BREEDING OF ANTARCTIC TERNS AT THE SNARES ISLANDS, NEW ZEALAND

By P. M. SAGAR*

ABSTRACT

The breeding and habits of the Antarctic Tern *(Sterna vittata)* were studied during a summer at the Snares Islands. Daily records were kept of ten nests situated on cliff ledges and rocks. Egg-laying occurred during two periods; late October/early November and late November. The usual clutch was one egg, but some two-egg clutches were laid. Re-laying probably occurred on one occasion when the first clutch was lost. Both parents incubated, and the incubation period averaged 24 days.

The chicks were guarded for two to three days after hatching and were fed by both parents. Chicks fledged between 27 and 32 days after hatching. Adverse weather severely restricted chick growth during the early stages of development and was a major factor in chick mortality.

INTRODUCTION

The Antarctic Tern is a circumpolar species breeding in coastal areas from about 47°S to 68°S (Watson 1975). In the New Zealand region it breeds on Campbell, Auckland, Snares, Antipodes, Bounty and South Cape Islands (Falla *et al.* 1970).

Despite its wide distribution, there are only a few general accounts of its biology, the most informative being those of Bailey & Sorenson (1962) who outlined breeding at Campbell Island (52°33'S, 169°08'E) and Parmelee & Maxson (1975) who studied breeding on Anvers Island (64°45'S, 64°05'W).

Antarctic Terns were recorded first at the Snares Islands (48°02'S, 166°36'E) by Buller (1896). Subsequently, brief mention of them has been made by Fleming (1948), Stead (1948), Richdale ("1948") and Warham (1967).

This paper outlines the breeding biology of the Antarctic Tern for the 1976-77 summer at the Snares Islands, New Zealand. This formed part of the study programme of the 1976-77 University of Canterbury Snares Islands Expedition, which was at the Snares from 9 November 1976 to 3 March 1977.

STUDY AREA AND METHODS

The Snares Islands consist of granite with a gneissic structure (Fleming 1953). The granite forms precipitous cliffs which rise to

* University of Canterbury Snares Islands Expeditions Paper No. 35.

about 200 m on the west coast of the main island. The study area was on the less precipitous and lower cliffs of the east coast of the main island (Figure 1A).

Daily checks of the study area (Figure 1B) were made from 12 November 1976 to 31 January 1977 to find Antarctic Tern nests. Most adult terns defending nest sites were caught using traps at the nest and colour-banded for individual recognition; however none was sexed. Behaviour of terns before egg-laying was recorded. Nest contents were recorded at about the same time each day, until the chick(s) fledged. Eggs were marked with red ink for individual recognition. Chicks were weighed and measured at each visit. Bill and tarsus lengths were measured to the nearest 0.1 mm using vernier calipers. Chicks were weighed in a bag of known weight on a spring balance, accurate to 2 g. Chicks were banded before fledging, and post-fledging sightings were recorded.

Observations of 4-5 hours duration were made at two nests when adults were feeding chicks. Food samples were obtained from a chick regurgitation and food remains collected around a nest site.

Counts were made of terns at a roost in Boat Harbour on most evenings. Additional observations at Antarctic Tern nests outside the study area were made and have been incorporated where relevant.

Place names mentioned in the text follow those of Warham (1967) and Horning & Horning (1974).

RESULTS

The nest site and nest.

In the study area, Antarctic Terns nested solitarily (Figure 1B), the closest nests (4 and 5) being 10 m apart. Nests were either on cliff ledges overlooking the sea or on the tops of rocks a short distance inland. All nests were exposed; however a screening of light vegetation gave slight protection from the weather to some nests. With the exception of nest 3, all were associated with groups of Red-billed Gulls *(Larus novaehollandiae)*. The gulls were nesting just inside the forest edge, often within 3 m of a tern nest. There was no competition for nest sites with Red-billed Gulls as the gulls chose the shelter of vegetation, whilst the terns nested in the open. This association benefits both species against predation by Southern Skuas *(Catharacta lonnbergi)*.

Outside the study area a further six nests were found. Four were within 10 m of one another at Mollymawk Bay while single nests were found on the north side of Punui Bay and the south side of Mollymawk Bay.

All nests were slight scrapes in shallow peat and vegetation. A thin layer of leaves, usually dead *Poa astonii* and *Hebe elliptica*, lined the bottom of scrapes.

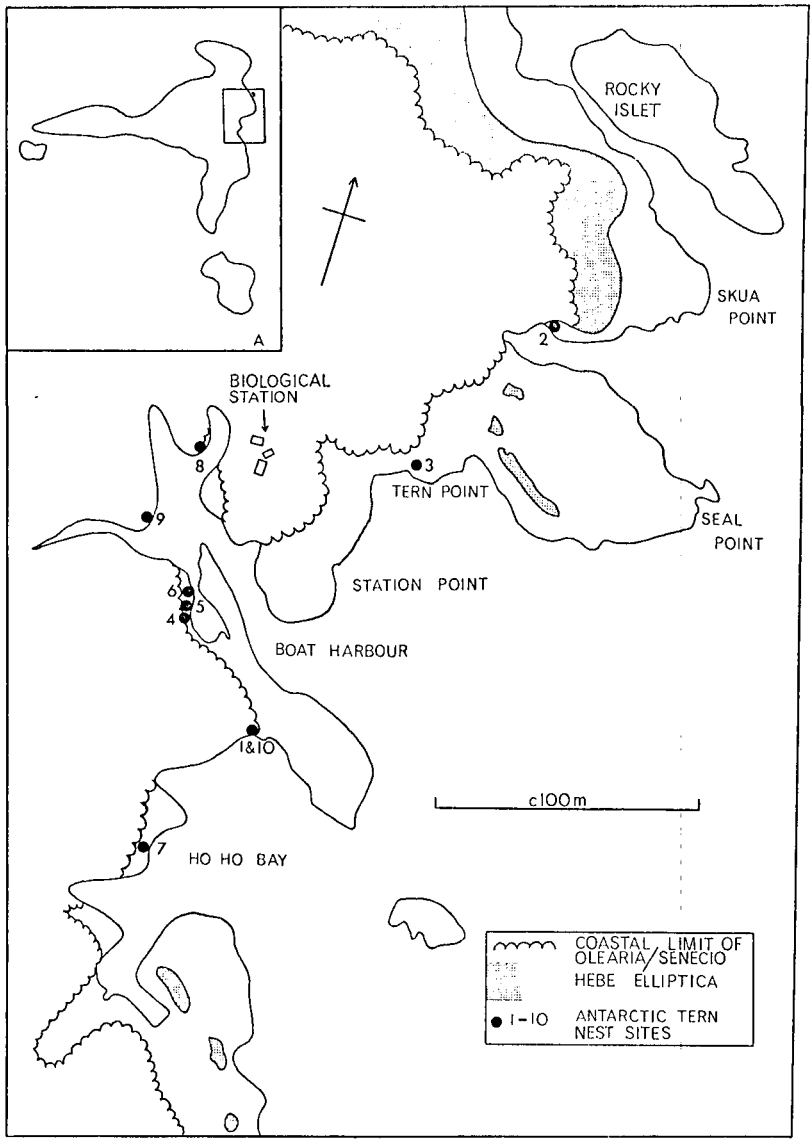

FIGURE 1 — A. The location of the study area on the main Snares Island.

B. The study area.

Pre-egg-laying behaviour.

Pairs were seen in courtship flight, with one bird carrying a small fish across its bill. They would land briefly at several places before settling. After the fish had been offered, received and eaten, both birds would appear to test several places on the light *Poa astonii* by pressing their breasts onto the ground while scraping with their feet. Eventually one site was selected and one bird would continue pressing and scraping while the other stood by.

Following nest-site selection both birds were seen to defend the immediate area of the scrape. Red-billed Gulls and other terns were driven off by fierce dives and bill clicking. Two nest sites were defended for 11 days and one nest site for 9 days before egg-laying.

Copulation was observed only once, at nest site 8, 6 days before egg-laying.

Egg-laying.

Complete clutches were found in nests 1-5 on 12 November. However, by back calculation from hatching dates, using incubation periods (determined later) the dates of first eggs were estimated (Table 1).

The egg from nest 1 disappeared between 1600 on 13 November and 0900 on 14 November. Another egg was laid in the same nest (nest 10) on 23 November. As neither of the birds from nest 1 were banded re-laying is not proven.

Stead (1948) noted that this tern has a prolonged breeding season at the Snares and suggested individual pairs may raise two broods a year. This is not supported by my observations, which suggest there is a double peak in egg laying activity, one in late October/early November and the other in late November; the second peak occurring about the time the first eggs hatch (Table 1).

Clutch and egg sizes.

Fourteen complete clutches were recorded; 10 were one-egg and 4 were two-egg clutches. However, no account can be made for eggs laid and lost before being recorded.

Fourteen eggs were measured and ranged from 41.2-49.2 x 30.5-33.2 mm with a mean of 46.2 ± 1.84 x 32.1 ± 0.70 mm. The mean weight of six fresh eggs was 24 g.

Incubation behaviour.

Nest relief was observed three times during incubation. On all occasions a bird flew in from the sea and gave a brief call before landing near the nest. The incubating bird then flew from the nest and out over the sea as its partner flew onto the nest .

Table 1: Breeding data for ten Antarctic Tern nests at the Snares Islands.

Nest No.	1	2	3	4	5	6	7	8	9	10
First egg laid	by 12.XI.76	by 12.XI.76	27.X.76*	2.XI.76	30.X.76*	25.XI.76	26.XI.76	27.XI.76	28.XI.76	23.XI.76
Second egg laid			30.X.76*			27.XI.76	28.XI.76			25.XI.76
First egg hatched	D	D	19.XI.76	26.XI.76	22.XI.76	19.XII.76	20.XII.76	20.XII.76	21.XII.76	D
Second egg hatched			22.XI.76			21.XII.76	22.XII.76			D
First young fledged			20.XII.76	23.XII.76	21.XII.76	20.I.77	D	D	D	
Second young fledged			24.XII.76			D	D			
Clutch size	1	1	2	1	1	2	2	1	1	2

* estimates from average known incubation period

D died or disappeared

Incubation period.

In two-egg clutches incubation began after the first egg was laid. The incubation period was taken as the time between the laying and hatching of the last egg in the clutch. The incubation periods of six eggs were 24, 24, 24, 24, 25 and 25 days.

Hatching.

In eight cases the interval between the first observed starring of an egg and its hatching ranged from 1-3 days. In two two-egg clutches the second egg hatched two and three days after the first. After hatching shells were removed from the nest.

Chick behaviour.

Chicks were brooded for two days before they abandoned the nest and sought shelter in nearby open vegetation. When adults were present the chicks readily stood in the open.

Chick growth and development.

The weights of four chicks are presented in Figure 2. The curves for chicks 3.1, 3.2 and 4 are typical of those obtained for other seabirds, with a steady rise to a maximum, followed by a fall before fledging. These chicks hatched from eggs laid in late October/early November. Chick 6.1 hatched from an egg laid in late November. Its growth curve was normal until six days after hatching. When this chick was 6-13 days old strong winds and cool, wet weather persisted and the chick's rate of weight increase was severely depressed. This was proably due more to metabolic problems of the chick than to feeding problems of adults as terns were seen feeding frequently during this period. Once favourable weather conditions returned the weight of the chick increased steadily.

Chick 4 was from a single egg clutch and increased in weight more rapidly than the two chicks from nest 3.

The average tarsus and bill length measurements of the four chicks are presented in Figure 3. The tarsus grew quickly to adult length while mean bill length was shorter at fledging than that of the average for adults.

Initially the chicks were down-clad. The first feathers to appear were the primaries, which burst their quills about 11 days after hatching. Chicks were down-free 1-2 days before fledging i.e. at about 25-30 days. At fledging the heavily barred dorsal plumage, which distinguishes Antarctic Tern juveniles from Arctic Tern *(Sterna paradisea)* juveniles and is typical of juvenile Southern Hemisphere *Sterna* (Murphy 1938), was obvious (Figure 4). The tarsus, feet and webs were dusky red while the bill was dark with a slight pink tinge.

Food and feeding.

Chicks were fed by both parents at irregular intervals. Typically, an adult flew towards the nest from the sea with a fish across its

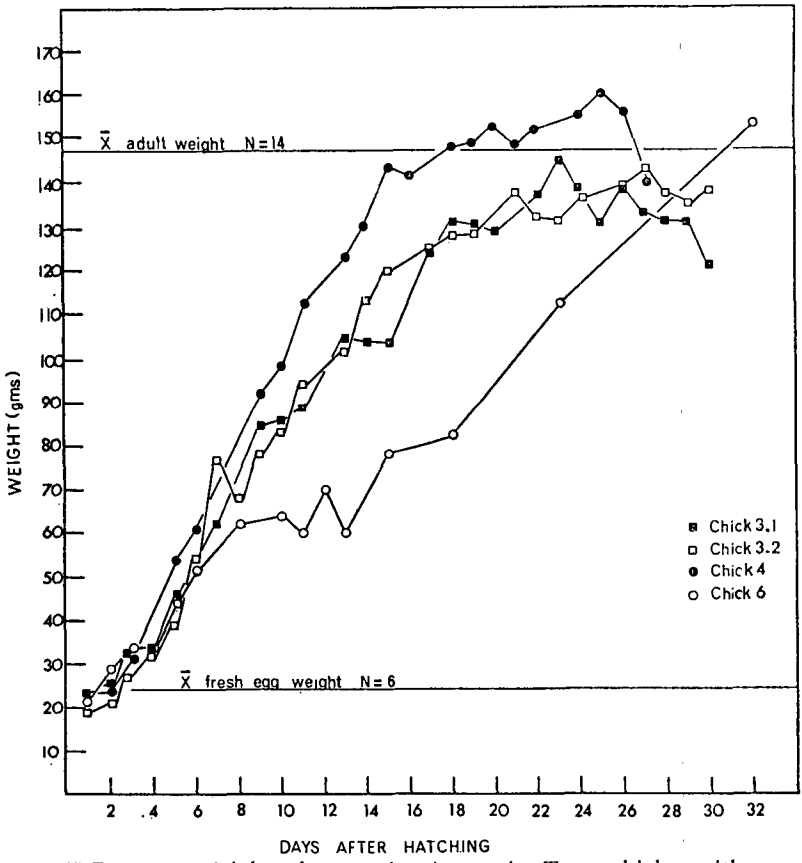

FIGURE 2 — Weight changes in Antarctic Tern chicks with age.

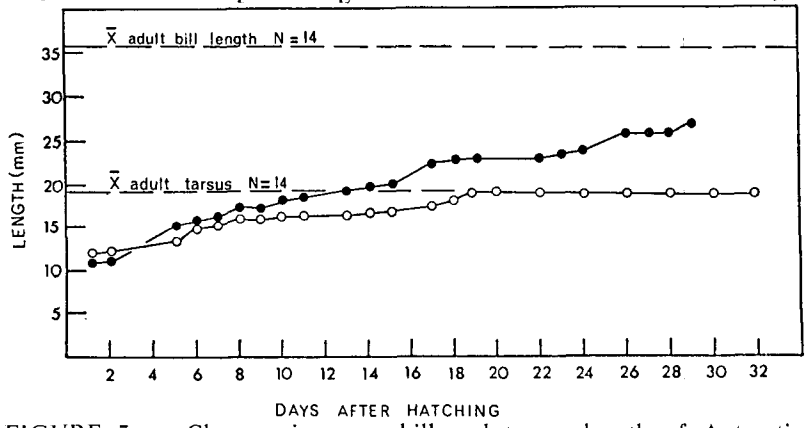

FIGURE 3 — Changes in mean bill and tarsus length of Antarctic Tern chicks with age.

FIGURE 4 — Recently fledged Antarctic Tern chick.

bill. When 10-20 m from the nest site the adult gave a short call and on landing the chick appeared, running out of the vegetation, begging. The fish was passed immediately to the chick which quickly swallowed it whole, head first. The adult then flew off and the chick retired into the vegetation.

When two chicks were present, the first to reach the parent was given the fish. After several feeds the first chick became less responsive to the call of a landing parent, allowing its sibling to be fed.

Antarctic Terns fed close inshore. They flew slowly over the sea, occasionally hovering, then dropping into the water briefly, almost totally submerging. Flocks of up to 49 were seen congregated to feed.

All identified food proved to be fish. The species identified were *Cheilodactylus macropterus* and *Notothenia microlepidota* (det. J. Moreland, National Museum, Wellington). Three whole fresh *C. macropterus* found by a nest measured 76, 80 and 90 mm. Presumably the chick either was too well fed or the fish were too large for it to swallow.

Fledging period.

Four chicks fledged from 27-32 days after hatching (Table 1). These seem to be the first data on fledging periods for Antarctic Terns recorded.

Chicks were fed by their parents for at least three days after fledging. After this time both parents and chicks left the breeding area. At nest 3, once the older chick had fledged it accompanied the parents when feeding and occasionally roosted on an exposed rock near the nest site. Both chicks were flying with the parents the day after the younger chick fledged.

Mortality.

Three clutches disappeared before hatching (Table 1). At nest 1 the terns probably re-laid (see above). However, at nest 2 the terns deserted the site.

Southern Skuas are the principal predators of Antarctic Terns (Parmelee & Maxson, 1975). These skuas breed within 50 m of Antarctic Terns at the Snares Islands. Terns were seen actively pursuing skuas. Whenever a skua flew into Boat Harbour all the terns and unoccupied Red-billed Gulls gave chase. The terns then returned quickly to their nests.

Red-billed Gulls were potential predators of tern eggs and chicks. I saw no sign of such predation but terns defended their nest sites against intrusion by gulls.

Five tern chicks died during the windy, cold wet weather mentioned previously. All were less than five days old and neither the surviving chick (chick 6.1) nor the dead chicks were being brooded.

Roost composition and numbers.

Both first-year and non-breeding adult terns usually roosted near nests 4, 5 and 6 in Boat Harbour during early and late summer. They were joined by up to five juveniles during February. Non-breeding terns were easily distinguishable from adult terns by their white foreheads, and dull red-black bills and tarsi.

The number of first year terns dropped sharply (from 11 to 1) in late November. Parmelee & Maxson (1975) recorded a similar pattern in first-year terns at Anvers Island. Emigration and/or moult are possible explanations for these declines. The numbers of adult terns remained steady (3-4) during November and December but rose sharply in January (19) and peaked in February (25). Juveniles first appeared at the roost on 2 February. These increased numbers were indicative of the end of the breeding season.

DISCUSSION

Colonial nesting of Antarctic Terns has been recorded from Heard Island (Downes *et al.* 1959), Gough Island (Swales 1965), Saint Paul and Amsterdam Islands (Segonzac 1972) and Anvers Island (Parmelee & Maxson 1975). On Tristan da Cunha, following the introduction of rats, Antarctic Terns abandoned nesting on sandy beaches for inaccessible ledges (Elliott 1957). At the Snares Islands, although mammalian predators are absent, the terns usually nest solitarily. Habitats suitable for colonial nesting do exist; however, their use by Fur Seals *(Arctocephalus forsteri)* and Hooker's Sea Lions *(Phocarctos hookeri)* as hauling out grounds and Southern Skuas for breeding denies terns the use of these areas.

The breeding cycle of Antarctic Terns varies significantly with locality. Egg dates from the Snares agree with those reported from Saint Paul and Amsterdam Islands by Segonzac (1972). Eggs were seen from late November to late January on Campbell Island by Bailey & Sorenson (1962) and from late January to early March on Gough Island (Swales 1965). Further south, on Crozet, Kerguelen and Heard Islands, laying begins in late December (Watson 1975). At Anvers Island egg laying occurred from about 11 November to 27 November (Parmelee & Maxson 1975). These data do not follow the trends shown by Warham (1972) for Rockhopper Penguins *(Eudyptes chrysocome)* and Young (1977) for Southern Skuas, where sea temperature and latitude affected the onset of breeding. The prolonged and varied breeding seasons indicate that Antarctic Terns have adapted to local conditions, the Anvers Island population being adapted to the short Antarctic summer.

Antarctic Tern clutch size increases with increasing latitude. Contrary to my findings, Stead (1948) reported one-egg clutches from the Snares, and Oliver (1955) reported one-egg clutches for New Zealand subantarctic islands. At Campbell Island the nests often

contained one egg, although the complete set was two (Bailey & Sorenson, 1962). Further south, at Anvers Island, the ratio of two-egg clutches to one-egg clutches was 27:2 (Parmelee & Maxson 1975). This trend contrasts with that of the Arctic Tern which displays a marked decrease (mean 2.4 in boreal, 2.1 in low-arctic and 1.5 in high-arctic) in clutch size with increasing latitude (Salomonsen 1972). One, or a combination of factors such as food availability, predation pressure and migratory habits may be responsible for these contrasting trends. However, until more detailed data on these species are available, the roles of such factors remain conjectural.

My value for the incubation period of 24-25 days supports that estimated by Parmelee & Maxson (1975). This period is similar to those stated for other *Sterna* species.

Dunn (1975) has shown that wind, rainfall and sea conditions had measurable effects on the weight increase of Common Tern *(S. hirundo)* chicks and that wind speed had a strongly linear depressive effect on the weights of Roseate Tern *(S. dougalli)* chicks. My observations support those of Dunn.

The fledging period of 27-32 days is similar to that given for the Common Tern, about 28 days (Witherby *et al.,* 1941) but is significantly longer than that given for the Arctic Tern, about 21 days.

CONCLUSIONS

The breeding biology of Antarctic Terns at the Snares Islands is typical of other *Sterna* species, especially with regard to clutch-size, incubation and fledging periods and mortality. Elsewhere this species has adapted to local conditions in breeding when conditions are most favourable.

ACKNOWLEDGEMENTS

The 1976-77 University of Canterbury Snares Islands Expedition was supported by a grant from the University Grants Committee. The Royal New Zealand Navy provided transport to the Snares Islands on the *HMNZS Taranaki* (Commander C. J. Carl) while *FV Sapphire* (Mr I. Leask) returned us to Bluff. Their help and interest in this expedition was most appreciated. I thank R. Guest, Dr J. Warham and Joy L. Woods for criticising the manuscript.

LITERATURE CITED

BAILEY, A. M.; SORENSEN, J. H. 1962. Subantarctic Campbell Island. Proceedings of the Denver Museum of Natural History 10. 305 pp.

BULLER, W. L. 1896. Notes on New Zealand ornithology, with an exhibition of specimens. Transactions and Proceedings of the New Zealand Institute 28: 326-358.

DOWNES, M. C.; EALEY, E. H. M.; GWYNN, A.M.; YOUNG, P. R. 1959. Birds of Heard Island. Australian National Antarctic Research Reports (ser. B) 1: 1-135.

DUNN, E. K. 1975. *The role of environmental* factors in the growth of tern chicks. Journal of Animal Ecology 44: 743-754.

ELLIOTT, H. F. I. 1957. A contribution to the ornithology of the Tristan da Cunha group. Ibis 99: 545-586.

FALLA, R. A.; SIBSON, R. B.; TURBOTT, E. G. 1970. A field guide to the birds of New Zealand. 2nd ed. Auckland: Collins. 256 pp.

FLEMING, C. A. 1948. The Snares Islands Expedition, 1947. New Zealand Bird Notes 2: 181-184.
FLEMING, C. A. 1953. The geology of the Snares Islands, Part 1: General Geology. Scientific Results of the New Zealand Sub-Antarctic Expedition, 1941-45. Cape Expedition Series Bulletin 13: 9-27.
HORNING, D. S.; HORNING, C. J. 1974. Bird records of the 1971-73 Snares Islands, New Zealand, Expedition. Notornis 21: 13-24.
LACK, D. 1968. Ecological adaptations for breeding in birds. London: Methuen. 409 pp.
MURPHY, R. C. 1938. Birds collected during the Whitney South Sea Expedition. XXXVII On Pan-Antarctic Terns. American Museum Novitates 977: 1-17.
OLIVER, W. R. B. 1955. New Zealand Birds. 2nd ed. Wellington: A. H. & A. W. Reed. 661 pp.
PARMELEE, D. F.; MAXSON, S. J. 1975. The Antarctic Terns of Anvers Island. The Living Bird 13: 233-250.
RICHDALE, L. E. [1948] Wildlife on an island outpost: Expedition to the Snares Islands (1947-48). Wildlife Series 8: 105-120.
SALOMENSEN, F. 1972. Zoogeographical and ecological problems in arctic birds. **in:** Proceedings of theXVth International Ornithological Congress, The Hague, Netherlands, 30 August - 5 September 1970. 745 pp.
SEGONZAC, M. 1972. Donnees recentes sur la faune des iles Saint-Paul et nouvelle Amsterdam. Pp. 3-68 **in:** Ecologie des Oiseaux Antarctiques. Paris: Comite National Francais des Rescherches Antarctiques.
STEAD, E. F. 1948. Bird life on the Snares. New Zealand Bird Notes 3: 69-80.
SWALES, M. K. 1965. The sea-birds of Gough Island. Ibis 107: 17-42, 215-229.
WARHAM, J. 1967. Snares Islands birds. Notornis 14: 122-139.
WARHAM, J. 1972. Breeding seasons and sexual dimorphism in Rockhopper Penguins. Auk 89: 86-105.
WATSON, G. E. 1975. Birds of the Antarctic and Subantarctic. Washington, D.C.: American Geophysical Union. 350 pp.
WITHERBY, H. F.; JOURDAIN, F. C. R.; TICEHURST, N. F.; TUCKER, B. W. 1938-41. The Handbook of British Birds. London: Witherby.
YOUNG, E. C. 1977. Egg-laying in relation to latitude in Southern Hemisphere skuas. Ibis 119: 191-195.

P. M. SAGAR, *Department of Zoology, University of Canterbury, Christchurch*