968. Breeding biology of the Brown Skua, *Catharacta skua lonnbergi* (Mathews), at Signy Island, South Orkney Islands. Br. Ant. Surv. Bull. 15: 9-28.
- COULSON, J. C. 1963. Egg size and shape in the Kittiwake (*Rissa tridactyla*) and their use in estimating age composition of populations. Proc. Zool. Soc. Lond. 140: 211-227.
- DESPIN, B.; MOUGIN, J. L.; SEGONZAC, M. 1972. Oiseaux et mammiferes de l'île de l'Est. Paris: Com. Nat. Fr. Rech. Ant. 31: 1-106.
- DOWNES, M. C.; EALEY, E. H. M.; GWYNN, A. M.; YOUNG, P.S. 1959. The birds of Heard Island. ANARE Rep. Ser. B 1: 1-135.
- JONES, E.; SKIRA, I. J. 1979. Breeding distribution of the Great Skua at Macquarie Island in relation to numbers of rabbits. Emu 79: 19-23.
- MURPHY, R. C. 1936. Oceanic birds of South America. 2 Vols. New York: Am. Mus. Nat. Hist. 1245 pp.
- OLIVER, W. R. B. 1955. New Zealand birds. 2nd ed. Wellington: A. H. & A. W. Reed. 661 pp.
- PROCTER, D. L. 1975. The problem of chick loss in the South Polar Skua *Catharacta maccormicki*. Ibis 117: 452-459.
- REID, B. E. 1966. The growth and development of the South Polar Skua (*Catharacta maccormicki*). Notornis 13: 71-89.
- SPELLERBERG, I. F. 1971. Aspects of McCormick Skua breeding biology. Ibis 113: 357-363.

- STEAD, E. 1932. The life histories of New Zealand birds. London: Search Pub. Co. 162 pp.
- STONEHOUSE, B. 1956. The Brown Skua (*Catharacta skua lonnbergi*) (Mathews) of South Georgia. Falkland Is. Dep. Surv. Sci. Rep. 14: 1-25.
- WARHAM, J.; BELL, B. D. 1979. The birds of the Antipodes Islands. Notornis 26: 121-169.
- WOOD, R. C. 1971. Population dynamics of breeding South Polar Skuas of unknown age. Auk 88: 805-814.
- YOUNG, E. C. 1963a. The breeding behaviour of the South Polar Skua (*Catharacta maccormicki*). Ibis 105: 203-233.
- YOUNG, E. C. 1963b. Feeding habits of the South Polar Skua (*Catharacta maccormicki*). Ibis 105: 301-318.
- YOUNG, E. C. 1978. Behavioural ecology of *lonnbergi* skuas in relation to environment on the Chatham Islands, New Zealand. NZ J. Zool. 5: 401-416.

P. J. MOORS, *Wildlife Service, Department of Internal Affairs, Private Bag, Wellington.*



SHORT NOTE

COLONISATION OF COPPERMINE ISLAND BY THE NORTH ISLAND SADDLEBACK

The North Island Saddleback (*Philesturnus carunculatus rufusater*) was formerly abundant on the mainland and major offshore islands (Williams 1976). Today it is confined naturally to Hen Island in the Hen and Chickens Group (Fig. 1). Since 1964, Wildlife Service staff have transferred wild-captured birds from Hen to six other islands in the outer Hauraki Gulf (Mills & Williams 1978). All but one of these liberations have resulted in the establishment of successful populations (Merton 1975 a, b). Liberation of birds on to Fanal Island has failed (C. R. Veitch, pers. comm.).

Two populations were established on islands in the Hen and Chickens Group. Birds were transferred to Whatupuke Island in 1964 (Merton 1965) and to Lady Alice (Marotiri) Island in 1971 (Merton 1975 a, b). The birds are weak fliers and were considered incapable of crossing the 150 m from Whatupuke to Coppermine Island. They were believed capable of "only about 50 m of sustained flight" (Merton 1975 b).

Between 20 November and 3 December 1979, a party consisting of Dick Anderson, John Craig, Duncan Cunningham, Rod Hitchmough, Ian McFadden, Don Newman, Joan Robb and Anne Stewart visited Lady Alice, Whatupuke and Coppermine Islands to investigate the distribution and status of tuataras (*Sphenodon punctatus*), and Polynesian rats (*Rattus exulans*). During this period at least 10 pairs of Saddlebacks were seen on Coppermine dispersed over the entire island. Joan Robb and Rod Hitchmough also reported seeing a lone Saddleback on Middle Stack, which lies at least 250 m from both Lady Alice and Whatupuke Islands (Fig. 1). On two subsequent checks of the Stack, however, the bird was not seen.