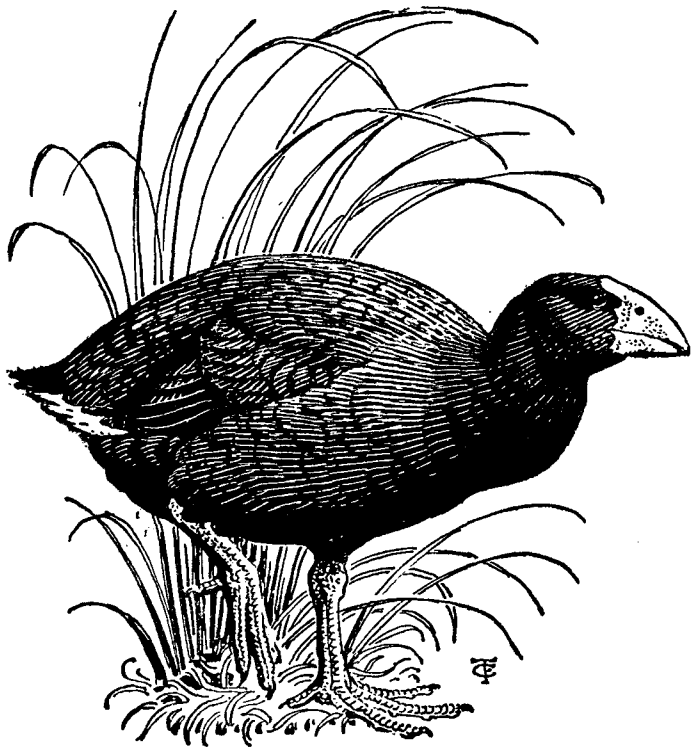
NOTORNIS

Journal of the Ornithological Society of New Zealand



Volume 27 Part 1 March 1980

OFFICERS 1979 - 80

SUBSCRIPTIONS AND MEMBERSHIP

Annual Subscription: Ordinary member $12; Husband & wife members $18; Junior member (under 20) $9; Life member $240; Family member (one Notornis per household) being other family of a member in the same household as a member $6; Institution $24; Overseas member and overseas institution $4.00 extra (postage).

Subscriptions are for the calendar year of first joining and are renewed by invoice each January. Please pay promptly to ensure receiving *Notornis* and *OSNZ News.*

Applications for membership, changes of address and resignations should be sent to the Treasurer.

Exchanges and library subscriptions should be sent to the Treasurer.

Editorial matters ONLY should be sent to the Editor.

[Registered with the GPO Gisborne as a publication]

ISSN 0029 - 4470

CONTENTS

Printed by TE RAU PRESS LTD., Peel Street, Gisborne

REGIONAL REPRESENTATIVES

FAR NORTH: }
NORTHLAND: } D. E. Crockett, 21 McMillan Ave., Kamo, Whangarei. Ph. 50954.

AUCKLAND: Mrs S. Reed, 4 Mamaku St., Auckland 5. Ph. 547784.

SOUTH AUCKLAND: Mrs Beth Brown, 39 Red Hill Rd., Papakura. Ph. 2988157.

WAIKATO: Mrs B. Seddon, 11 Grey Street, Cambridge. Ph. 7761.

BAY OF PLENTY: R. M. Weston, 250 River Road, Kawerau. Ph. 8357.

VOLCANIC PLATEAU: R. W. Jackson, 9 Kenrick Road, Rotorua. Ph. 86907.

GISBORNE/WAIROA: J. C. Henley, 9 Mason St., Gisborne. Ph. 81581.

TARANAKI: R. E. Lambert, Taranaki.Museum,.Box.315,.New Plymouth.

MANAWATU: Dr L. J. Davies, DSIR, Private Bag, Palmerston North. Ph. 87680.

HAWKES BAY: N. B. Mackenzie, Wildlife Trust, Main Road, Westshore, Napier. Ph. 59451.

WAIRARAPA: D. Sim, Lake Ferry, R.D. 2, Featherston. Ph. 828 Pirinoa.

WANGANUI: L. C. Edlin, 5 Poutini St., Wanganui East. Phone 32452.

WELLINGTON: A. H. Gollop, 6 Dawn Grove, Akatarawa, Upper Hutt. Phone 268749.

NELSON: Mrs J. Hawkins, 772 Atawhai Drive, Nelson. Ph. 520151.

MARLBOROUGH: Mrs P. Jenkins, 30 Maxwell Road, Blenheim. Phone 83775.

CANTERBURY: P. M. Sagar, 38A Yardley Street, Christchurch 4. Phone 429720.

WEST COAST: C. S. Lauder, 9 Winnie Street, Greymouth. Ph. 6349.

OTAGO: M. R. R. Foord, 39 Park St., Dunedin North. Phone. 776213.

SOUTHLAND: R. R. Sutton, Lorneville, No. 4 R.D., Invercargill. Ph. 358230.

LITERATURE AVAILABLE

From all bookshops:

A field guide to the birds of New Zealand, by R. A. Falla, R. B. Sibson and E. G. Turbott, new ed. $13.95

From B. D. Heather, 10 Jocelyn Crescent, Silverstream:

A biology of birds, by B. D. Heather. $1.50

From Mrs H. Hagen, 53 Minnehaha Street, Titirangi, Auckland 7:

Back numbers of 'Notornis': Parts of Vol. 1, 50c each; Vols. 2-13, $1.00 per part; Vols. 14-21, $1.50 per part; Vols. 22-25, $2.00 per part; Vols. 26-, $3.00 per part; all plus postage (10% in NZ).

Reports and bulletins (1939-1942) $2.00

OSNZ Library catalogue (1976 ed) 17 pp. $0.55

Banding reports, Nos 8-14, 55c each.

Kermadec Expedition, 1964, by A. T. Edgar. $0.50

Guide to Identification of Shearwaters and Petrels in New Zealand waters (Auckland Museum), J. P. Croxall $0.55

From P. C. Harper, Dept of Extension Studies, University of Canterbury, Christchurch:

Southern albatrosses and petrels: an identification guide, by P. C. Harper & F. C. Kinsky, 1978 edition $5.00

From P.O. Box 12397, Wellington North:

Bird distribution in N.Z. A provisional atlas. $6.00

From B. D. Bell, 9 Ferry Road, Seatoun, Wellington:

OSNZ tie (mid-grey with Notornis motifs). $6.00

NOTORNIS

is the journal of the Ornithological Society of New Zealand (Inc.)

Editor: B. D. Heather,
10 Jocelyn Crescent,
SILVERSTREAM

VOLUME 27 PART 1 MARCH, 1980

CENSUSES OF LAKES OF NORTH KAIPARA

By H. R. McKENZIE

ABSTRACT

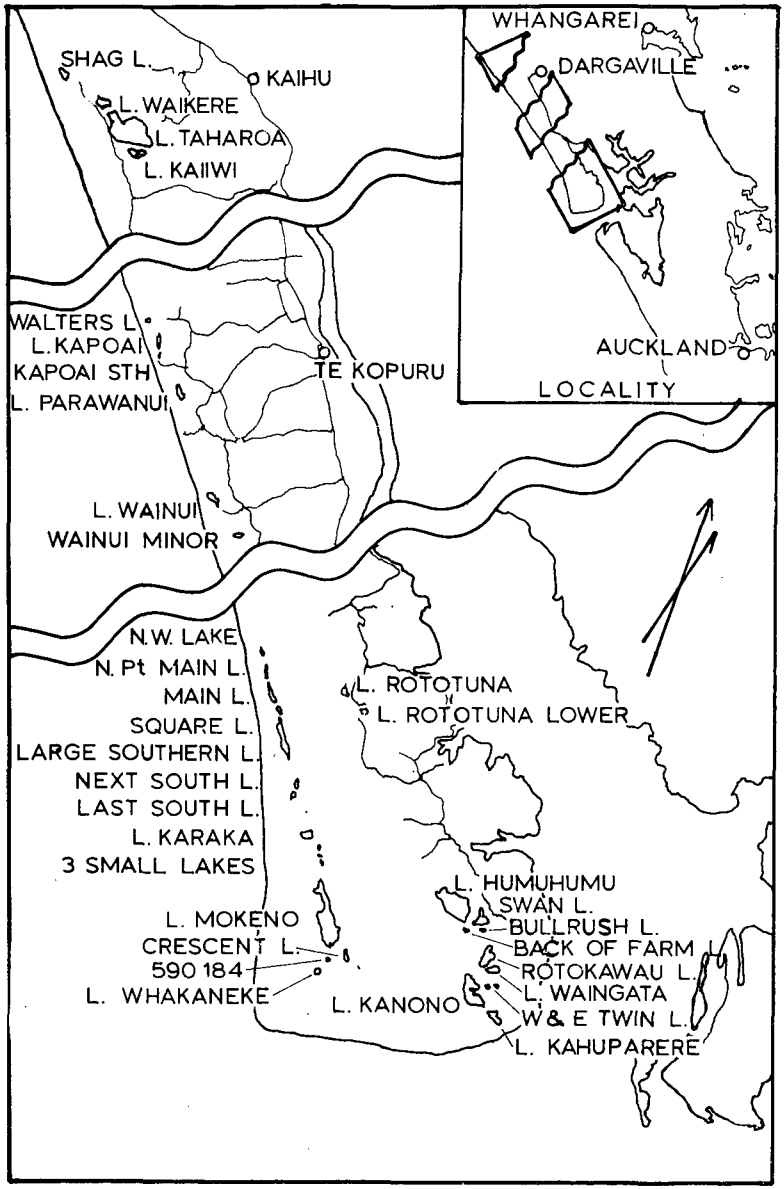
In March 1956 and March 1958 members of OSNZ made bird censuses of lakes in the North Kaipara area from Pouto to west of Kaihu. The results are tabulated. Poor weather and shortage of trained observers may have caused low counts. There were few Mallard Duck *(Anas platyrhynchos)*. Lack of habitat is suggested as the reason for low numbers of Pied Stilt *(Himantopus leucocephalus)* and Pukeko *(Porhpyrio melanotus)* but Bittern *(Botaurus poiciloptilus)* were relatively numerous. White-faced Heron *(Ardea novaehollandiae)* and Welcome Swallow *(Hirundo neoxena)* were not found.

INTRODUCTION

The study area was from Poutu in the south to the group of lakes west of Kaihu (Fig. 1). This attenuated line of lakes, ponds and swamps was to be covered by allotting portions of it to parties of OSNZ members and friends. The recruiting and organising was carried out by J. C. Davenport and myself. Volunteers came from as far north as Kawakawa and as far south as Waiuku, arriving by car on the Fridays and returning on the Sundays.

10 March 1956

The weather on the Saturday was partly fine at first, but there was much wind and rain late in the day. Teams were allocated to tasks according to physical and ornithological ability. It was found that few of even the more highly trained members were well versed in the water birds, and so the experience was extremely valuable. The counts were not a complete success because some of the larger southern lakes were unavoidably not fully covered and in other areas conditions


WHANGAREI
DARGAVILLE
AUCKLAND
LOCALITY
SHAG L.
KAIHU
L. WAIKERE
L. TAHAROA
L. KAIIWI
WALTERS L.
L. KAPOAI
KAPOAI STH
L. PARAWANUI
TE KOPURU
L. WAINUI
WAINUI MINOR
N.W. LAKE
N. Pt MAIN L.
MAIN L.
SQUARE L.
LARGE SOUTHERN L.
NEXT SOUTH L.
LAST SOUTH L.
L. KARAKA
3 SMALL LAKES
L. ROTOTUNA
L. ROTOTUNA LOWER
L. HUMUHUMU
SWAN L.
BULLRUSH L.
BACK OF FARM L.
ROTOKAWAU L.
L. WAINGATA
W & E TWIN L.
L. KAHUPARERE
L. MOKENO
CRESCENT L.
590 184
L. WHAKANEKE
L. KANONO

for observation were far from suitable. The rough water on the large lakes made it difficult to see such birds as Dabchick *(Podiceps rufopectus)* and to separate Scaup *(Aythya novaeseelandiae)* and ducks in the large mixed flocks. Only the lakes listed inTable1 were censused. Some species were observed still to have young with them. The numbers of young birds seen are therefore recorded separately in the tables.

9 March 1957

This attempt failed. Heavy rain set in on the Friday evening and lasted to the Sunday morning. Nothing could be done. It was worrying to waste our time after travelling so far but it was very heartening when one after another came and asked about trying again the next year.

On the way home on the Sunday a good variety of birds was studied at the Rototuna lakes and most of the party called in at Waipu and saw some Brown Teal *(Anas chlorotis)*.

D. G. McMillan mistook the date and visited the Kaihu lakes the next week in fine weather. His totals for the group were 65 Grey Duck *(Anas superciliosa)*, 5 Dabchicks *(Podiceps rufopectus)*, 23 Little Shags *(Phalacrocorax melanoleucos)* and 1 Bittern *(Botaurus poiciloptilus)*.

1 March 1958

This third attempt to obtain a census was very frustrating, some members being hindered by car trouble and others by illness, while the flood conditions from heavy rains a week earlier had scattered the birds and allowed some to hide in flooded swamps. The great amount of extra water was a particularly severe handicap for identifying distant birds. Very long distances of rough walking were covered by most. In spite of the difficulties a good count was obtained.

All the lakes named in Fig. 1 were censused but some had no birds and so are not included in Table 2.

SPECIES SEEN

The following observations are in addition to the data contained in Tables 1 and 2.

NEW ZEALAND DABCHICK *Podiceps rufopectus*

The two counts were similar but may not be the totals because of the difficulty with rough water.

PIED SHAG *Phalacrocorax varius varius*

Possibly breeds at Shag Lake.

LITTLE BLACK SHAG *Phalacrocorax sulcirostris*

Probably some were misidentified as Little Shag in 1956.

TABLE 1 — North Kaipara lakes census 10 March 1956

LAKES	DABCHICK	SHAG SPP.	BLACK SHAG	PIED SHAG	LITTLE SHAG	BLACK SWAN	MALLARD DUCK	GREY DUCK	SHOVELLER DUCK	SCAUP
KAIHU GROUP										
SHAG	–	6	–	–	–	–	–	15	–	–
WAIKERE	–	43	–	–	–	–	–	–	–	–
TAHAROA	–	–	1	6	4	–	–	–	–	–
KAIIWI	1	–	1	–	8	–	–	24	–	–
TE KOPURU GROUP										
WALTERS	–	–	–	–	–	–	1	45	–	–
KAPOAI	–	–	–	–	–	–	–	5	–	–
KAPOAI SOUTH	1	–	–	–	–	–	–	5	–	–
PARAWANUI	–	–	10	4	–	–	–	5	–	–
TANGITIKI GROUP										
ROTOTUNA	3	–	12	–	9	–	–	80	–	2
ROTOTUNA LOWER	6	–	18	–	6	2+3y	–	72	5	2
NORTHWEST	–	–	1	–	–	–	–	14	–	–
NORTH PART MAIN	–	–	–	–	–	–	–	70	–	–
MAIN	–	–	4	–	–	2+6y	–	44	2	4
LARGE SOUTHERN	2+2y	–	4	–	1	2	–	14	–	6+4y
NEXT SOUTH	–	–	2	–	–	–	–	1	–	–
LAST SOUTH	–	–	–	–	–	–	–	20	–	–
POUTO EAST GROUP										
HUMUHUMU	6	–	–	–	–	2+5y	–	122	–	–
SWAN	–	–	1	–	1	–	–	–	–	–
BACK OF FARM	1	–	1	–	–	–	–	17	–	–
ROTOKAWAU	–	–	6	–	8	2	5	40	–	–
WAINGATA	–	6	–	–	–	–	–	30	–	–
KANONO	9	58	–	–	–	7	–	80	–	200
WEST TWIN	–	–	–	–	2	–	–	13	–	–
EAST TWIN	–	–	–	–	–	–	–	50+12y	–	–
KAHUPARERE	7	–	2	–	1	5	–	2	–	–
POUTO WEST GROUP										
MOKENO	1+1y	–	6	–	4	10	–	106	2	60
TOTALS	37+3y	113	69	10	44	32+14y	6	824+12y	9	274+4y

LITTLE SHAG *Phalacrocorax melanoleucos brevirostris*

Probably breeds spasmodically. On 13 April 1965 HMMcK and HRMcK visited a colony of disused nests in drowned tea-tree on the shores of Lake Kanono where c. 35 came in to roost that evening, with 3 Little Black Shags.

AUSTRALASIAN BITTERN *Botaurus stellaris poiciloptilus*

16 seen in 1956 and 13 in 1958 are good counts compared with other parts of the country.

MALLARD *Anas platyrhynchos*

6 in 1956 and 1 in 1958 presumably indicated that it had not yet reached Northland in numbers.

GREY DUCK *Anas superciliosa*

The species made up more than 60% of the population. A further 8 ducks in 1956 and 316 in 1958 were recorded as "unidentified." The species composition of these flocks was probably similar to the identified birds.

TABLE 2 — North Kaipara lakes census 1 March 1958

LAKES	DABCHICK	SHAG SPP.	BLACK SHAG	PIED SHAG	LITTLE BLACK SHAG	LITTLE SHAG	BLACK SWAN	MALLARD DUCK	GREY DUCK	SHOVELLER DUCK	SCAUP
KAIHU GROUP											
SHAG	5+2y	–	–	–	3	–	–	–	23	–	–
TAHAROA	–	–	1	–	–	–	–	–	–	–	–
KAIIWI	5	–	–	–	3	9	–	–	105	–	–
TE KOPURU GROUP											
WAINUI	–	–	–	–	–	3	–	–	6	–	–
WAINUI MINOR	–	–	2	–	1	23	–	1	14	–	–
KAPOAI	–	–	–	–	–	1	–	–	27	–	–
TANGITIKI GROUP											
ROTOTUNA	4	–	2	–	–	50	1	–	–	–	–
ROTOTUNA LOWER	–	–	–	–	–	–	3	–	28	3	–
NORTHWEST	–	–	–	–	–	–	–	–	2	–	10
MAIN	–	–	–	–	–	–	–	–	–	–	8+2y
SQUARE	–	–	–	–	–	–	2+7y	–	60	–	–
LARGE SOUTHERN	–	–	–	–	–	–	2+4y	–	12	–	30
NEXT SOUTH	–	–	–	–	–	–	1	–	–	–	–
LAST SOUTH	–	–	–	–	–	–	2	–	6	–	–
POUTO EAST GROUP											
HUMUHUMU	13	–	–	–	4	6	7	–	100	2	80
SWAN	–	–	2	–	–	–	6	–	1	–	–
ROTOKAWAU	–	9	–	–	–	–	2	–	17	–	12
WAINGATA	–	–	–	–	2	2	–	–	–	–	–
KANONO	4	30	–	1	–	–	16+4y	–	–	–	2
KAHUPARERE	–	–	–	–	–	4	1	–	4	–	–
POUTO WEST GROUP											
KARAKA	2	–	–	–	–	–	–	–	–	–	–
MOKENO	3	–	5	–	1	3	33	–	178	–	3+5y
CRESCENT	–	–	–	2	–	–	5	–	8	–	–
590 184	4+1y	–	1	–	–	–	–	–	70	–	–
WHAKANEKE	–	–	–	5	–	–	53	–	50	–	–
TOTALS	40+3y	39	13	8	14	101	134+15y	1	711	5	145+7y

BROWN TEAL *Anas aucklandica chlorotis*

2 suspected, but not confirmed, on Large Southern Lake, N32/540295, in the Tangitiki Group.

PUKEKO *Porphyrio porphyrio melanotus*

This bird was relatively scarce in the area. The absence of a count in 1956 was due to the term " Water birds " being used when the scheme was being prepared. The same applies to the Pied Stilt.

PIED STILT *Himantopus himantopus leucocephalus*

The 1958 count indicates the unsuitable nature of the lakes and swamps with their clean sand and stiff rushes.

NORTH ISLAND FERNBIRD *Bowdleria punctata vealeae*

3 in 1956 and 1 in 1958 does not indicate the true population. Good weather and work in the late evening would have produced quite high figures.

RAILS Rallidae

Small rails were reported by residents to be present but the species could not be identified.

By today's birding standards we would expect to see White-faced Heron *(Ardea novaehollandiae)* and Welcome Swallow *(Hirundo tahitica neoxena)* in this area. None was recorded during our visits.

It is good to know that further census work on the area is being carried out by Northland members of OSNZ, led by D. E. Crockett. This area is a fruitful field which is worthy of concentrated and sustained study.

ACKNOWLEDGEMENTS

Thanks are proffered to J. C. Davenport for assistance with organising and to G. R. McMillan for painstakingly drafting the original tables. I cannot praise too highly the participants, all of whom made long journeys by car and braved tough going in swamps, scrub, flood-water and rain. Also warm thanks are due to the good people of the peninsula for friendly assistance and hospitality. The team members surely deserve mention. They were J. Allen (2 of the 3 trips), Miss C. Bernrieder (1), B. S. Chambers (1), E. Cheesman (1), J. Craigie (1), M. P. Daniel (1), Mr & Mrs J. C. Davenport (2 & 1), J. Duder (1), R. T. Duder (2), S. Dyer (1), L. E. Fooks (1), Miss P. Gillespie (3, 1 as Mrs Fooks), G. Gorbey (2), Miss J. Forrester (1), D. Graham (1), Miss A. J. Goodwin (1), R. Kidd (1), Miss N. Macdonald (1), G. K. McKenzie (2), Mr & Mrs H. R. McKenzie (3 & 1), D. G. McMillan (3), Mr & Mrs A. McQueen (2), Miss D. McQueen (1), — Monteith (1), Miss C. Mormon (1), R. Moynihan (2), R. Mueller (1), F. Murray (1), J. B. Murray (3), T. Otene (1), M. Paver (2), Mr & Mrs J. Prickett (3 & 3), Miss M. Ralph (1), Mr & Mrs W. Renouf (1 & 1), Mr & Mrs R. A. Ringer (1 & 1), I. M. Rutherford (2), V. M. Rutherford (2), R. Shanks (1), — Smith (*), Miss G. Stead (1), Miss D. Whyte (1).

I am grateful to C. R. Veitch for typing the tables.

H. R. McKENZIE, *21 Estuary Road, Weymouth, Manurewa*

Lamprolia AS PART OF A SOUTH PACIFIC RADIATION OF MONARCHINE FLYCATCHERS

By STORRS L. OLSON

The Silktail, *Lamprolia victoriae,* is a small passerine bird that exists in two morphologically distinct populations in the Fijian islands of Taveuni and Vanua Levu; on the latter it is evidently confined to the Natewa Peninsula (Heather 1977). Its plumage is velvety black, spangled about the throat, crown, and epaulets with metallic blue; the upper tail coverts and variable portions of all but the outer rectrices are silky white. The female plumage is like that of the male but duller. The striking livery of *Lamprolia* has occasioned much wonder and is probably one of the chief factors responsible for its familial relationships having remained obscure up to the present. Mayr (1945), for example, regarded it as " one of the most puzzling birds of the world " and did not assign it to a particular family.

Cottrell (1967) reviewed the literature of *Lamprolia* in detail and the reader is referred to his paper for the history of taxonomic opinions regarding the genus. Heather (1977) provided new information on ecology and behaviour of the population on Vanua Levu, *L. v. kleinschmidti.* Although Cottrell (1967: 253) considered " the problem of relationship " to be " as open as ever," both he and Heather (1977) expressed a tendency to favour the old idea that *Lamprolia* may belong with the birds-of-paradise (Paradisaeidae). The evidence for paradisaeid affinity is excessively tenuous, having originated in the similarity of the metallic spangled plumage to that of paradisaeids such as *Manucodia,* and of the velvety black feathers to those of *Ptiloris.* This view was supported subsequently only by Cottrell's observation that the movements of *Lamprolia* among vegetation were reminiscent to him of the movements of *Paradisaea.*

The evidence against a paradisaeid relationship for *Lamprolia* is far more satisfying. Beecher (1953: 294) dissected the jaw muscles of *Lamprolia,* finding them to be unlike those of the Paradisaeidae. He concluded that " *Lamprolia* is definitely not related to the birds of paradise." Bock (1963: 119) found a number of distinctive characters of the skull in the Paradisaeidae, none of which occurs in *Lamprolia.* He likewise conclusively stated that " *Lamprolia* is not a paradisaeid." *Lamprolia* bears no particular resemblance to any bird-of-paradise in size (it is much smaller), plumage pattern, or bill shape. Nothing yet known of its behaviour can be linked to any of the ritualised behavioural patterns known in birds-of-paradise. Adding to the unlikelihood of *Lamprolia* being a bird-of-paradise is the fact that the Paradisaeidae

do not exist outside of Australo-Papua and a few of the Moluccan islands, the family being absent even from the Bismarck Archipelago.

The only other tentative placement of *Lamprolia* with any currency is based on the suggestion of Beecher (1953) that the genus might belong with the "Malurini," as then construed. Harrison and Parker (1965), in restricting the limits of the Malurinae, noted a similarity in plumage between *Lamprolia* and *Malurus alboscapulatus*. They provisionally included *Lamprolia,* along with *Malurus, Todopsis, Chenoramphus, Clytomyias* and *Stipiturus,* in a subfamily Malurinae, which they placed in the Timaliidae. Again, the same zoogeographic problem arises as encountered with the Paradisaeidae; none of these genera save *Lamprolia* occurs outside Australia and New Guinea.

The resemblance of *Malurus alboscapulatus* to *Lamprolia* is very superficial, being confined to a tendency towards a metallic sheen on the black portions of the plumage, combined with silky white feathers, which, however, are restricted to the mantle and epaulets, rather than the rump and tail. The bill is shorter, wider, and flatter, and lacks the notch at the tip seen in *Lamprolia.* The nostrils in *Malurus* have a decided operculum, lacking in *Lamprolia,* and the loreal feathering does not extend out over the nostrils as in *Lamprolia.* The proportions are utterly different, the tarsi in the two genera being of nearly equal length, while in *Lamprolia,* which is a much larger bird, the wing is nearly twice the length of that in *M. alboscapulatus.* The wing and tail are nearly equal in length in *Malurus,* whereas in *Lamprolia* the tail is only a little over half the length of the wing.

On the basis of plumage and external morphology, as well as zoogeography, I believe that a much more convincing argument can be made for placing *Lamprolia* with the monarchine flycatchers (Muscicapidae: Monarchinae). Conspicuously contrasting patterns of black and white are characteristic of a number of monarchine genera (e.g. *Monarcha, Arses, Metabolus, Terpsiphone).* In many species the dark portions of the plumage have a metallic iridescence and the feathers often have a squamate spangled appearance, though not to the same degree as in adult males of *Lamprolia* (e.g. *Monarcha barbatus, M. leucurus, M. guttula, M. manadensis, M. trivirgata, M. alecto, Arses telescophthalmus, Metabolus rugensis,* and various species of *Terpsiphone).* The rectrices in *Monarcha leucurus* are patterned with white in a manner reminiscent of *Lamprolia,* and in adult males of *Metabolus rugensis* of the Caroline Islands, the entire plumage, except the throat, forehead and primary tips, is a soft silky white, not unlike that of the rump and rectrices of *Lamprolia.* Furthermore, the females of *Metabolus* are dull sooty-gray birds resembling an overgrown juvenile *Lamprolia,* and they sometimes have white colouring on the rump or tail (Baker 1951), also like *Lamprolia.*

The bill in *Lamprolia* is longer and more slender than typical of most Monarchinae, but the bill of *Metabolus rugensis* is similar in

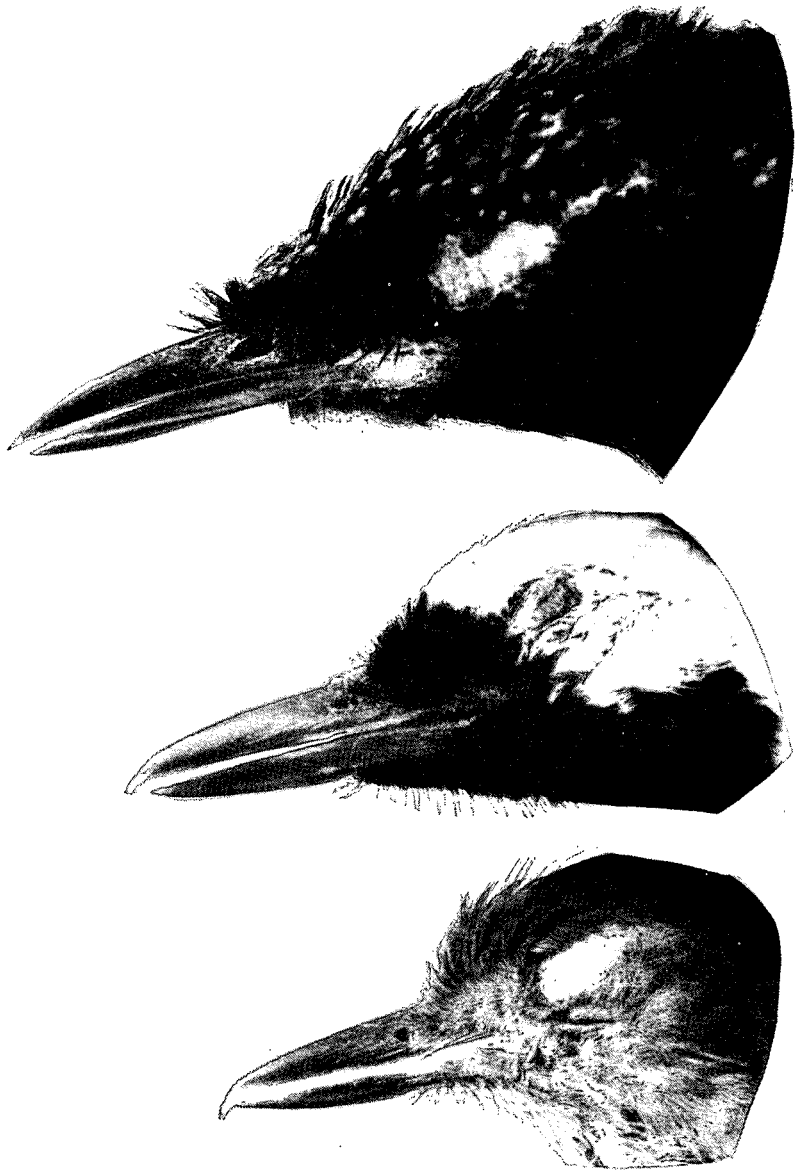


FIGURE 1 — (Top to bottom) **Lamprolia victoriae, Metabolus rugensis, Clytorhynchus v. vitiensis,** to show the general similarity in bill shape. Not to scale, **Lamprolia** being considerably enlarged relative to the others.

shape to that of *Lamprolia victoriae* (Fig. 1) and neither species represents a great departure from the more slender-billed species of *Monarcha* or certain forms of *Clytorhynchus,* especially *C. v. vitiensis.* The monarchines and *Lamprolia* possess the tomial notch, which is lacking in *Malurus.* Although the tail in *Lamprolia* appears to be relatively shorter than in other monarchines, the rest of its proportions are otherwise not dissimilar.

On zoogeographic grounds, a monarchine relationship for *Lamprolia* is most reasonable. The monarchine flycatchers have undergone considerable radiation in Oceania, and the Fijian Islands are at the centre of this radiation. With 3 genera, 6 species, and 17 subspecies, in addition to *Lamprolia,* Fiji has a larger number of monarchine taxa than any island group in the Pacific (the species are *Myiagra vanikorensis, M. azureocapilla, Mayrornis versicolor, M. lessoni, Clytorhynchus vitiensis,* and *C. nigrogularis).* Unlike the Paradisaeidae or Malurinae, the monarchine flycatchers have dispersed widely to many isolated island groups — as far east as the Marquesas *(Pomarea)* and as far north as the Hawaiian islands *(Chasiempis).*

As a member of the Monarchinae, *Lamprolia* presents fewer anomalies of morphology and distribution than it does if included with any of the families heretofore suggested. Although this placement requires confirmation by anatomical studies, I cannot see that *Lamprolia* is particularly aberrant, apart from plumage differences of a specific nature. Within the Monarchinae, the similarities of *Lamprolia* lie on one hand with *Metabolus* and *Clytorhynchus,* and on the other with *Monarcha* itself. In the sequence of Morony *et al.* (1975), *Lamprolia* could therefore be interposed as follows: *Clytorhynchus, Metabolus, Lamprolia, Monarcha.*

ACKNOWLEDGEMENTS

I am grateful to John Farrand, Jr. for assistance with this problem, George E. Watson for comments on the manuscript, and Victor E. Krantz for the photographs.

LITERATURE CITED

BAKER, R. H. 1951. The avifauna of Micronesia, its origin, evolution, and distribution. Univ. Kansas Publ. Mus. Nat. Hist. 3 (1): 1-359.
BEECHER, W. J. 1953. A phylogeny of the oscines. Auk 70: 270-333.
BOCK, W. J. 1963. Relationships between the birds of paradise and the bower birds. Condor 65: 91-125.
COTTRELL, G. W. 1967. A problem species: **Lamprolia victoriae.** Emu 66: 253-265.
HARRISON, C. J. O.; PARKER, S. A. 1965. The behavioural affinities of the blue wrens of the genus **Malurus.** Emu 65: 103-113.
HEATHER, B. D. 1977. The Vanua Levu Silktail **(Lamprolia victoriae kleinschmidti):** a preliminary look at its status and habits. Notornis 24: 94-128.
MAYR, E. 1945. Birds of the Southwest Pacific. New York: Macmillan Company.
MORONY, J. J.; BOCK, W.; FARRAND, J. 1975. Reference list of the birds of the world. New York: American Museum of Natural History.

STORRS L. OLSON, *Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, DC, USA 20560.*

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.

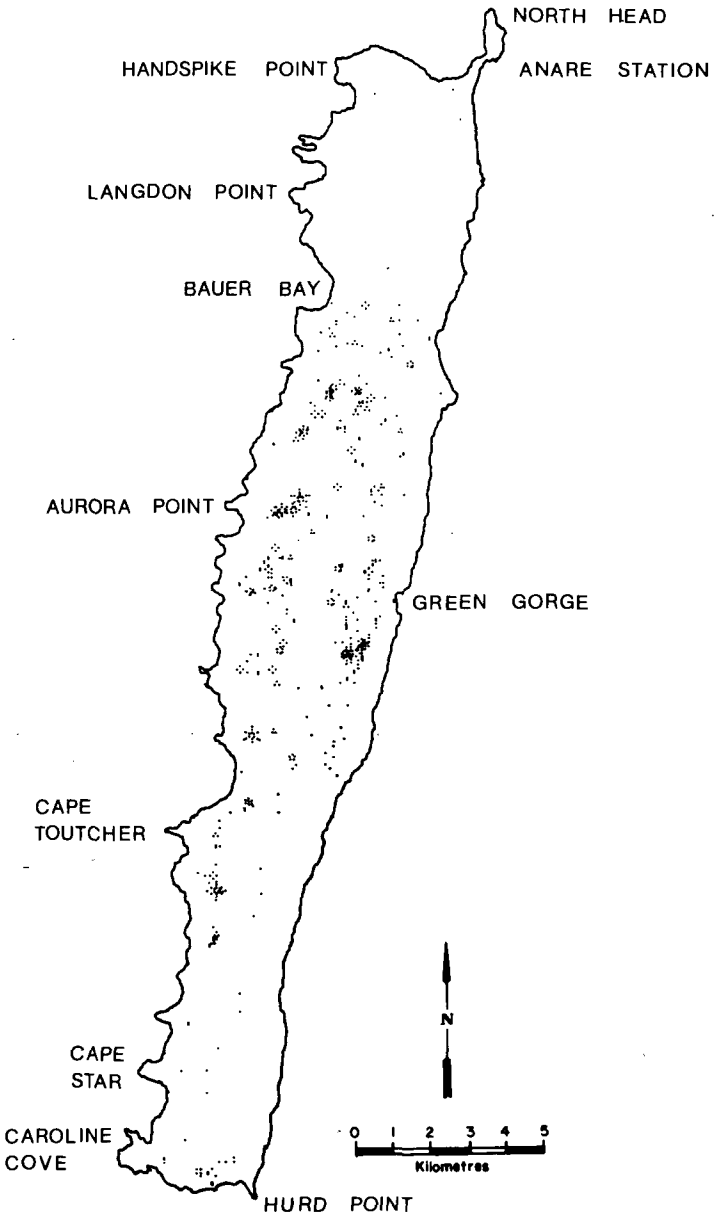


FIGURE 1 — Locations of all remains of Antarctic Prion recorded from cat and skua kills, Dec. 1973 - Mar. 1975.

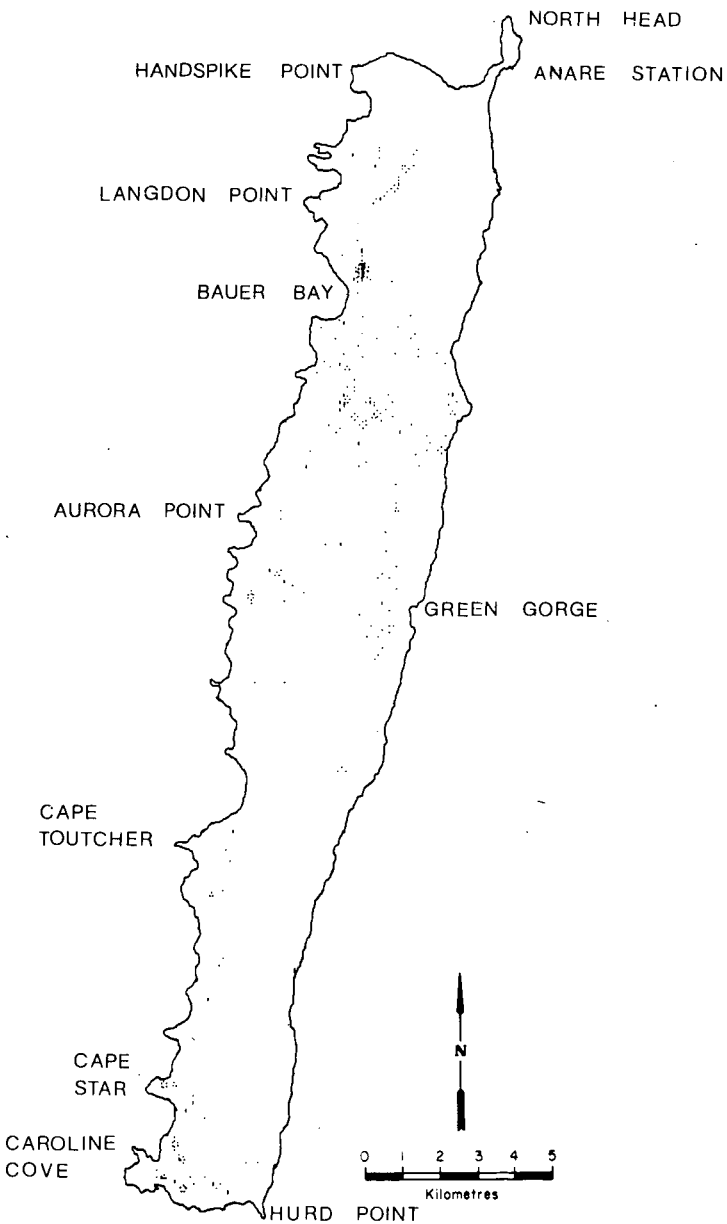


FIGURE 2 — Locations of all remains of White-headed Petrel recorded from cat and skua kills, Dec. 1973 - Mar. 1975.

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.

LITERATURE CITED

CAMPBELL, A. J. 1900 Nests and eggs of Australian birds. Melbourne: Wren Edition 1974.
CARRICK, R. 1956. The wildlife of Macquarie Island. Aust. Mus. Mag. 12: 255-60.
CUMPSTON, J. S. 1968. Macquarie Island. ANARE Sci. Rep. Al. Pub. No. 93.
DEBENHAM, F. (Ed.) 1945. The voyage of Captain Bellingshausen to the Antarctic seas, 1819-1821. Vol. 2. London: Hakluyt Society.
FALLA, R. A. 1937. Birds. BANZARE Rep. Ser. B. Vol. 2.
HAMILTON, A. 1894. Notes on a visit to Macquarie Island. Trans. NZ Inst. 27: 559-79.
JOHNSTONE, G. W. 1977. Comparative feeding ecology of the Giant Petrels **Macronectes giganteus** (Gmelin) and **M. halli** (Mathews). **In:** Llaus, G. A. (Ed.) Adaptations within Antarctic Ecosystems. Pp. 647-68. Houston: Gulf Publishing Co.
JONES, E. 1977. Ecology of the feral cat, **Felis catus** (L.), (Carnivora: Felidae) on Macquarie Island. Aust. Wildl. Res. 4: 249-62.
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.
KEITH, K.; HINES, M. P. 1958. New and rare species of birds at Macquarie Island during 1956 and 1957. CSIRO Wildl. Res. 3: 50-53.
LAW, P. G.; BURSTALL, T. 1956. Macquarie Island. ANARE Interim Rep. No. 14, Pub. No. 29.
MERILEES, W. 1971. Bird observations — Macquarie Island 1967. Notornis 18: 55-57.
MURPHY, R. C.; HARPER, F. 1921. A review of the Diving-petrels. Bull. Amer. Mus. Nat. Hist. 44: 495-554.
SCOTT, J. H. 1882. Macquarie Island. Trans. NZ Inst. 15: 484-93.
WARHAM, J. 1967. The White-headed Petrel **Pterodroma lessoni** at Macquarie Island. Emu 76: 1-22.
WARHAM, J. 1969. Notes on some Macquarie Island birds. Notornis 16: 190-97.

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.*

★

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.*

SEASONAL AND LONG-TERM CHANGES IN BIRD NUMBERS AT LAKE WAINONO

By R. J. PIERCE

ABSTRACT

Monthly bird counts were carried out at Lake Wainono, South Canterbury, from August 1968 to April 1978. Highest numbers of birds were at the lake from January to April because of a post-breeding increase in numbers of 18 common species. Six species reached peak numbers during the winter and only five during spring and early summer. Since 1968 White-faced Herons *(Ardea novaehollandiae)* have declined in numbers, whereas Paradise Shelducks *(Tadorna variegata)*, Spur-winged Plovers *(Vanellus miles novaehollandiae)* and Black-backed Gulls *(Larus dominicanus)* have increased in numbers.

INTRODUCTION

Lake Wainono is typical of New Zealand lagoons in the species that use it and the seasons they use it in. It not only provides valuable feeding grounds for coastal species but also acts as a pre- and post-breeding centre for inland-breeding species. The importance of the lake is increased by the absence of similar extensive wetland in the 250 km between Lake Ellesmere and Karitane Estuary. Lake Wainono is situated midway between these two localities and so occupies a vital link in the diminishing chain of lagoons and unaltered estuaries around the New Zealand coastline.

A regular series of observations over one or more years provides much more information about lagoons than do isolated counts. Regular surveys not only reveal the true value of such habitats and provide essential background information for future management but also help reveal seasonal trends in various species, their dispersals, and their movements to and from the breeding grounds. In this paper I present and discuss the seasonal variations in the abundance of 32 species at Lake Wainono based on monthly counts kept for ten years. Long-term changes in the numbers of some species during the study period are described also.

THE LAKE

Physical characteristics

Lake Wainono is situated on the South Canterbury coast 35 km south of Timaru at latitude 44° 42′ S. The Maoris called it Ki-Wainono,

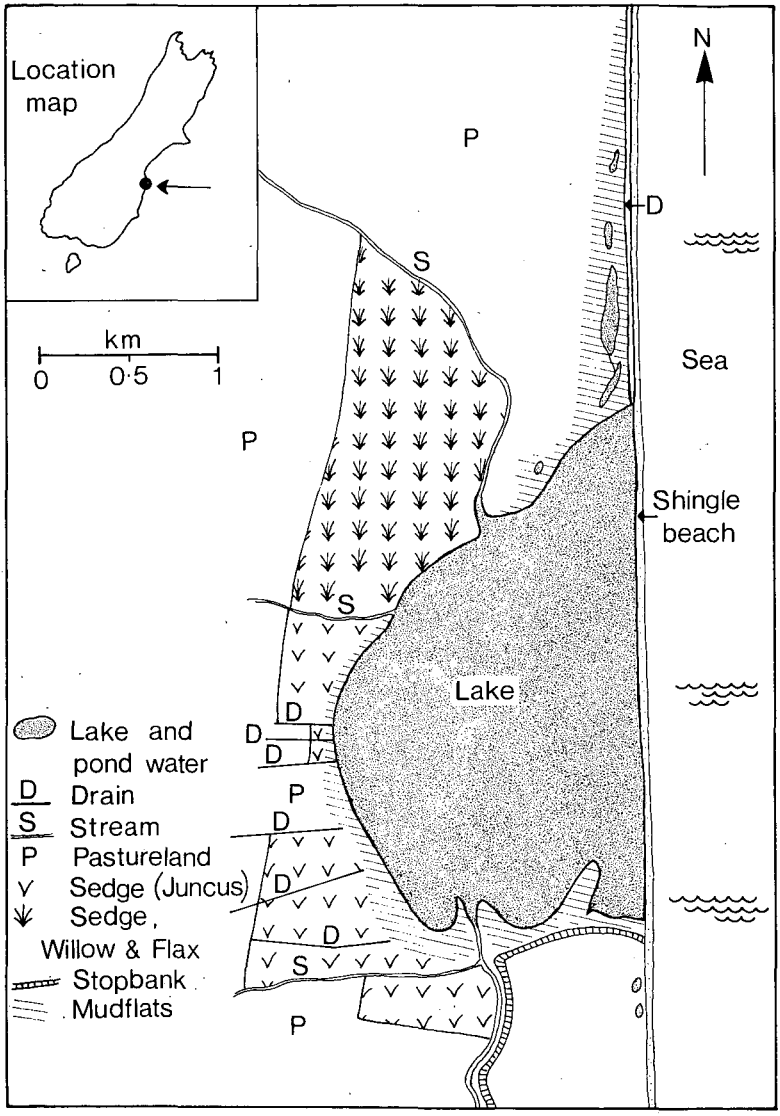


FIGURE 1 — Lake Wainono at normal water level.

" the lake of muddy waters " because the bed is a 20-40 cm thick layer of soft mud which is easily stirred up by winds. At its normal water level of 1.0 metre a.s.l., the lake covers 335 hectares and has a maximum length of 2.8 km (north to south) and a width of 1.7 km (Fig. 1). At very high water levels (1.5 metres a.s.l.), a narrow tongue of the lake extends northwards to give a total length of 5.0 km, covering 420 hectares. An artificial stop-bank at the south end of the lake prevents southward flooding. Separating the lake from the sea is a shingle beach about 50 m wide. Lake Wainono is very shallow, averaging less than one metre in depth and, except for the mouth of one of the streams, never exceeding 2 metres. The deep outlet stream flows southwards for 8 km to join the Waihao River where their combined waters enter the sea. When the sea is calm, the outlet often becomes a tidal channel and so the outlet stream and Lake Wainono fluctuate in level for several days to several weeks. In rough weather the outlet usually blocks, causing water from the Waihao River to back up into Lake Wainono. Because of these changes the salinity of the lake varies widely from about 5% to 25%, but is usually less than 10%. Seawater also seeps through the shingle-beach into the lake and vice versa.

During a drought in 1969 Lake Wainono became progressively shallower and from August until early December was less than 0.6 metre a.s.l. Mudflats were more than twice as extensive as when the lake was at its normal level. Except for two months in autumn 1973, these extremely low water levels were not repeated during the study period.

Vegetation

Judging by the old hummocks around most of the lake's edge, the original swamp vegetation of the lake was probably dominated by the tall rush *Juncus fuscus*. *J. fuscus* occurs now only on the western side of the lake, merging to the north-west with thickets of willows (*Salix* spp.), flax *(Phormium tenax)* and the very tall grass *Festuca arundinacea*. The low-lying flats north of the lake support extensive areas of the small rush *Elaeocharis acuta* and, further back from these mudflats, several species of introduced grass grazed by cattle. The shingle beach is sporadically vegetated, the main shrubs being *Plagianthus divaricatus*, gorse *(Ulex europeus)* and lupins *(Lupinus arboreus)*. Lining the lake's edge near these shrubs are the sedge *Scirpus caldwellii* and various grasses including *F. arundinacea*. The hummocky grassland to the south of the lake, which is grazed by cattle, has small patches of glasswort *(Salicornia australis)*.

The main aquatic plants in the lake are *Myriophyllum* sp., *Lilaeopsis novaezealandiae*, *Ruppia megacarpa*, and *Ranunculus* sp. Several other species, including *Elodea* sp., grow in the freshwater drains and streams.

Aquatic invertebrates

Because the substrate is very muddy and because the salinity, although normally low, fluctuates widely at irregular intervals, the invertebrate fauna is limited to only a few species. Only three groups, midges *(Chironomidae)*, craneflies *(Tipulidae)* and amphipods *(Amphipoda)* are very common. At least two species of *Chironomus* and two species of tipulids occur as larvae in the mud. They emerge mainly in late spring and summer when large swarms of adults occur along the lakeshore. This means, however, that the larger larvae, on which many species of birds feed, decline at that time of year. The small amphipod *Paracorophium lucosi* is abundant in the water and soft mud throughout the year but tends to be replaced in the drains and pools by another amphipod, *Paracalliope fluviatilis*. Other less common inhabitants of the mud include oligochaetes, snails *(Potamopyrgus* spp.), and larvae of the caddis fly *Pycnocentria* sp. and the aquatic moth *Nymphula nitens*.

The transparent swimming mysid *Tenagomysis novaezealandiae* is often common along the sheltered eastern shore of the lake, while waterboatmen *(Sigara arguata* and *Diaprepocoris zealandiae)*, which may not tolerate wide changes in salinity, are less common and of irregular occurrence. Larvae of the shorefly *(Ephydrella aquaria)* are usually common in the very salty ponds south of the lake, where swarms of adults occur in summer and autumn. At the edges of the lake, ponds and streams, the pond skater *(Microvelia macgregori)* often occurs in large numbers.

Fish

Four species of fish occur in the lake throughout the year. They are long-finned eel *(Anguilla dieffenbachii)*, short-finned eel *(A. australis)*, brown trout *(Salmo trutta)* and flounder (*Rhombosolea* sp.). At certain times of the year the lake is visited by shoals of other species, particularly whitebait (*Galaxias* spp.), smelt *(Retropinna retropinna)* and yellow-eyed mullet *(Aldrichetta forsteri)*. Lampreys *(Geotria australis)* occur in the outlet stream.

METHODS

From August 1968 to April 1978 I carried out 96 bird counts at Lake Wainono, all but one of which were carried out in fine weather. Only three counts were made in May (the duck-shooting season) because of the danger of being shot. During each visit to the lake all species were counted except the ducks (*Anas* spp.) which were difficult to identify far out on the lake, Pukekos *(Porphyrio p. melanotus)* and crakes (*Porzana* spp.) which inhabited the densely vegetated lake margins, and all passerines apart from Welcome Swallows *(Hirundo neoxena)*. In 1977, I made monthly estimates of the duck and pukeko populations in order to calculate the total bird population. Birds seen on the ocean beach or offshore were always excluded from the counts.

TABLE 1 — Number and average dates of counts and average monthly lake-level, October 1968 - April 1978.

	Summer		Autumn			Winter			Spring			
	J	F	M	A	M	J	J	A	S	O	N	D
No. of counts	9	9	8	7	3	7	6	8	6	7	12	14
No. of years in which counts were made	9	8	8	7	3	7	5	7	6	6	9	9
Average date of count	14	16	13	13	18	23	19	23	17	21	17	20
Average lake-level (metres above sea-level)	1.0	1.0	0.8	1.0	1.3	1.1	1.0	1.1	0.8	0.9	1.0	1.0

During each visit I walked over the entire lakeshore from the pools north of the lake clockwise around the lake. The grassland to the south and south-west of the lake was also visited because several species foraged there. Birds were counted, their habitats and the level of the lake (Table 1) were noted, and feeding and nesting were noted incidentally. Although each count took 5 hours the figures are considered to be fairly accurate, because regular dawn-to-dusk observations since 1976 have revealed that few species, other than swallows, move far around the lake unless disturbed. Whenever birds were disturbed, their numbers were rapidly checked by driving a vehicle to the appropriate parts of the lakeshore along one or more of the several access tracks.

To find the regular seasonal trends, the counts for each month are averaged for the ten-year period. Standard deviations are large for some species, due in some cases to long-term changes in a species' abundance during the study period, in others to fluctuations in local conditions such as lake level. When numbers are averaged for ten years, however, the seasonal trends still show.

The year-to-year data are presented as average counts for each year, but using only those months that show no significant seasonal variation. For example, numbers of Paradise Shelducks occurring in the months January, February, March and April are not significantly different ($p>0.1$) from one another, so for each year I have used the four counts from January to April only.

A list of all species recorded at Lake Wainono during the study period is given in Appendix 1.

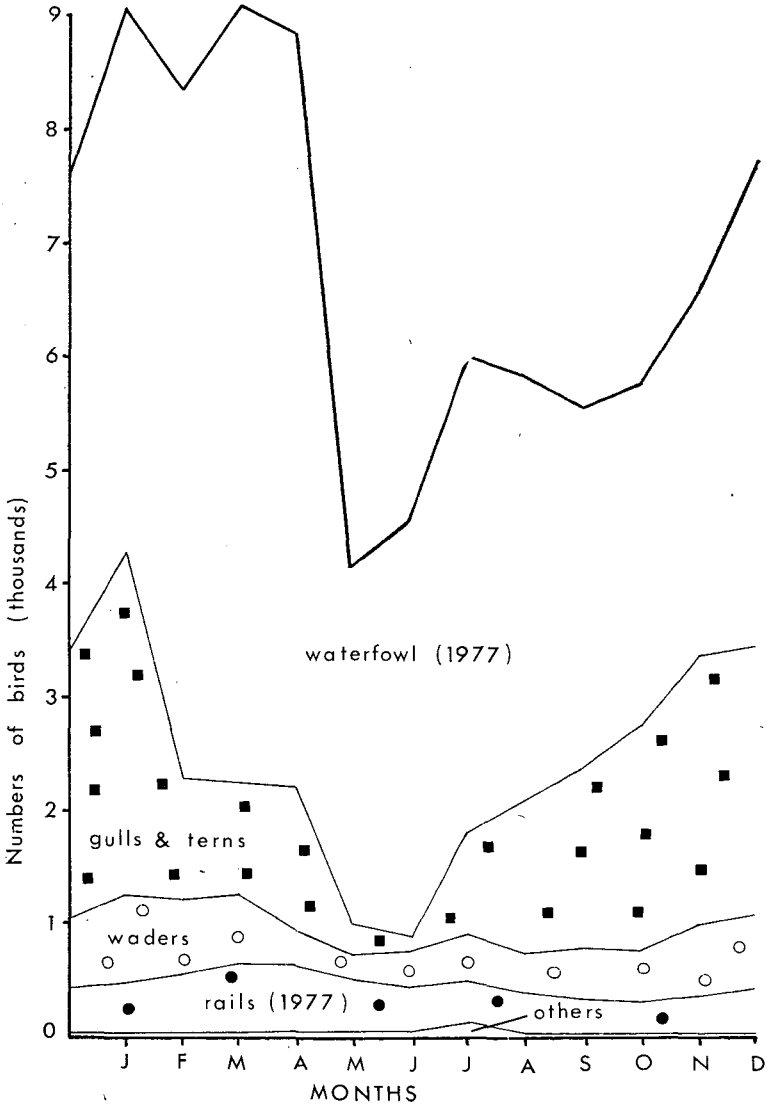


FIGURE 2 — Seasonal occurrence of total bird numbers at Lake Wainono. Passerines (except swallows) are excluded.

RESULTS

An influx of birds to the lake resulted in a very large total population (up to 9100) in summer and autumn with waterfowl and gulls contributing 80-85% of the total (Fig. 2). In May the average numbers of birds plummeted to about 4000, due mainly to an exodus of waterfowl, and did not increase markedly again until November. The May exodus of waterfowl was accentuated by the start of the shooting season, which made many species visit safer areas such as the Washdyke Lagoon sanctuary 38 km to the north (Sagar 1976) or form large diurnal " rafts " out to sea. In all months, however, over half the bird population was waterfowl.

Despite wide fluctuations in total bird numbers, Lake Wainono was used extensively by most bird groups throughout the year. More than 100 each of waterfowl, rails, waders, and gulls and terns were always present. Different species, however, used the lake in different ways and most had their own patterns of seasonal abundance.

COMMON SPECIES

BLACK SHAG *Phalacrocorax carbo*

Black Shags breed commonly inland in South Canterbury, the nearest colony to Lake Wainono being only 25 km to the north-west. They occurred at the lake throughout the year but were common only during winter (Fig. 3a). Four counts — two in June and two in July — produced more than 50 birds, the highest count being 155 in July 1976. Comparatively few birds were present during the spring, when the breeding grounds were occupied, and in May when they were probably scared away by shooters. I often saw Black Shags catching small unidentified fish, sometimes in the lake but usually in the outlet stream, which was usually less turbid than the main lake. Most sightings were of flying birds or of birds roosting in trees or on posts around the lake's edge. Many birds also fed at sea and returned to roost at the lake but the relative importance of sea and lake for feeding is not known.

LITTLE SHAG *Phalacrocorax melanoleucos*

The nearest known colony of Little Shags to Lake Wainono is nearly 80 km to the south at Moeraki. Therefore, the number present during the spring breeding season was significantly less than at other seasons, except for the May shooting season (Fig. 3b). The highest counts were 35 in August 1971 and 34 in December 1971. Unlike the Black Shag, Little Shags were seen to feed only in the lake and outlet stream and not at sea. Their dependence on lake foods was reflected in their scarcity during the 1969 drought, when very low lake levels combined with strong winds kept the lake permanently turbid. The average monthly count for 1969 was one, whereas in 1970 and 1971, when the lake was higher, the average monthly counts were five and 15.

SPOTTED SHAG *Stictocarbo punctatus*

Spotted Shags were common offshore from late January to June each year and they regularly roosted on the shingle beach bordering the lake. They rarely used the lake itself up to 1977. The only birds found at the lake were two roosting together near the outlet stream in June 1971. However, during April and May 1977, up to 100 Spotted Shags fished and roosted at the lake, dropping by June to only ten. This unusual invasion of shags coincided with a period of very heavy seas and also with unusually large numbers of smelt on which they were feeding in the lake.

WHITE-FACED HERON *Ardea novaehollandiae*

White-faced Herons occurred at Lake Wainono throughout the year and a few pairs nested in trees to the west of the lake. Numbers were greatest in late summer (Fig. 3c), followed by a marked autumn exodus to unknown wintering areas. The high July average possibly represented the return of these birds from their winter quarters before a dispersal to the breeding grounds. White-faced Herons fed in a variety of habitats in the Lake Wainono area and their numbers were not affected by the level of the lake. The drains entering the lake provided a fairly constant supply of aquatic vertebrate and invertebrate food, and terrestrial animals including skinks (*Leiolopisma* sp.), grass-grubs *(Costelytra zealandica)* and earthworms (Lumbricidae) were also eaten.

Although White-faced Herons have increased in numbers throughout New Zealand (Carroll 1970) and are still increasing in inland South Canterbury, the Lake Wainono population has declined since the autumn of 1973 (Fig. 4a and b). The average numbers of herons at the lake from 1968 to 1973 was 21.0 compared with 7.3 from 1973 to 1978 ($t = 5.49$, 89 d.f., $p < 0.001$). The decline did not correlate with previous weather conditions (Meteorological Service data), lake level or water salinity. Surprisingly, an abundance of smelt (a common food of herons at the lake) during 1977 did not cause in influx of birds. This lack of response suggests there was a drop in the heron population of coastal South Canterbury and not just at Lake Wainono. Some evidence in support of this suggestion comes from observations I have made at other South Canterbury localities, such as Opihi River mouth, where the number of herons also declined. Current (1979) observations show that heron numbers are increasing again at Lake Wainono and it will be interesting to see if a cycle is starting to repeat.

WHITE HERON *Egretta alba*

Before 1975, the White Heron was a rare late summer and autumn visitor to Lake Wainono, and only single birds were seen. Since November 1975, however, small numbers have occurred throughout the year with the highest count being seven in December 1977. Unlike White-faced Herons, which fed also in the pastures, White

Herons fed only in water where they caught smelt and possibly other fish. They also visited ponds and streams several kilometres from the lake. Their numbers seemed unaffected by changes in lake level.

AUSTRALASIAN BITTERN *Botaurus stellaris*

A few resident Bitterns frequented the densely vegetated western margins of the lake and the banks of the outlet stream and other streams and ponds near the lake.

ROYAL SPOONBILL *Platalea leucorodia*

Royal Spoonbills visited Lake Wainono from November to April but were most often seen in December and January, the biggest flocks being 11 in December 1968 and 13 in December 1975. As this species is a late nester (H. A. Robertson, pers. comm.), the December flocks would have been entirely non-breeders. No juveniles were seen at the lake. As with White Herons, their numbers were unaffected by changes of water level. Both arrivals that I have seen (4 on 16/11/76 and 3 on 18/11/76) have been from the south and all three departures that I have seen (9 on 18/11/76, 1 on 24/12/76, and 2 on 22/2/77) have been to the north. Clearly, Lake Wainono functions only as a temporary feeding ground for birds bound for more northerly winter quarters.

BLACK SWAN *Cygnus atratus*

The Black Swan is one of the most conspicuous species on Lake Wainono but its numbers have fluctuated widely over the years. The maximum count was 2500 in February 1977, and the lowest was only 42 in November 1969, at the height of a drought. The usual pattern was for swan numbers to increase in late summer and autumn, but seasonal changes were obscured by changes in the breeding cycles of birds at Lake Wainono and by changes in the numbers of birds at the main Canterbury nesting grounds of Lake Ellesmere (Williams 1977).

There were two peaks in egg-laying at Lake Wainono, one in early spring and another in late summer or autumn. This contrasted with Lake Ellesmere where all eggs, including those of re-nesting birds, are laid in late winter or spring (Miers & Williams 1969). At Lake Wainono the spring peak was usually larger than the autumn peak and contributed to the build-up in swan numbers during the summer. In 1976, however, the autumn peak was the larger, which may have caused the unusual winter and spring increase in numbers of that year, although an influx of immature birds from Lake Ellesmere (Williams 1977) may also have occurred.

The swans fed mostly on the lake or in short-turfed pastures within a few hundred metres of the lake. Nesting occurred all around the lake shore but particularly amongst the *Juncus* on the western side.

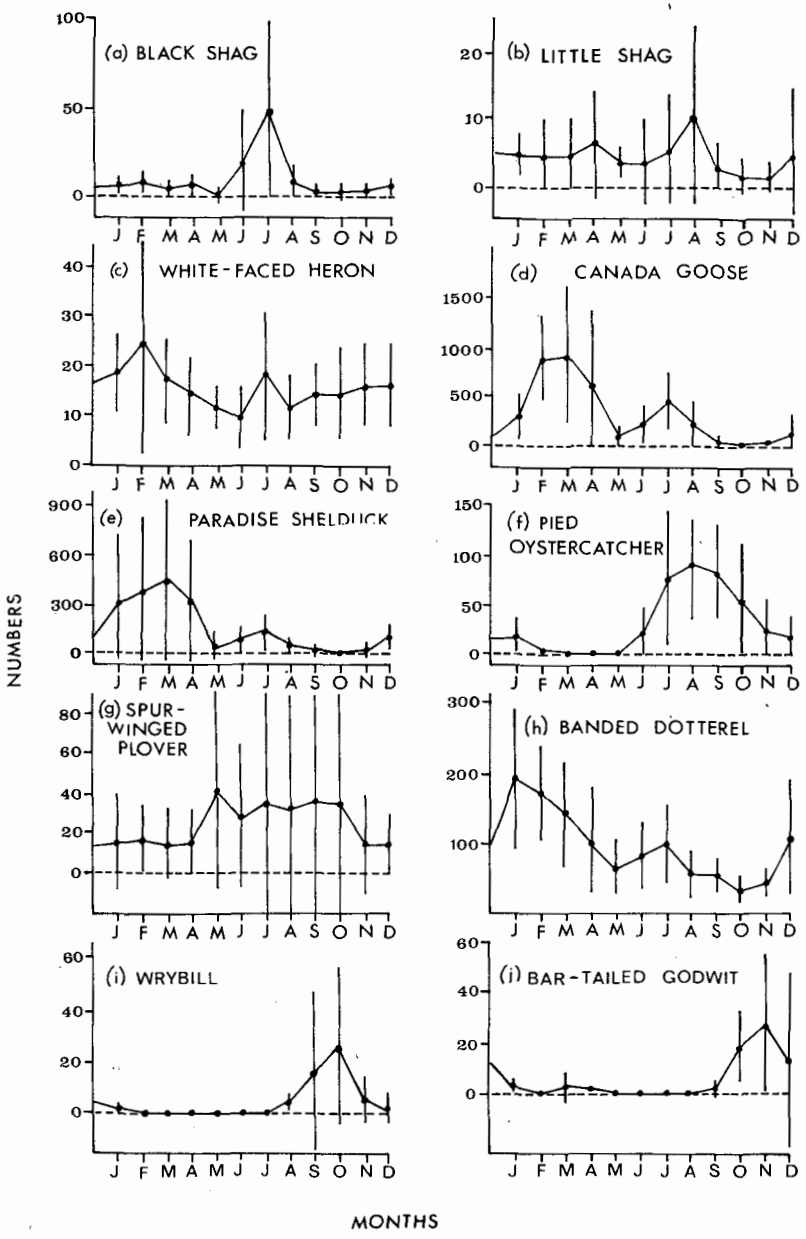


FIGURE 3 — Seasonal changes in bird numbers. The vertical lines are standard deviations of the means.

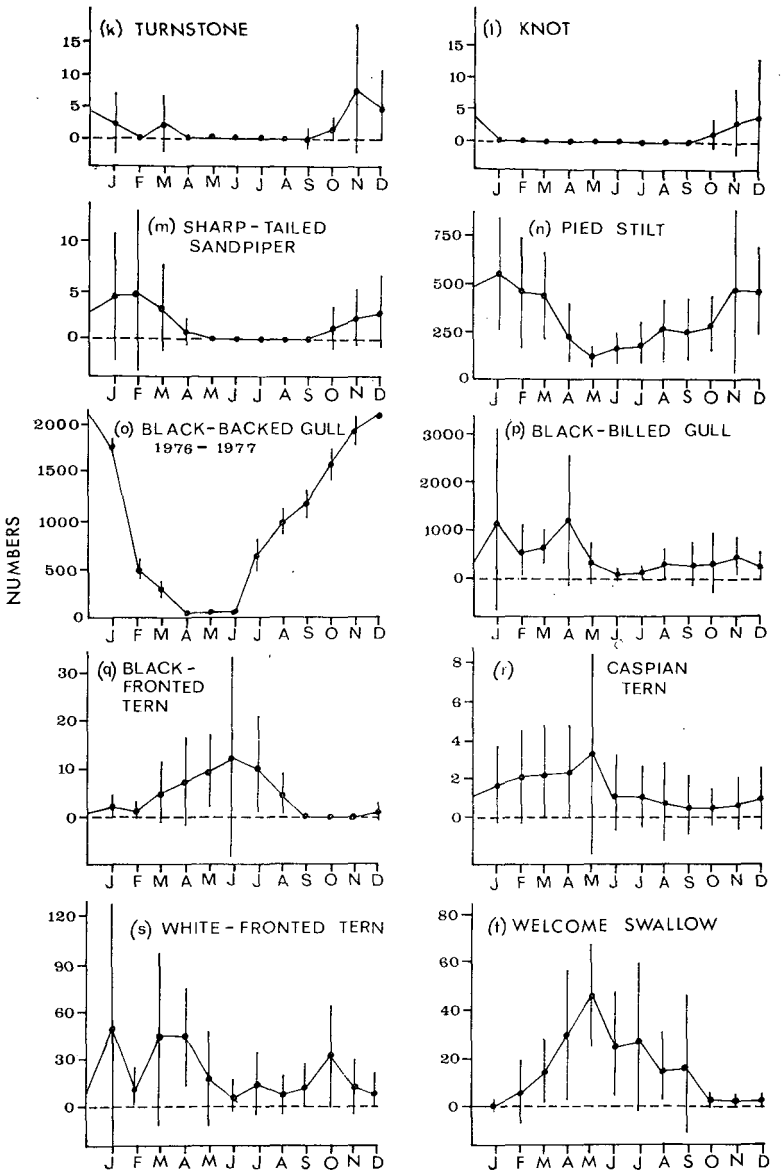


FIGURE 3 — Continued

CANADA GOOSE *Branta canadensis*

Lake Wainono is an important coastal feeding and moulting site for Canada Geese, with numbers increasing during the summer to a peak from February to April (Fig. 3d). The maximum count was c. 2000 in March 1972. Few were found on the lake during the daylight hours of the May shooting season, but sometimes several hundreds were out at sea. Others probably visited the Washdyke Lagoon sanctuary where Sagar (1976) recorded peak numbers in April and May. Geese returned in large numbers to Lake Wainono following the shooting season, matching an exodus from Washdyke Lagoon, and were common until late August by when most had left for their inland breeding grounds. Fewer than 100 remained at the lake from September to November. I recorded nesting only once during the study period (in spring, 1977), but at least two pairs nested successfully the following year. Canada Geese fed mainly on pasture immediately north and south of the lake and occasionally flew to fields many kilometres from the lake to feed at night.

PARADISE SHELDUCK *Tadorna variegata*

The Paradise Shelduck population at Lake Wainono followed a similar pattern to that of the Canada Goose with a post-breeding peak in numbers from January to April (Fig. 3e). Many of these birds moulted at the lake. Only a small percentage of Paradise Shelducks returned after the shooting season indicating dispersal to other localities, including perhaps the breeding grounds. By October almost all the birds remaining were breeding pairs which nested at haystacks, ponds and streams near the lake.

Since 1969 there has been a spectacular increase of Paradise Shelducks at the lake: the maximum count in 1969 was of 52 birds, but by 1978 it had increased to c. 1600 (Fig. 4c). Apart from 1969, when there was little water in the lake and surrounding pools, the quality of habitat for waterfowl has not visibly improved over the years. The increase in numbers, therefore, probably reflects a general increase of the Paradise Shelduck throughout South Canterbury, a reversal of the trend for the previous twenty years of excessive shooting (Williams 1971). During this study the Paradise Shelduck could not be shot at Lake Wainono. Since 1973, it has only gradually been returned to the game list in the Waitaki Valley, and in 1978 small numbers were shot at Lake Wainono (Waitaki Valley Acclimatisation Society Annual Report, 1978). This low hunting pressure has probably permitted the increase in population size. I have observed a similar increase inland in the Lake Tekapo region since 1968.

DUCKS *Anas* spp.

Four *Anas* species were common at the lake throughout the study period. The Mallard *(A. platyrhynchos)* was the most common and the Grey Duck *(A. superciliosa)* the least common, while Grey

Teal *(A. gibberifrons)* and New Zealand Shoveler *(A. rhynchotis)* were in about equal numbers. Mixed flocks containing up to 400 of each of Grey Teal and Shoveler were regularly seen. All four species nested at the lake and reached peak numbers in summer and autumn. The maximum count of ducks (for 1977) was c. 4000 in March and April.

AUSTRALASIAN HARRIER *Circus approximans*

Harriers were too mobile to be counted accurately. Increased sightings in autumn and winter, however, probably represented a seasonal influx of birds to the lake. Harriers nested at several sites around the lake, particularly in long grass and on *Juncus,* and one was on the base of a disused Black Swan nest. I have seen Harriers successfully kill a Spotted Shag and a Mallard and attempt to prey on these species and other species of waterfowl.

MARSH CRAKE *Porzana pusilla*

I occasionally say Marsh Crakes in the rushes on the western side, in the flax and willow thickets beside two of the inlet streams, and along the outlet stream. About 1970, several pairs of Marsh Crakes and a single Spotless Crake *(P. tabuensis)* were located along the outlet stream within a few kilometres of the lake by a former Acclimatisation Society ranger, Mr Mervyn Keioller (pers. comm.).

PUKEKO *Porphyrio porphyrio*

The Lake Wainono area has the greatest concentration of Pukekos in South Canterbury and single flocks of up to 300 birds were seen during some visits. They breed mostly on the densely vegetated western side of the lake from where they disperse to feed, particularly in the damp fields to the south-west. The *Elaeocharis* flats north of the lake support a small breeding population. Few birds were seen foraging on the open mudflats, except where *Juncus* or other plants were growing nearby. In 1977 the Pukeko population was highest during autumn and early winter and lowest during spring.

SOUTH ISLAND PIED OYSTERCATCHER *Haematopus ostralegus*

Unlike the Washdyke Lagoon area, which had flocks of oystercatchers throughout the year (Sagar 1976), Lake Wainono was used by oystercatchers only in the winter and spring, with peak numbers from July to October (Fig. 3f). Almost all these birds were non-breeders because the flocks remained throughout the spring, whereas the few birds that nested around the lake were usually territorial by July and had laid eggs by August. They fed mostly in the damp pastureland to the south and south-west of the lake, where earthworms and grassgrubs were the main prey and were easily accessible. Few oystercatchers fed in the lake, probably because large prey such as bivalves and polychaetes were absent.

In late summer and autumn, when a post-breeding influx of

birds from inland South Canterbury might be expected, almost no oystercatchers were at the lake. Perhaps after October the food supply in the pastures was poor. In the pastures of mid-Canterbury, East & Pottinger (1975) found that the large third-instar larvae of grassgrubs were available for Starlings *(Sturnus vulgaris)* during winter and early spring but that the ensuing prepupal and pupal stages were smaller and not eaten by Starlings. Oystercatchers remaining at the Lake Wainono pastures after October would have to subsist mainly on earthworms, but earthworms also become less accessible as summer approaches, firstly because dropping soil moisture causes them to move to greater depths (Barnes 1968), and secondly because the ground hardens making it more difficult for oystercatchers to probe. In some irrigated pasture areas of South Canterbury, small flocks of oystercatchers may persist until February, suggesting that inaccessibility of earthworms is an important factor in the Lake Wainono exodus. The summer and autumn flocks at Washdyke Lagoon can be explained by their foraging mainly along the rocky seashore (P. M. Sagar, pers. comm.), a habitat not at Lake Wainono.

During the 1969 drought, fewer oystercatchers visited Lake Wainono than in any other year (Fig. 5). They were not seen feeding in the pastures, most feeding instead on midge larvae in the lake. A combination of three factors — hard soil, stunted growth of grassgrub larvae (East & Pottinger 1975) and deep burrowing of prey — probably contributed to the low numbers of oystercatchers in 1969, but the relative importance of each factor remains uncertain. Conversely, all the high counts (maximum of 162 in August 1968) coincided with wet pastures and the readily available food.

SPUR-WINGED PLOVER *Vanellus miles novaehollandiae*

The Spur-winged Plover was first reported in the Lake Wainono area in 1965 (Barlow 1972). During the study period it increased considerably at Lake Wainono (Fig 4d), reflecting its general increase and expanded range throughout South Canterbury. By the 1977 winter, flocks of over 100 were regularly seen with the highest count 153 in August 1977. Fewer birds were present in summer and autumn (Fig. 3g). The presence of large flocks during much of the breeding season (eggs laid mainly in July and August by the several pairs nesting at Lake Wainono) indicates that many of the birds present were non-breeders or perhaps late breeders.

Spur-winged Plovers preferred the damp fields around the lake, where earthworms and grassgrubs were taken on and just below the surface. Recently ploughed land was as popular with Spur-winged Plovers as with oystercatchers and Black-billed Gulls *(Larus bulleri)*. During the 1969 drought no more than three birds were seen per visit and on four visits none was seen. Up to 23 birds were recorded the following year when the rainfall was normal. Like oystercatchers, Spur-winged Plovers occasionally visited the lakeshore to feed.

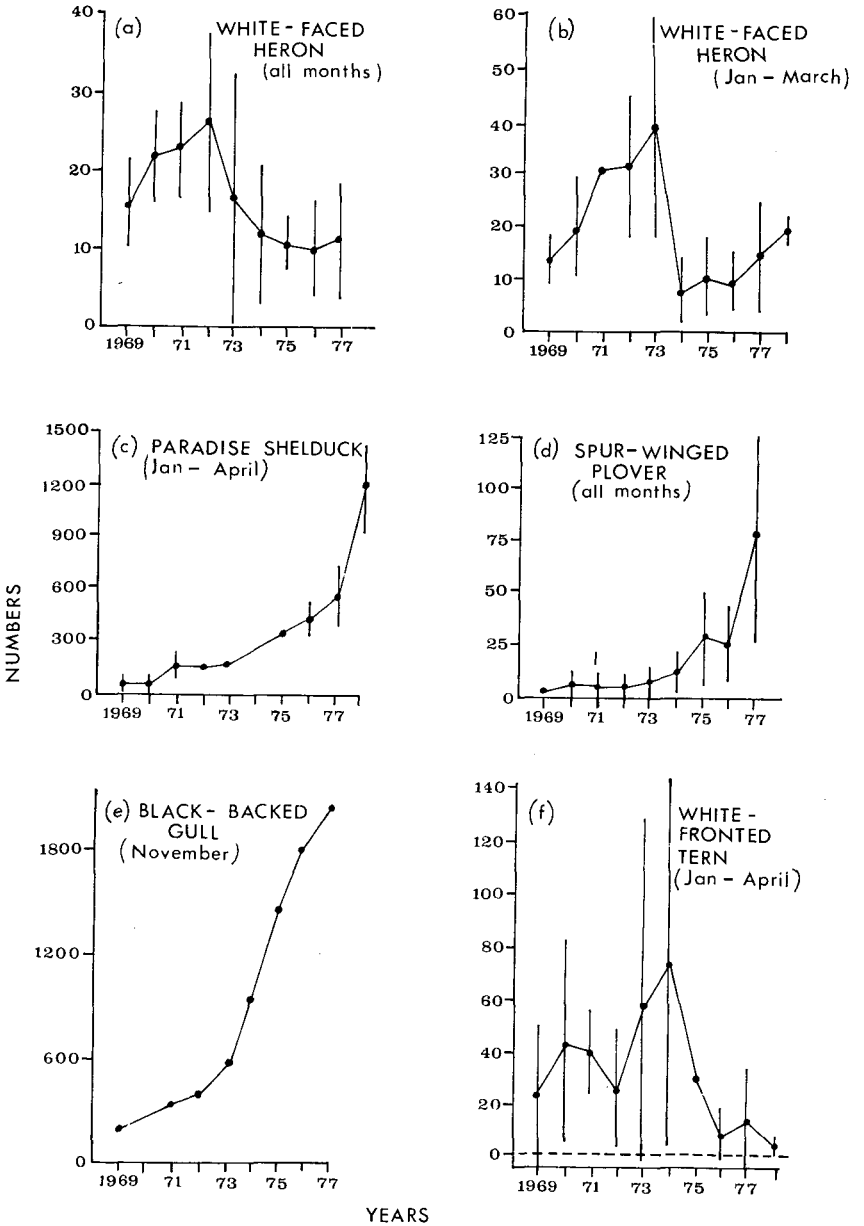


FIGURE 4 — Long-term changes in populations of five species. The vertical lines are standard deviations of the means.

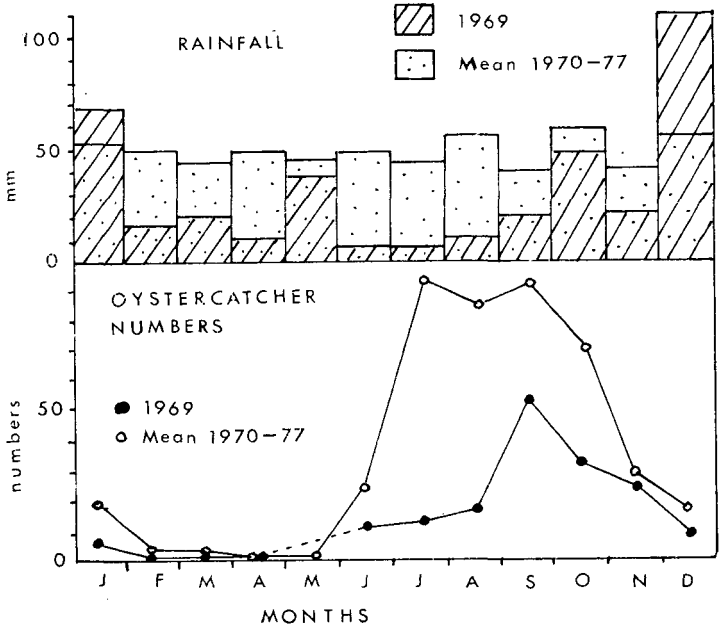


FIGURE 5 — Rainfall and oystercatcher numbers. Rainfall was recorded at Waimate Meteorological station, 8 km south-west of Lake Wainono.

BANDED DOTTEREL *Charadrius bicinctus*

Post-breeding flocks of Banded Dotterels began to form at Lake Wainono in mid-December with peak numbers occurring in January and February (Fig. 3h). The highest count was 380 in January 1977. Although large numbers of dotterels left the lake in autumn, up to 50% of the summer number remained for the winter. A further decline in August coincided with the return of birds to their breeding grounds in inland South Canterbury. Usually fewer than 60 birds were present from August to November, of which only 5-10 pairs nested along the inner margin of the shingle beach and mainly south of the lake. This scarcity of nesting birds was probably due to a shortage of their preferred nesting habitat — flat expanses of shingle with low plant cover (Bomford 1978). In August most dotterels at the lake were in adult plumage and by September all were in adult plumage. By mid-October the first juveniles were seen. During summer and autumn the non-breeding flocks foraged mainly in the short-turfed fields south of the lake, and few occurred at the lake's edge unless mudflats were exposed. During winter and spring most birds foraged beside the lake.

WRYBILL *Anarhynchus frontalis*

Wrybills visited Lake Wainono from August to January with peak numbers occurring in September and October (Fig. 3i). The highest counts were 81 in October 1969 and 73 in September 1970, when there were extensive mudflats suitable for their feeding. On the mudflats Wrybills fed on amphipods and adult and larval midges, while at the ponds south of the lake they also ate adult and larval shoreflies. All the Wrybills at Lake Wainono were in breeding plumage, but the late peak in numbers (September-October) suggests that not all would nest that year (R. Hay, pers. comm.). No juveniles or post-breeding flocks of adults were seen, despite an abundance of amphipods and other suitable food throughout the summer. This contrasts with Lake Ellesmere, which has a similar invertebrate fauna to Lake Wainono, where I have seen flocks of up to 30 adults and juveniles as late as 19 February. The absence of post-breeding Wrybills from Lake Wainono might be because South Canterbury birds can find mudflat food at the many inland tarns and lagoons near their usual riverbed habitat (Pierce 1979), and so they by-pass Lake Wainono on their northward migration. At one tarn near Lake Tekapo I have seen post-breeding flocks of up to 25 birds in January and February, with a few birds remaining until March or April.

BAR-TAILED GODWIT *Limosa lapponica*

TURNSTONE *Arenaria interpres*

KNOT *Calidris canutus*

These three Northern Hemisphere migrants visited Lake Wainono in spring and early summer, but almost all had left by mid-December (Fig. 3j, k, l). Only two Bar-tailed Godwits were recorded in February, the month when peak numbers occur in Otago Harbour (Otago Branch, OSNZ, pers. comm.). All three species disappeared from the lake in December perhaps because, with the emergence of the largest (fourth instar) midge larvae, the biomass of exploitable mudflat food was temporarily but greatly reduced by early summer. By mid-summer almost all these birds had moved to other presumably more profitable feeding grounds in New Zealand. In March a few northbound Bar-tailed Godwits and Turnstones — usually in partial breeding plumage — paused at the lake and fed on the next generation of midge larvae, which had by then increased in size. All the Bar-tailed Godwits and Turnstones seen in winter were in non-breeding plumage, and birds in partial or complete breeding plumage were not seen until late September. In October, up to 50% of all three species retained traces of breeding plumage.

SHARP-TAILED SANDPIPER *Calidris acuminata*

The Sharp-tailed Sandpiper was the only northern hemisphere wader to spend the whole summer at Lake Wainono. Peak numbers occurred in January and February (Fig. 3m) with the highest count

23 in February 1973. These sandpipers could exploit amphipod prey after the midges had emerged and so they found the lake suitable for feeding throughout the New Zealand summer. None was seen in winter.

PIED STILT *Himantopus himantopus leucocephalus*

Pied Stilts were the most common wader regularly at Lake Wainono and the highest count was 1392 in November 1970. Their numbers followed the pattern of other South Island breeding birds with a post-breeding increase during the summer and a decrease in autumn (Fig. 3n). From February to April small flocks were regularly heard flying north at night en route to the northern North Island where large numbers spend the winter (Sibson & McKenzie 1944, Veitch 1978). Many birds remained at Lake Wainono, however, and winter numbers were about one-third of the summer numbers. On the lake, the stilts usually ate amphipods, midge larvae and mysids, but they also ate larval and adult shoreflies at the nearby ponds and, in winter and spring, earthworms and grassgrubs in the fields. From August to December, a few stilts nested around the edges of the lake and at some of the ponds.

BLACK-BACKED GULL *Larus dominicanus*

Black-backed Gulls used Lake Wainono for nesting and roosting only, feeding almost entirely elsewhere. Peak numbers occurred during the height of the breeding season from October to January, and few birds were present by day in autumn and early winter (Fig. 3o). In all seasons, however, evening roosts contained many hundreds or thousands more birds than were present during the day. Some birds foraged in farmland west of the lake, but most flew north along the beach in the early morning and returned from the north in the late evening, suggesting that most of the large numbers of Black-backed Gulls at the coastal effluent discharge of the Pareora Freezing Works 25 km to the north, were Lake Wainono birds. From 1969 to 1977 the Lake Wainono breeding population increased ten-fold (Fig. 4e). In 1969 the colony occupied the peninsula at the south end of the lake but in subsequent years it spread over many hectares of adjacent pastureland. The local abundance of food possibly assisted the spectacular increase in gull numbers, although the freezing works had been operating for many years before 1969.

BLACK-BILLED GULL *Larus bulleri*

Post-breeding flocks of Black-billed Gulls occurred at Lake Wainono from January to April, the highest count being c. 5000 in January 1974. Few birds were present in winter (Fig. 3p). Up to 1000 were seen during spring when 150-200 pairs sometimes nested on the peninsula at the south end of the lake and particularly at the pools south of the lake. At the pools, nests were closely spaced on small islands and usually 50 or more fledglings were reared. These

nest sites were unusual because Black-billed Gulls normally nest inland on shingle riverbeds and the other few coastal nest sites I have seen in Canterbury have been at rivermouths. When the lake was low, flocks of Black-billed Gulls foraged for amphipods on the mudflats, but at higher lake levels they foraged further afield and returned only to roost. Like Black-backed Gulls, large evening roosts formed at the lake, particularly on the peninsula at the south end.

BLACK-FRONTED TERN *Sterna albostriata*

Lake Wainono was used by Black-fronted Terns mainly as a roosting area, with most feeding being carried out along the open sea coast where they were excluded from the counts. Despite the lake being unimportant for feeding, a seasonal pattern of Black-fronted Tern abundance was evident and it corresponded closely with the pattern I found during three years (1968-70) of sea-watching at St Andrews, 20 km north of Lake Wainono. Peak numbers occurred at the lake during the autumn and winter (Fig. 3q), but there were no records from September to November, the early part of the breeding season in inland South Canterbury and North Otago (Lalas 1979).

The highest count of terns was 60 in June 1974, on a day when the sea was particularly rough, perhaps disrupting normal feeding there. Only occasionally did I see birds catching small fish in the lake and unidentified aerial insects over the mudflats.

CASPIAN TERN *Hydroprogne caspia*

Although recorded in all months of the year, Caspian Terns were uncommon at Lake Wainono, the highest count being only nine in May 1977. Greatest numbers occurred from December to May, with fewer birds during the winter and spring (Fig. 3r). The scarcity of birds at Lake Wainono in winter contrasted with the Opihi River mouth, 60 km to the north, where at the same time of year, I have seen flocks of up to 32 birds. Both areas support large numbers of fish — the staple diet of Caspian Terns — but whereas the water is clear at the Opihi River mouth, Lake Wainono was often very turbid, preventing the terns from seeing their prey. No birds were seen at the lake during the 1969 drought when the water was turbid all year. In the spring of 1977, a pair of Caspian Terns raised a chick in the Black-backed Gull colony, this being the only nesting I have found at the lake. In December 1978 the colour-banded juvenile was seen at the Opihi River mouth.

WHITE-FRONTED TERN *Sterna striata*

White-fronted Terns occurred irregularly at Lake Wainono but were generally most common during summer and autumn (Fig. 3s) when juveniles as well as adults visited the lake. Like Black-fronted Terns, White-fronted Terns used the lake mainly for roosting by day and by night, the southern peninsula and the many posts in the lake being the favoured sites. Since 1975 the White-fronted Tern population

has declined (Fig. 4f) for unknown reasons, the pooled counts of 1976-78 being significantly less than the pooled counts of 1969-75 ($t = 3.52$, 84 d.f., $p < 0.001$). Unfortunately no regular counts were made at the two local breeding colonies at the mouths of the Waitaki and Opihi Rivers.

WELCOME SWALLOW *Hirundo tahitica neoxena*

Although the many ponds, streams and mudflats around Lake Wainono provide good feeding grounds for fly-catching birds throughout the year, Welcome Swallows were common during the non-breeding season only (Fig. 3t). Each year numbers began to increase in late February and flocks occurred during autumn and winter, but by mid-September most had dispersed for breeding. The Lake Wainono area is currently the most southerly breeding centre for Welcome Swallows in New Zealand but the breeding population is quite small (5-10 pairs) and cannot account for all of the winter influx. This and observations of southbound flocks in South Canterbury and Otago during late summer and autumn suggest that many swallows disperse southward from breeding grounds further north. A winter influx of swallows to Otago and Southland is also well in excess of the few known isolated pairs (Dr R. F. Smith, R. R. Sutton, pers. comm.).

OTHER PASSERINES

Several species of introduced passerines visited the edges of Lake Wainono to feed but they were not counted. When the lake was low, flocks of Yellowhammers *(Emberiza citrinella)*, Skylarks *(Alauda arvensis)* and Starlings *(Sturnus vulgaris)* fed on invertebrates and/or seeds on the mudflats. House Sparrows *(Passer domesticus)* and Starlings regularly nested on the shooters' maimais in the lake. A complete list of all passerines seen at the lake is included in Appendix 1.

LOCALLY EXTINCT SPECIES

Five species that occurred commonly in the Lake Wainono area during the late nineteenth century (Studholme 1940), were not recorded from 1968 to 1978 and are presumed locally extinct. They are Dabchick (*Podiceps* sp.), Brown Teal *(Anas aucklandica)*, Buff Weka *(Gallirallus australis hectori)*, Australian Avocet *(Recurvirostra novaehollandiae)* and Fernbird *(Bowdleria punctata)*.

SUMMARY OF SEASONAL TRENDS

Of the 32 species commonly recorded at Lake Wainono, at least 30 had seasonal variations in their numbers. There were three seasonal patterns with highest numbers occurring in either (i) winter, (ii) spring/early summer, or (iii) summer-early autumn. The remaining two species (Bittern and Marsh Crake) were seen too seldom for any seasonal change to be noted.

Winter peak

Six species of birds reached peak numbers at Lake Wainono during the winter. Two of these, the Black Shag and Black-fronted Tern, were non-breeding visitors from inland South Canterbury or Otago and appeared to use the lake mainly for roosting. Wintering flocks of Welcome Swallows and probably Pied Oystercatchers had a northern origin, while Harriers and Spur-winged Plovers were probably local breeders. The last four species nested in small numbers near the lake during spring.

Spring/early summer peak

Five species were most common at the lake during spring and early summer. Three of these (Bar-tailed Godwit, Turnstone and Knot) are migrants from the Northern Hemisphere and their stay at the lake was quite brief. They had usually left by December, probably because of a scarcity of suitable prey after December. Pre-breeding flocks of Wrybills paused at the lake, the greatest numbers occurring in September and October, over a month before the Northern Hemisphere waders. The Black-backed Gull was the only lake-breeding species that reached peak numbers in spring. Other species nesting regularly at the lake (Appendix) did not increase significantly until after the breeding season.

Summer/early autumn

Nineteen species reached their peak in summer and/or early autumn. Except for the Sharp-tailed Sandpiper, all were New Zealand breeders congregating temporarily at Lake Wainono after the breeding season. They were Little Shag, White-faced Heron, White Heron, Royal Spoonbill, all waterfowl (seven species), Pukeko, Banded Dotterel, Pied Stilt, Black-billed Gull, Caspian Tern and White-fronted Tern. Most of these species breed inland in large numbers and move to the coast afterwards.

The autumn migration from Lake Wainono was complete for only two (Royal Spoonbill and Sharp-tailed Sandpiper) of the 19 species, with up to 50% of the numbers of some species remaining during the winter. Food was still available to aquatic-feeding species during winter because temperatures were not low enough for the lake to freeze over. Nor did the ground in surrounding fields remain frozen for long enough each day to prevent probing birds such as oystercatchers obtaining sufficient food. The precise numbers of each over-wintering species probably depended on an interplay of several factors, such as normal dispersal habits, prey behaviour and abundance, daylength available for feeding, and seasonal changes in metabolic requirements.

ACKNOWLEDGEMENTS

Many helpful comments on the manuscript were provided by Dr C. W. Burns, B. D. Heather and H. A. Robertson. I am grateful to my parents who regularly provided transport to and from Lake Wainono in the early years and to E. Saunders and A. Rollinson who kindly provided accommodation near the lake in 1977 and 1978.

APPENDIX 1 — *Birds recorded at Lake Wainono, 1968-1978.*

SPECIES	STATUS			HABITATS				
	No. of records	Max. count	Months seen	B = breeding seen				
* = recorded since 1978 only	C = common (>20 records)		(1 = Jan. 2 = Feb. etc.)	Mudflats	Lake	Pond	Farmland	Thickets
Sooty Shearwater	1	2+	3		X			
Australian Pelican	2	3	2,4		X			
Australasian Gannet	6	2	3,4,5		X			
Black Shag	C	155	1-12		X			
Little Black Shag	2	3	1,2		X			
Little Shag	C	35	1-12		X			
Spotted Shag	4	100	4-6		X			
White-faced Heron	C	75	1-12	X	X	X	X^{B}	
White Heron	C	7	1-12		X	X		
Little Egret	2	1	5,6		X			
Cattle Egret	4	2	4,5,8,10				X	
Australasian Bittern	C	2	1-12			X		X
Glossy Ibis	5	4	2,3,4,12	X	X	X		
White Ibis	1	1	12			X		
Royal Spoonbill	C	13	1-4,11,12		X			
Mute Swan	1	1	6		X			
Black Swan	C	2550	1-12	X	X^{B}	X^{B}	X	X^{B}
Canada Goose	C	2000	1-12	X	X	X	X	X^{B}
Paradise Shelduck	C	1600	1-12	X	X	X^{B}	X^{B}	
Grey Teal	C	-	1-12	X	X	X	X	X^{B}
Grey Duck	C	-	1-12	X	X	X^{B}	X	X^{B}
Mallard	C	-	1-12	X	X	X^{B}	X^{B}	X^{B}
NZ Shoveler	C	-	1-12	X	X	X	X	X
NZ Scaup	1	3	3		X			
Australasian Harrier	C	17	1-12	X	X	X	X^{B}	X^{B}
Nankeen Kestrel	1	1	12				X	
Marsh Crake	C	3	1-12					X
Spotless Crake	1	1	?					X
Pukeko	C	700	1-12	X		X	X^{B}	X^{B}
SI Pied Oystercatcher	C	162	1-12	X			X^{B}	
Black Oystercatcher	2	1	2,8	X				
Spur-winged Plover	C	153	1-12	X		X	X^{B}	
Least Golden Plover	14	3	1-3,11,12	X		X	X	
NZ Dotterel	2	1	2,10	X				
Banded Dotterel	C	380	1-12	X		X	X^{B}	
Oriental Dotterel	1	1	1	X				
Black-fronted Dotterel*	1	1	4	X				
Wrybill	C	81	1,8-12	X		X		
Far-eastern Curlew	1	1	10	X				
Asiatic Whimbrel	1	1	1	X				
Little Whimbrel	1	1	11			X		
Bar-tailed Godwit	C	135	1-5,7-12	X		X	X	

APPENDIX 1 — Continued

Asiatic Black-tailed Godwit	3	2	5,7,12			X	X	
Lesser Yellowlegs	2	1	2,3	X				
Greenshank	2	1	1,10	X		X		
Turnstone	C	25	1-7,9-12	X		X		
Knot	C	27	10-12	X		X		
Sharp-tailed Sandpiper	C	23	1-4,10-12	X		X		
Pectoral Sandpiper	11	4	1-4,12			X		
Curlew Sandpiper	7	5	1,3,6,9, 11,12	X		X		
Red-necked Stint	17	13	1-3,6,8, 10-12	X		X		
Pied Stilt	C	1392	1-12	X	X	X[B]	X[B]	
Black Stilt	4	1	2,3,11,12	X	X	X		
Oriental Pratincole	1	1	3	X				
Southern Skua	1	1	11		X			
Arctic Skua	12	3	1-4,12		X			
Black-backed Gull	C	2150	1-12	X	X		X[B]	
Red-billed Gull	2	1	11,12			X		
Black-billed Gull	C	5000	1-12	X	X	X[B]	X	
Black-fronted Tern	C	60	1-8,12	X	X	X		
White-winged Black Tern	6	4	2,6,7,12	X	X	X		
Caspian Tern	C	9	1-12	X	X		X[B]	
Little Tern	2	1	11,12	X	X			
White-fronted Tern	C	225	1-12	X	X	X		
Rock Pigeon	C	-	1-12				X	
Shining Cuckoo	C	-	9-12					X
Long-tailed Cuckoo	2	1	10,11					X
Little Owl	C	2	1-12				X	X
Little Kingfisher	6	2	4,5,8		X	X		
Skylark	C	-	1-12				X[B]	
Australian Tree Martin	1	1	6			X		
Welcome Swallow	C	90	1-12	X	X	X	X[B]	
NZ Pipit	C	4	2-8,12	X			X	
Hedgesparrow	C	-	1-12				X[B]	X[B]
Grey Warbler	C	-	1-12					X[B]
Fantail	C	-	1-12					X[B]
Song Thrush	C	-	1-12				X[B]	X[B]
Blackbird	C	-	1-12				X[B]	X[B]
Silvereye	C	-	1-12				X	X
Bellbird	2	1	5,7					X
Yellowhammer	C	-	1-12	X			X[B]	X[B]
Chaffinch	C	-	1-12				X[B]	X[B]
Greenfinch	C	-	1-12				X[B]	X[B]
Goldfinch	C	-	1-12				X[B]	X[B]
Redpoll	C	-	1-12				X[B]	X[B]
House Sparrow	C	-	1-12		X[B]		X[B]	X[B]
Starling	C	-	1-12	X			X[B]	X[B]
Magpie	C	-	1-12				X[B]	X
Rook	1	1	12				X	

LITERATURE CITED

BARLOW, M. 1972. The establishment, dispersal and distribution of the Spur-winged Plover in New Zealand. Notornis 19: 201-211.
BARNES, R. D. 1968. Invertebrate zoology. 2nd ed. Philadelphia: W. B. Saunders.
BOMFORD, M. 1978. The behaviour of the Banded Dotterel, **Charadrius bicinctus.** MSc thesis, Univ. Otago, Dunedin.
CARROLL, A. L. K. 1970. The White-faced Heron in New Zealand. Notornis 17: 3-24.
EAST, R.; POTTINGER, R. P. 1975. Starling (**Sturnus vulgaris** L.) predation on grass grub (**Costelytra zealandica** (White), Melolonthinae) populations in Canterbury. NZ J. Ag. Res. 18: 417-452.
LALAS, C. 1979. Seasonal movements of Black-fronted Terns. Notornis 26: 69-72.
MIERS, K. A.; WILLIAMS, M. 1969. Nesting of the Black Swan at Lake Ellesmere, New Zealand. Wildfowl 20: 23-32.
PIERCE, R. J. 1979. Foods and feeding of the Wrybill (**Anarhynchus frontalis**) on its riverbed breeding grounds. Notornis 26: 1-21.
SAGAR, P. M. 1976. Birds of the Washdyke Lagoon area, South Canterbury. Notornis 23: 205-212.
SIBSON, R. B.; McKENZIE, H. R. 1944. Some observations on stilts in the Firth of Thames. NZ Bird Notes 1: 51:57.
STUDHOLME, E. C. 1940. Te Waimate; early station life in New Zealand. Dunedin: A. H. & A. W. Reed.
VEITCH, C. R. 1978. Waders of the Manukau Harbour and Firth of Thames. Notornis 25: 1-24.
WILLIAMS, M. 1971. The distribution and abundance of the Paradise Shelduck (**Tadorna variegata**, Gmelin) in New Zealand from pre-European times to the present day. Notornis 18: 71-86.
WILLIAMS, M. 1977. Locations of recoveries of Black Swans (**Cygnus atratus** Latham) banded at Lake Whangape and Lake Ellesmere, New Zealand. Aust. Wildl. Res. 4: 289-299.

R. J. PIERCE, *Department of Zoology, University of Otago, Dunedin*

★

SHORT NOTE

SPINE-TAILED SWIFTS IN SOUTH OTAGO

At 11 a.m. NZDST on 16 February 1979, at Tautuku Lodge, South-east Otago, about 30 km south of Owaka on Highway 92, I noticed a Spine-tailed Swift *(Chaetura caudacuta)* and pointed it out to my companions Roger McElwain, Geoff Patterson, Paul Wright and Tony Harris. Closer observation revealed the presence of six birds, and over the next 15 minutes this increased in steps through 9 and 12 to 13. Five minutes later, at 11.20 a.m., a large flock appeared over the bush to the west, bringing the total number to at least 60.

The weather was overcast with light rain. The birds were flying fairly high over the bush (which in this area is podocarp-hardwood forest) with a rapid bat-like flight, interspersed with brief glides. They had long swept-back pointed wings and square tails. They were completely dark with under the tail a patch of white that was not easy to see. No white was noticed under the chin but could easily have been missed in the light conditions.

We last saw 25 of them flying over the Fleming River valley while we were looking for Fernbirds. We then left the area for the Tautuku Estuary.

P. MILLER, *25 Ramsay Street, Dalmore, Dunedin.*

THE MORPHOLOGY, MOULT AND TAXONOMIC STATUS OF THE BLACK-FRONTED TERN

By C. LALAS and B. D. HEATHER

ABSTRACT

The plumage stages and moult of the Black-fronted Tern *(Sterna albostriata)* of New Zealand are described, largely from field observations, and measurements are given. The Black-fronted Tern is compared with the Whiskered Tern *(Chlidonias hybrida)* with the conclusion that they are not closely related. The characters of *albostriata* are those of *Sterna* rather than *Chlidonias*. The possibility of relationship with the Antarctic Tern *(S. vittata)* and the Kerguelen Tern *(S. virgata)* is revived and discussed.

INTRODUCTION

The Black-fronted Tern *(Sterna albostriata)* of New Zealand has recently (Kinsky 1980) been restored to the status of an endemic New Zealand species after several decades as a subspecies of the Whiskered Tern *(Chlidonias hybrida)*.

Its previous position was hard to understand because, although the Black-fronted Tern undoubtedly has feeding habits reminiscent of the marsh terns, it differs from the Whiskered Tern in many ways and can easily be separated in the field in all plumages. Now that the Whiskered Tern has been recorded in New Zealand (Heather & Jones 1979, Brown & Habraken 1979), the distinction between the two terns needs to be clarified so that they can be recognised in the field and also so that the relationship of the Black-fronted Tern with *Chlidonias* and *Sterna* terns can be better examined.

We present here observations on the plumage and moult of the Black-fronted Tern made by CL during an 18-month field study of the bird's food and feeding behaviour in 1975 and 1976, together with information from museum skins. Measurements by CL of study skins in New Zealand museums are also given. This material is then compared with the plumage and available measurements of the Whiskered and other medium-sized grey terns with black crowns, particularly the Antarctic Tern *(S. vittata)* and the Kerguelen Tern *(S. virgata)*. The Black-fronted Tern is compared and contrasted with the Whiskered Tern, the extent to which it shows the characteristics of *Chlidonias* or *Sterna* is examined, and its possible relationships are discussed.

NOTORNIS 27: 45-68 (1980)

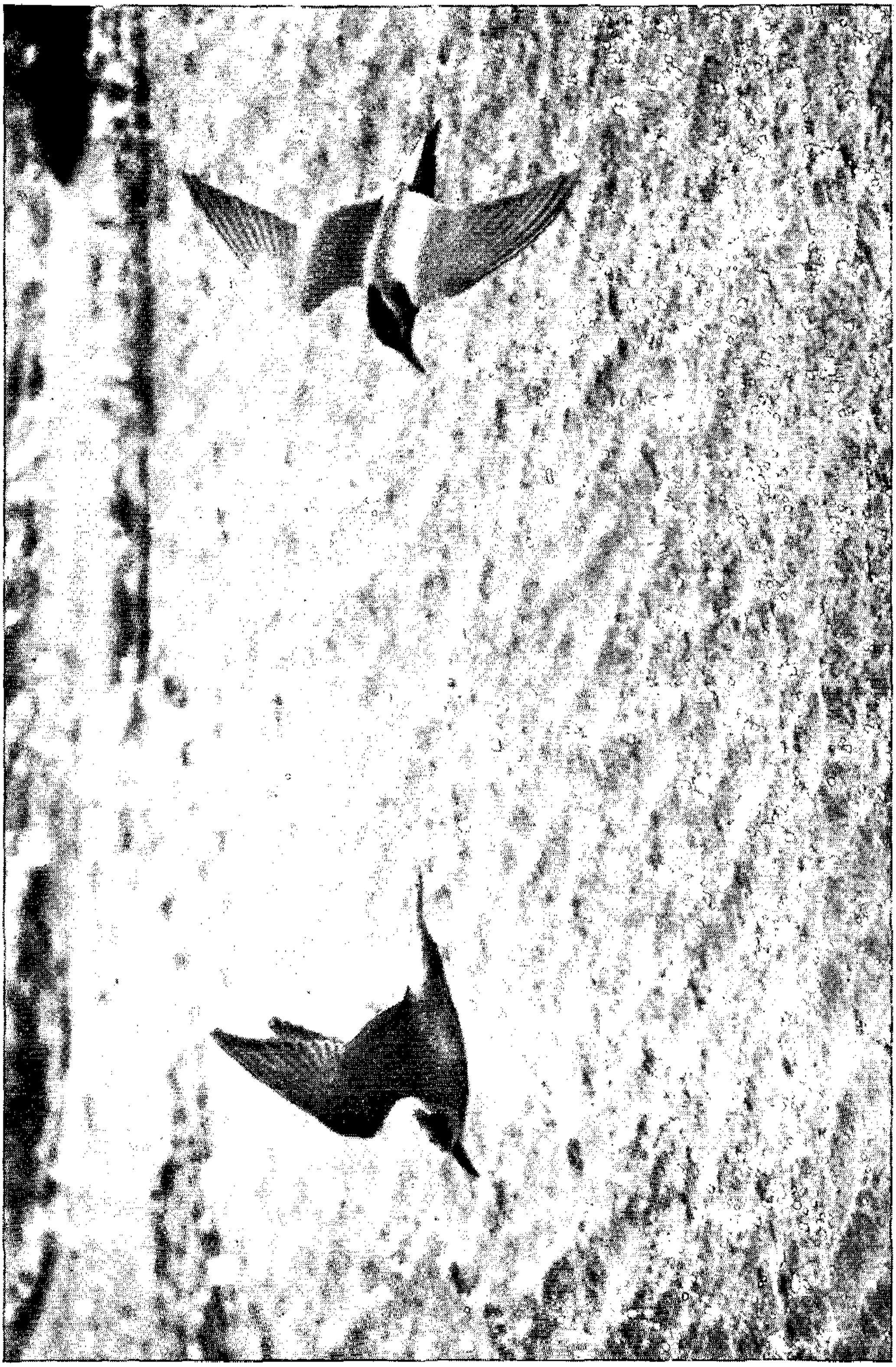


FIGURE 1 — Immature (left) and adult Black-fronted Terns, Otago Harbour, June. By June, all adults are in breeding plumage, whereas immatures remain in immature plumage all their first year.

Photo: C. Lalas

MORPHOLOGY AND MOULT

Plumage

The breeding and non-breeding plumages of adults, as seen in the field, are defined by the colour and pattern of the head, the only region of change noticeable in the field.

Adult breeding: Black crown approximately 70 mm long, extending from bill to nape and surrounding the eye, bordered below by a thin line of white. Rump, upper and under tail-coverts white. Wings and rest of body grey, slate grey above, paler below. Underwing pale grey. Primaries with darker tips; outermost primary with dark leading edge and a prominent white shaft. Rectrices pale grey with darker tips. Bill and feet bright orange. Iris black. See Figures 1, 10B and 12.

Adult, non-breeding: Like the breeding plumage, except that the head is pale grey with black feathers forming a rough U round the eyes and the base of the nape. See Figure 2A. A light scattering of black feathers on the rest of the head is visible only at close quarters. The bill and feet remain orange, but the tip of the bill may darken. Intermediate stages are shown in Figures 2B, 3A and 3B.

First winter and second summer (immature): Crown grey mottled with black; nape and ear-coverts black; chin white. Upper and lower body surfaces as in adults. Median wing-coverts pale brown, greater and lesser wing-coverts slate grey. Remiges and rectrices pale or mid-brown. Primaries and rectrices with darker tips. See Figures 1, 4A, 5A and 5B. The bill colour varies: it is usually very dark brown, reddish at the base, but may be at an intermediate stage towards the adult orange. Feet bright orange.

Juvenile: Crown and nape greyish brown mottled with black; lores and ear-coverts black. Lesser wing-coverts and feathers of the mantle and back brown, darker towards the tips but margined with yellow, giving the upper surface a mottled appearance. Throat, foreneck, upper and under tail-coverts white; the rest of the underparts grey. Greater and median wing-coverts pale brown. Remiges, rectrices, and feet as in first-winter plumage. See Figures 4B and 6B. Bill very dark brown, reddish at the base. Feet bright orange.

Nestling: Covered with long down. Upper surface either greyish brown or pale olive-green, in each case with dark speckling. A dark patch on the lores and cheeks but not extending forward to the bill or back beyond the eye. Throat dark but not mottled. Rest of under surface white. See Figure 6A. Bill dark yellow with a black tip. Feet bright orange.

Moult

These notes are drawn from CL's field observations and photographs and so cannot be fully definitive. Most adults are in full breeding plumage by late May and all from the beginning of June to early

FIGURE 2 A — Black-fronted Tern adult in non-breeding plumage, Tasman Valley, January 1976. Note grey head, dark round and behind eye; primary moult in progress.

Photo: C. Lalas

FIGURE 2 B — Adult tern showing an early stage of head moult into non-breeding plumage. Tasman Valley, January 1976. Note head speckled with white feathers; new inner, worn outer primaries; pointed outer tail feather.

Photo: C. Lalas

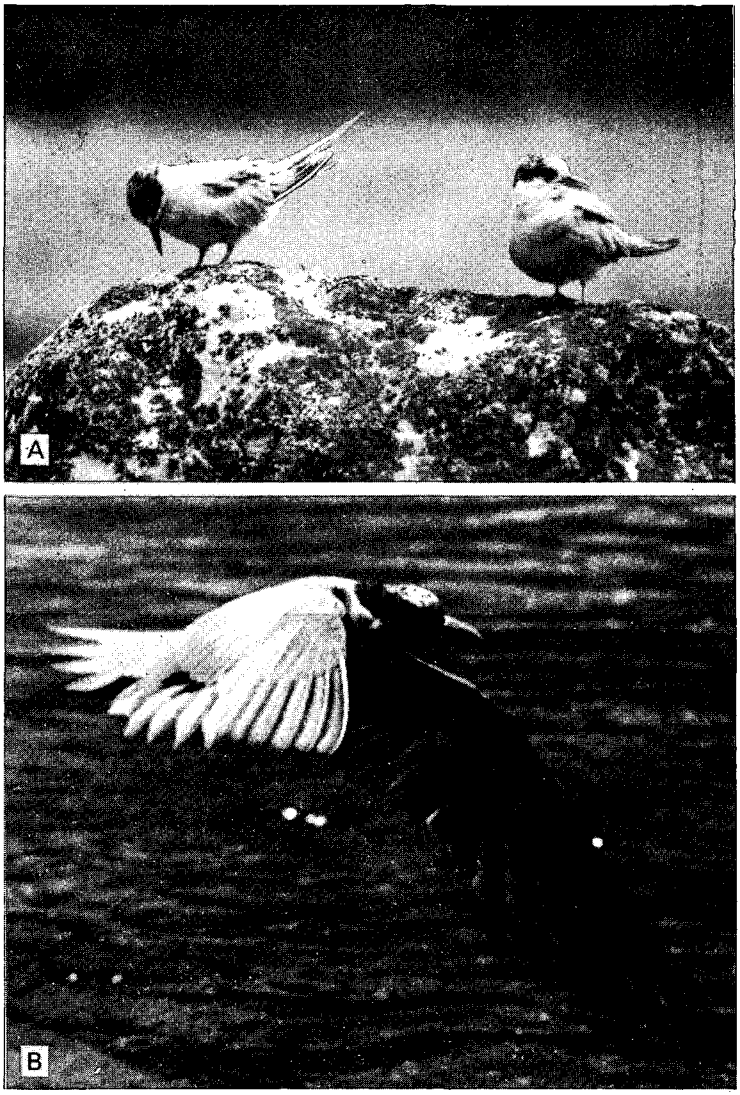


FIGURE 3 — Adults showing head moult into non-breeding "winter" plumage. A — Tasman Valley, March 1975. Unlike immatures, bill remains orange. B — Tasman Valley, January 1976. Crown is approaching the pale grey of winter plumage; black remains from eye to eye round the nape. Note prominent white shaft on leading primary.

Photos: C. Lalas

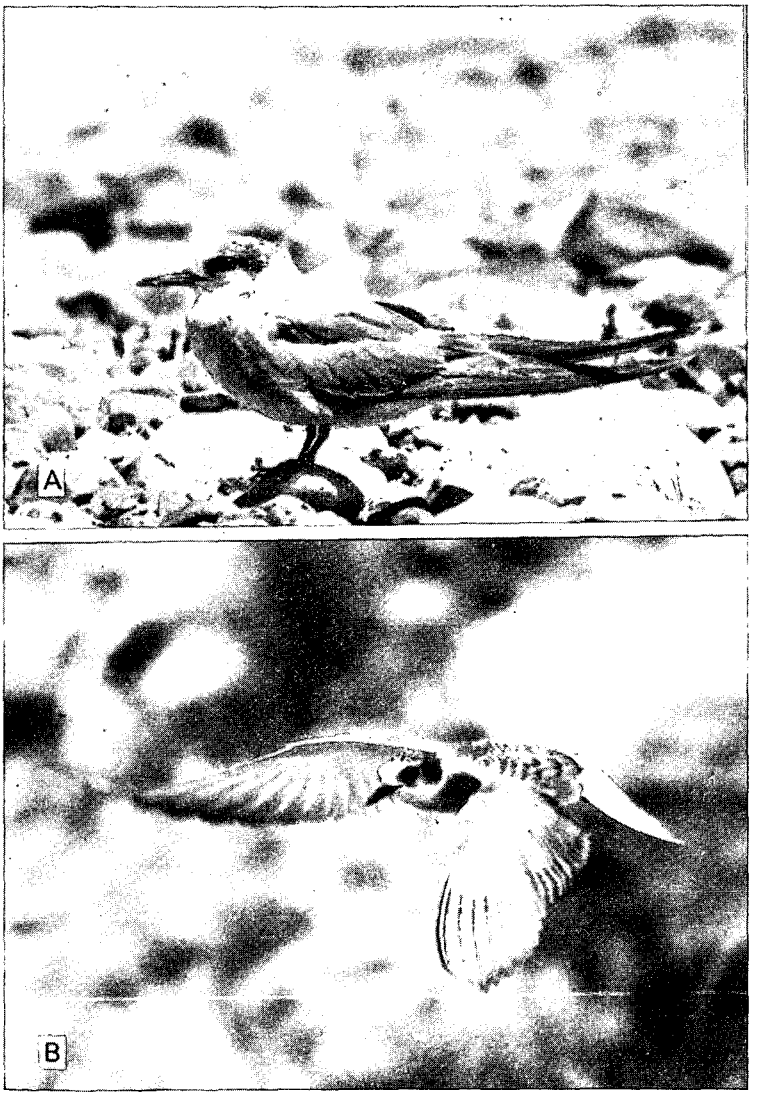


FIGURE 4 — A — Immature, Tasman Valley, November 1975. Note dark patches from lores to ear-coverts, not extending to nape; mottled crown; dark bill (dark brown in life). Much of wings and tail is brown. B — Juvenile, Tasman Valley, January 1976. Note white forehead, heavily mottled crown, mantle and back; black patches on lores and ear-coverts (black on "nape" is shadow); dark edge and white shaft of leading primary.

Photos: C. Lalas

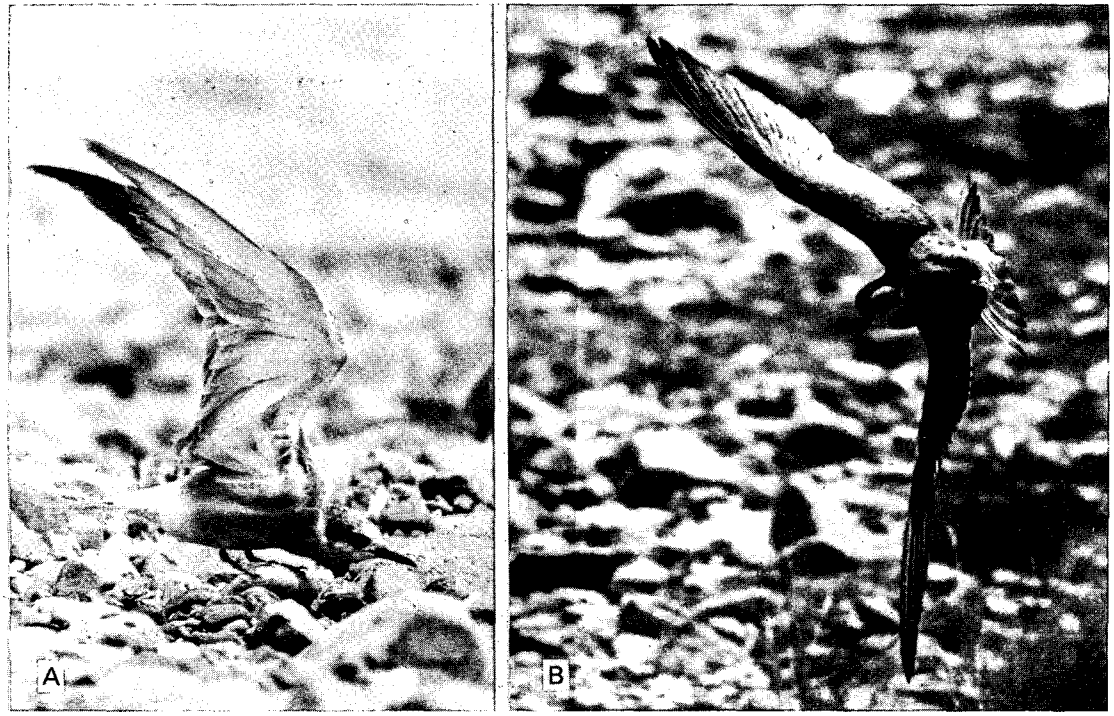


FIGURE 5 — Immatures, Tasman Valley. A — November 1975. Note head pattern; white rump and upper tail-coverts, characteristic of the species; grey underwings and underparts, as in adult. Bill is brown, legs orange. B — January 1976. Note shape of fully extended tail.

Photos: C. Lalas

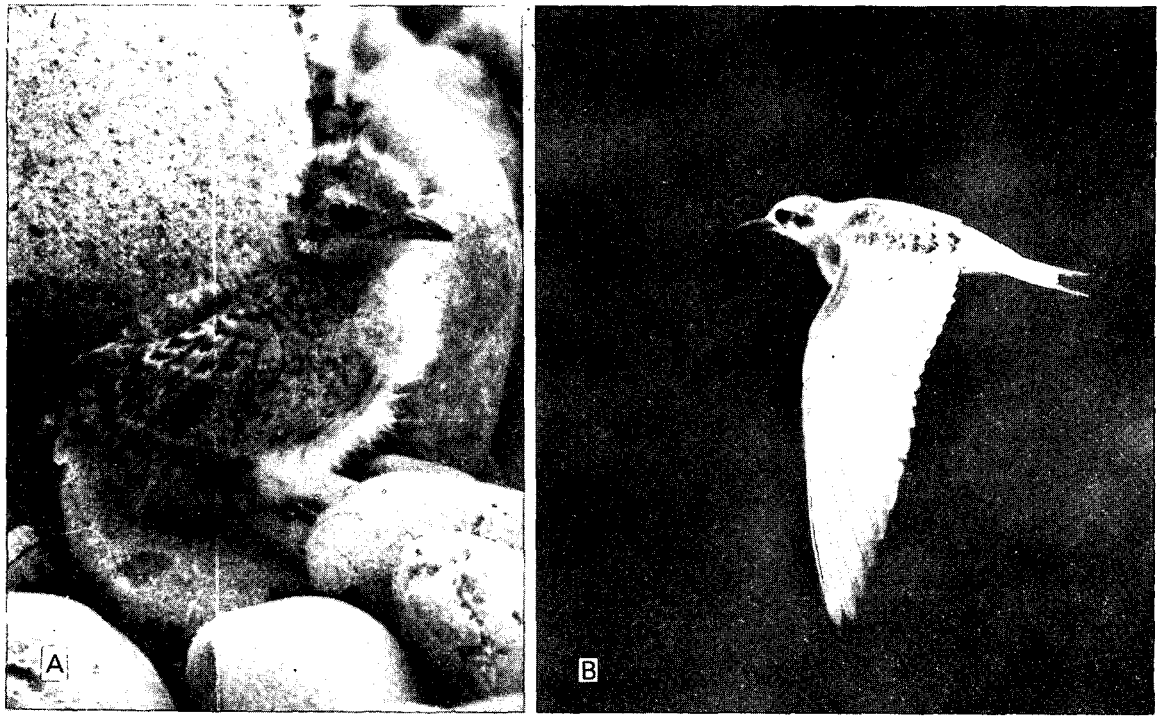


FIGURE 6 — A — Nestling, showing some growing back-feathers. Note down pattern of dark eye-patch, speckled upper surface, white below. B — Juvenile, Tasman Valley, January 1976. Note mottled upperparts, dark-tipped primaries, dark bill, forked tail. Wing-coverts are pale brown; lesser coverts mottled.

Photos: C. Lalas

November. They are in full non-breeding plumage from February to late April, only 2-3 months. Visible post-nuptial moult is confined to the head and begins with pale grey feathers replacing the black ones at the base of the upper mandible (Fig. 3A). Stead (1932) stated that the black cap starts to be lost before March, and CL has found from field observations that, more exactly, it starts in most birds between mid-December and mid-January. The roosting sites are littered with contour feathers from January to early May.

As with Charadriiformes in general, adult terns moult twice a year (Dwight 1901). The post-nuptial moult is always complete, and in the Black-fronted Tern, the moult of adult remiges and rectrices starts in January. The underparts of most grey-bodied terns, including the Whiskered Tern, lighten after the post-nuptial moult and the bill and feet darken to almost black in species with brightly coloured soft parts. By contrast, the colour of the body plumage of the Black-fronted Tern does not change visibly during the year, and the bright orange bill and feet of adults do not change colour.

Plumage changes distinguish in the field three age groups of immature Black-fronted Terns:

1. After first flying during December and January, the young are in juvenile plumage until March.
2. During March, the speckled wing-coverts and back feathers are lost, and by April, the back is uniform grey like that of adults. A post-juvenile head moult begins visibly in March or April and is completed by June or July. The change of bill colour from dark brown to the adult orange, which seems to be highly variable in its timing, may occur as early as August in some but in many others as late as the start of their second year.
3. Immatures begin their first complete moult at 14-15 months old, during March of their second year.

Note that the feet of Black-fronted Terns of all ages and at all times of year are bright orange.

Measurements

Table 1 gives the measurements made by CL of study skins in New Zealand museums. The totals include birds that had not been sexed. Tarsus and tail lengths were not taken, but Oliver's (1955) values are given in Table 3. The bill-length range of 24-28 mm is similar to Oliver's range of 25-28 mm, but the wing-length range of 230-257 mm differs slightly from Oliver's range of 240-260 mm.

Unlike the Whiskered Tern, no sexual dimorphism of size is apparent. The average lengths of male and female bill and wing are almost identical. The gonys, a feature of the lower mandible of Laridae, is not prominent. The bill depth is not significantly different between the sexes (t-test: 19 samples; t-statistic = 1.06; probability > 0.2), which shows that, unlike Whiskered Terns, males do not have a "heavier" bill than females.

TABLE 1 — Bill and wing measurements of adult Black-fronted Terns. (Lengths in millimetres from museum study skins)

		Number	Mean	Range	SD
Bill length	male	10	25.4	24.6 - 26.5	0.7
	female	13	25.5	23.5 - 27.1	1.2
	Total	31	25.5	23.5 - 28.2	1.0
Bill depth	male	8	7.2	6.2 - 8.2	0.6
	female	11	7.0	6.4 - 7.5	0.4
Wing length	male	10	244	230 - 257	8.6
	female	11	244	235 - 251	5.0
	Total	27	244	230 - 257	6.9
Body length	Total	5	290	285 - 300	–

Bill length = tip to feathers. Bill depth = vertical measurement at feathers.

Wing length = length of flattened wing (with natural horizontal curvature) from carpal joint to tip of longest primary; specimens with feather wear or wing moult excluded.

Body length = lengths of fresh birds given with study skins.

Total = male + female + unsexed adults.

SD = standard deviation of mean.

Thirteen bill lengths (mean = 25.1 mm) and 14 wing lengths (mean = 231 mm) were taken from museum skins of fledged Black-fronted Terns less than one year old. These birds had a wing length significantly less than that of adults (t-test: 41 samples; $t = 5.42$; $p < 0.001$) but a similar bill length (44 samples; $t = 1.19$; $p > 0.2$).

BLACK-FRONTED AND WHISKERED TERNS COMPARED

The question of the Black-fronted Tern's supposed relationship to the Whiskered Tern was reopened by Mees (1977) who, after a full review of the *C. hybrida* races, concluded that *albostriata* was not a subspecies of *hybrida* and indeed was not related to *Chlidonias* at all.

Table 2 lists the points of difference that are known to us. Some of these points were made or suggested by Mees from the small amount of material available to him and are confirmed and extended by us from our more extensive material. The only aspect we have not been able to consider is the colouring of the eggs.

The differences between many accepted species of tern are small, but the differences between these two are many and some are strong; indeed, the two birds are so distinctive that if they *are* related, the relationship must be distant.

TABLE 2 — Differences between Black-fronted and Whiskered Terns.

Black-fronted Tern (**Sterna albostriata**)	Whiskered Tern (**Chlidonias hybrida**)
Bill orange — all year in adult	Bill dark red — blackish in winter
Legs always orange	Legs dark red, blackish in non-breeding dress
White rump	Grey rump
Underparts always uniform grey	Underparts grading from grey on neck to blackish on belly in breeding plumage; white in non-breeding
Underwing grey	Underwing white
Cheeks grey, leaving only a thin white line below cap	Broadly white across cheeks and sides of neck
Bill of ♂ and ♀ alike; gonys not prominent	Bill of ♂ longer and heavier; gonys prominent
Short-legged; awkward on land	Longer legged; agile on land
More or less sedentary, dispersing to coasts	Strongly migratory or nomadic
Breeding and non-breeding plumages alike, apart from head	Breeding and non-breeding plumages very different
Non-breeding-plumage head grey; some black from eyes to nape	Non-breeding-plumage head white streaked blackish, especially on nape; blackish round eyes and on ear-coverts
Tail forked (Figs. 6B, 8, 11)	Tail square or almost so
Feet almost fully webbed; toes short	Webs deeply incised; toes long (Fig. 7)
Hind toe rudimentary	Hind toe well developed
Chick down speckled above and on chin and throat	Chick down with dark blotches above and prominent dark pattern across forehead, throat and sides of neck; chin white (Fig. 9)
Breeds on bare river shingle; nest a shallow scrape, usually unlined	Breeds on shallow lakes and marshes; nest floating, built of vegetation
Feeds typically over fast-moving rivers	Feeds typically over still or slow-moving fresh waters
In winter, largely coastal seas, harbours, rivermouths	In winter, largely inland fresh waters

Both birds are associated with inland fresh waters and adjacent fields, but Whiskered Terns frequent lakes and marshes, where they build floating nests, and migrate toward the equator to winter mainly in similar habitat, whereas Black-fronted Terns frequent swift-flowing rivers, where they build shallow nest-scrapes on the bare shingle, and

most winter on the seas, rivermouths and lagoons of the coasts, a small number moving to some North Island coasts (Lalas 1979).

Both birds have fairly short bills and have a similar freshwater diet mainly of aquatic insects, small fish and crustaceans. Both hawk over water or land and can take flying insects on the wing; but the largely marine diet of the non-breeding Black-fronted Tern has not been described. Both birds feed typically by diving at a shallow angle with the wings partly extended and usually only the bill touching the water. However, both may also drop to the water in a gentle dive, the Whiskered apparently in conditions of clear water to take fish and the Black-fronted at times when insects are in short supply and also to get food used in courtship displays and to feed the nestlings.

These points of partial similarity do not seem to outweigh the many points of difference between the two species.

CHLIDONIAS OR *STERNA* ?

The marsh tern genus *Chlidonias* includes three species, the Black Tern *(C. niger)*, the White-winged Black Tern *(C. leucopterus)*, and the Whiskered Tern *(C. hybrida)*. It is largely a genus of convenience to accommodate those species which ornithologists recognise as a group apart by their feeding and breeding habitat and habits.

Some of the characters that define the genus seem rather arbitrary, the first two being probably the most meaningful:

1. The webs of the feet are deeply incised or indented;
2. The nest is a floating structure built of aquatic plants or twigs;
3. The toes, especially the mid-toe, are long and slender;
4. The hind toe is well developed; and
5. The tail is short and only slightly forked, the outermost feathers therefore having rounded tips like the rest.

The Black-fronted Tern fits none of these characters. It nests only on bare or sparsely vegetated river shingle, the nest being the simplest of scrapes and usually unlined (Fig. 10B, 12).* The feet are almost fully webbed, in the manner of *Sterna* terns (Mees 1977; F. C. Kinsky, pers. comm.; Fig. 7). The toes are not unusually long or slender. The hind toe is almost rudimentary. The tail, although shorter and much less deeply forked than that of typical *Sterna* terns (slightly under the defined minimum of 50% of the wing-length, a rule broken anyway by the small terns such as the Little and Fairy Terns *S. albifrons* and *S. nereis*), is clearly and distinctly forked (Fig. 6B, 8 & 11), quite unlike the tail of the *Chlidonias* terns, the outermost feathers being much more pointed than the rest.

---

* Note, however, that the pair of White-winged Black Terns that nested in New Zealand in 1973-74 (Pierce 1974), the only Southern Hemisphere record, did so on shingle beside a freshwater coastal lagoon, in association with Black-fronted Terns.

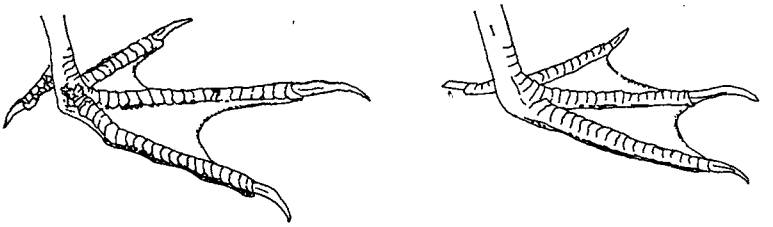


FIGURE 7 — Feet of (left) Whiskered Tern and (right) Black-fronted Tern; after Mees (1977). Note the difference in proportionate length of functional toes and hind toe, and in size of webs.

In addition, the marsh terns have dark-patterned nestlings, are strongly migratory, have short bills, and have very different breeding and non-breeding plumages. Of these points, the Black-fronted Tern has only the short bill, a feature of little significance on its own, particularly as its bill shape fits the classical shape of neither *Chlidonias* (stubby with distinct gonys) nor *Sterna* (longer than head, straight, and sharply pointed), being rather gull-like, abruptly curved at the tip (Fig. 12).

The upper half of Table 3 compares measurements of the Black-fronted Tern and the three species of marsh tern, including two subspecies of the Whiskered Tern. The two Whiskered Terns differ in size but have similar proportions. Much the same is true when the three marsh terns are compared, although some variation occurs, e.g. the Black Tern has a relatively short tarsus. The Black-fronted Tern is of roughly similar size to the Eurasian Whiskered Tern, much larger than the Australian Whiskered Tern, and yet its body proportions are different, having a shorter tarsus and longer tail proportionately than all the marsh terns.

Figure 9 compares the downy chicks of the Black-fronted with those of the Whiskered Tern and the Antarctic Tern. The Whiskered Tern chick has a prominent and precise pattern of blackish blotches on the back, black spots on the head, and black across the sides of the neck and the throat and on to the forehead. The chin is white, whereas the chin and throat of the other two are mottled. Apart from a dark patch that covers part of the lores and cheeks near the eyes, the Black-fronted Tern chick is very like the irregularly speckled chick of the Antarctic Tern, that is, typical of *Sterna* terns.

Because the Black-fronted Tern does not match the criteria for *Chlidonias,* it must by default belong to *Sterna,* some members of which it closely resembles. It thus returns to the generic status it originally had as *S. antarctica* (Finsch 1870, Saunders 1876, Sharpe 1879, Alexander 1928). The specific name *antarctica* was replaced by *albostriata* because it was also a primary homonym of the South American Tern *(S. hirundinacea).*

TABLE 3 — Measurements of three **Chlidonias** species, **S. albostriata**, and three other **Sterna** species.

Species Reference	Common name Breeding range	No. for means	mean Bill range	mean Wing range	mean Tail range	mean Tarsus range	mean Body range
Chlidonias hybrida hybrida	Whiskered Tern	14	-	223	-	-	-
Dementiev & Gladkov (1950)	Eurasia		27 - 34	223 - 247	80 - 90	22 - 25	270 - 280
C.h. javanicus	Whiskered Tern	12	29	222	77	21	-
Serventy *et al.* (1971)	Australia		25 - 32	208 - 231	70 - 82	19 - 23	240 - 265
C. leucopterus	White-winged Black Tern	46	-	208	-	-	≈255
Dementiev & Gladkov (1950)	Eurasia		23 - 27	196 - 222	65 - 75	18 - 22	245 - 270
C. niger niger	Black Tern	122	-	213	-	-	≈260
Dementiev & Gladkov (1950)	Europe, East Asia		25 - 29	200 - 227	80 - 90	15 - 18	245 - 280
Sterna albostriata	Black-fronted Tern	27	26	244	-	-	≈290
tail, tarsus Oliver (1955)	New Zealand		24 - 28	230 - 257	107 - 115	15 - 17	285 - 300
S. vittata bethunei	Antarctic Tern	14	36	258	134	19	-
Murphy (1938)	NZ subantarctic islands		32 - 38	250 - 270	119 - 138	18 - 20	-
S. vittata bethunei	Antarctic Tern	10	35	267	135	19	≈355
Bailey & Sorensen (1962)	NZ subantarctic islands		33 - 39	262 - 275	125 - 145	18 - 21	340 - 370
S. virgata	Kerguelen Tern	14	28	257	129	18	-
Murphy (1938)	South Indian Ocean		28 - 31	253 - 270	118 - 136	14 - 19	-
S. striata	White-fronted Tern	18	40	271	145	21	≈415
Serventy *et al.* (1971)	New Zealand		34 - 45	261 - 289	130 - 173	19 - 23	-

FIGURE 8 — Adult, breeding plumage. Note well-forked tail and pointed outer tail-feathers, though less so than the long streamers of many **Sterna** terns. Photo: M. F. Soper

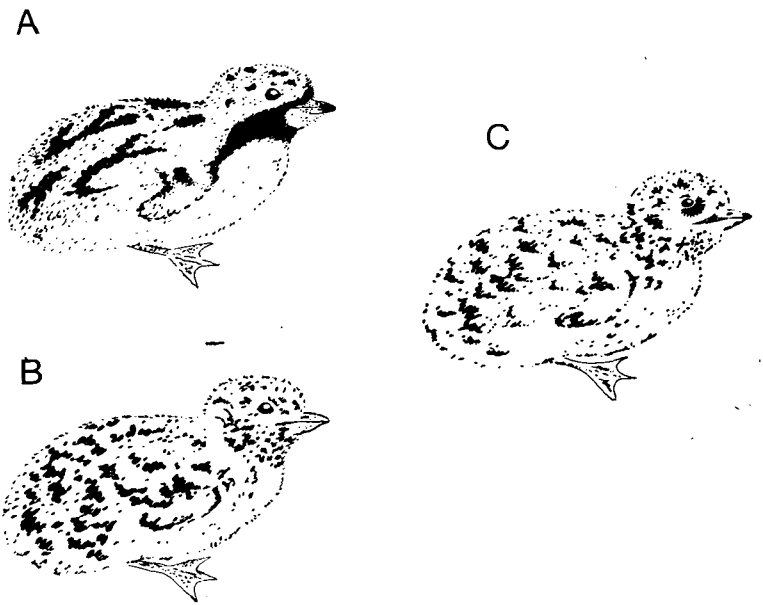


FIGURE 9 — Nestlings of three tern species. A — Whiskered Tern (after Volkers & de Vries 1946). B — Antarctic Tern (after Parmelee & Maxson 1974). C — Black-fronted Tern (from photographs).

A POSSIBLE *STERNA* RELATIVE

The Black-fronted Tern is very like two closely related Southern Hemisphere terns, the Kerguelen Tern *(S. virgata),* which breeds and is apparently sedentary at the Prince Edward, Marion, Crozet and Kerguelen Islands of the southern Indian Ocean, and the Antarctic Tern *(S. vittata),* which has a circumpolar breeding range, including the Antarctic Peninsula and the New Zealand subantarctic islands, that overlaps the Kerguelen Tern on the Crozet and Kerguelen Islands. Compare Figures 10A and 10B. Both Saunders (1876, 1877) and Sharpe (1879) thought *virgata* more closely related to *albostriata* than to *vittata,* although both they and Falla (1937) observed that they differed in bill and foot colours and in shape of bill. However, the bills of all three, and particularly of *virgata* and *albostriata,* are alike in being rather short and in curving fairly abruptly to the tip and, although the feet of *virgata* are dull red, those of the Crozet Island race of *virgata* are bright orange-red (Watson 1975).

The lower half of Table 3 compares measurements of Black-fronted, Antarctic, and Kerguelen Terns. Murphy's (1936) *vittata* measurements are for the Antipodes Islands and The Snares; Bailey

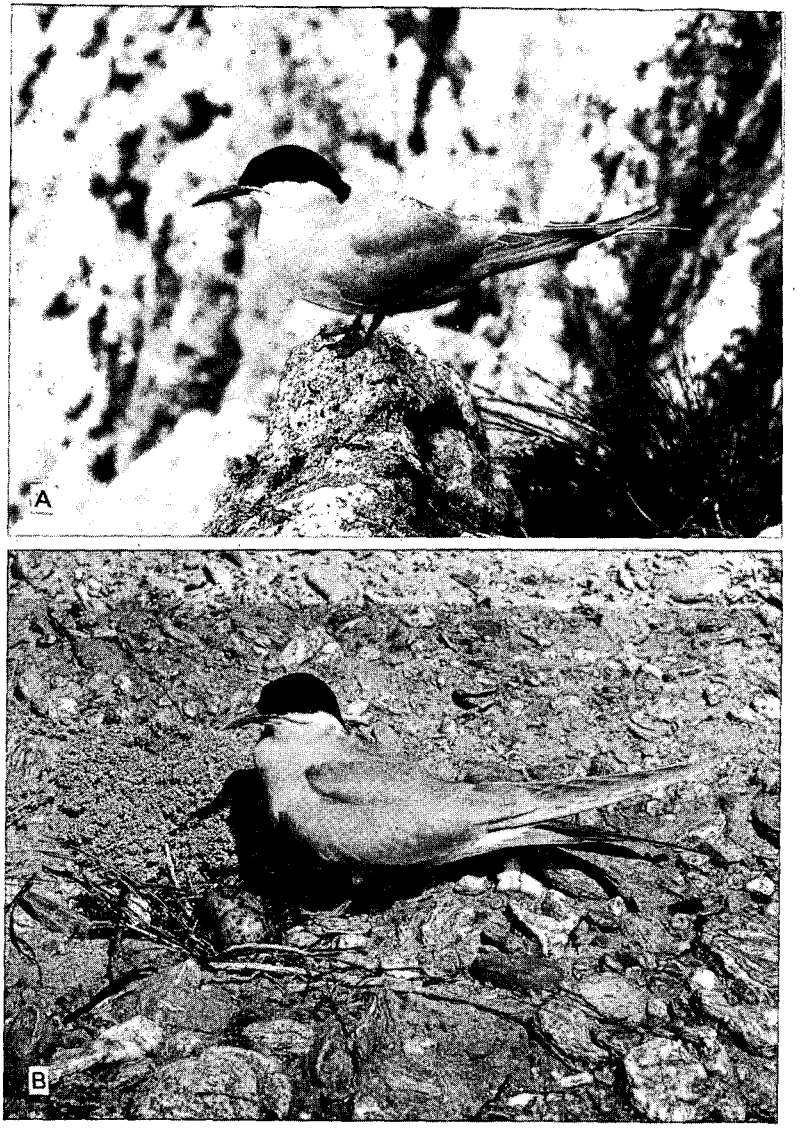


FIGURE 10 — A — Antarctic Tern **(S. vittata)** adult. The Snares, New Zealand, December 1976. Photo: P. M. Sagar

B — Black-fronted Tern **(S. albostriata)**. Adult at nest, Otago. Photo: M. F. Soper

& Sorensen's (1962) are for Campbell Island. The difference in wing-length values may reflect a difference in the populations or in the measuring techniques. For comparison, measurements are also given for the White-fronted Tern *(S. striata)* of New Zealand as an example of the medium-sized black-capped terns with long tails. The Black-fronted and Kerguelen Terns have a similar bill length, short compared with other *Sterna* terns. A progressive decrease can be seen in the relative length of the tail. The Black-fronted Tern has a wing length intermediate between *C. h. hybrida* and *S. virgata,* although it is overall of similar size to both.

Table 4 shows the measurements of *C. h. hybrida* and *S. virgata* expressed as percentage variations away from the *S. albostriata* measurements. They are calculated from Table 3 and so must be regarded as approximate only. All the Kerguelen Tern measurements are slightly longer than those of the Black-fronted, and their variations are not greatly different from one to another; whereas the Whiskered Tern measurements vary widely and most inconsistently. This comparison strongly suggests relationship to *Sterna,* to *S. virgata* in particular, rather than to *Chlidonias.*

TABLE 4 — Measurements of the Whiskered Tern of Eurasia and the Kerguelen Tern expressed as percentages of variation from the measurements of the Black-fronted Tern.

	Bill	Wing	Tail	Tarsus
C. h. hybrida	+17%	−5%	−24%	+47%
S. virgata	+ 8%	+5%	+15%	+13%

Of the Antarctic and Kerguelen Terns, the Kerguelen is remarkably like the Black-fronted, at least superficially. Of similar size, its plumage is very similar, although a shade darker grey, making its white cheek-stripe also narrow and even more prominent. The Kerguelen Tern, like the Black-fronted, has even-grey plumage, grey cheeks, contrasting white or whitish upper tail-coverts, and a short bill. Its underwing is grey, but, unlike the Black-fronted, is white in the juvenile, as in all stages of the Antarctic Tern. It is apparently non-migratory. Its non-breeding plumage differs from breeding plumage only about the head, which turns grey mainly on the forehead, but, unlike the Black-fronted, its bill darkens also. The feet of the Crozet Island race *(mercuri)* are almost orange, and the downy nestling is, from the description of Watson (1975), very like those of the Antarctic and Black-fronted Terns (Fig. 9).

Both the Kerguelen and Antarctic Terns build their nest scrapes away from the sea on rocky ground, often among mat plants, and sometimes on pebble or shell beaches but not sandy beaches. They are colonial but the nests are widely spaced. Kerguelen Terns start

FIGURE 11 — Adult Black-fronted Tern in flight, showing the prominent tail fork. Rakaia River, October 1977. Photo: C. R. Veitch

nesting about the beginning of October, and the young are usually fledged by January, a period similar to that of the Black-fronted Tern. The Antarctic Tern is about a month later, and on Kerguelen, Heard and Crozet Islands, it is about 2 months later, after the Kerguelen Terns there have finished (Falla 1937, Watson 1975).

The adults of the Kerguelen and Antarctic Terns are sedentary, but the young possibly stay at sea for their first winter. The Antarctic Tern feeds inshore taking small fish and crustaceans, using both steep- and shallow-angled dives (Murphy 1936, Sagar 1978). The Kerguelen

FIGURE 12 — Black-fronted Tern on nest. Note shape of bill; narrow white line below cap. Rakaia River, Oct. 1977. Photo: C. R. Veitch

Tern feeds over inland freshwater ponds and marshy terraces taking spiders, insects, and insect larvae, and over the shallow water and beaches of the rocky shoreline taking mainly amphipods and isopods (Falla 1937). It is not on record whether the insects taken inland are aquatic or terrestrial and what the feeding habits are in winter. Fish are not an important part of the diet. The food and foraging habits of the Kerguelen Tern and its nest sites are not too dissimilar from those of the Black-fronted Tern and no great adaptive change would be needed from one to the other.

Murphy (1936) separated the *Sterna* terns of the Southern Hemisphere from their Northern Hemisphere equivalents by differences in the juvenile plumage. Young southern terns, including *S. hirundinacea* of South America, *S. vittata, S. virgata, S. striata* (White-fronted Tern), and *S. albostriata* have a much more heavily barred and streaked upper surface than young northern terns. However, *striata* and *albostriata* juveniles are pale grey on the under surface, lacking the speckled brown and grey throat and upper breast of the juveniles of the other southern terns. In this respect, they are more like northern terns. Unlike the downy-nestling plumage, therefore, the juvenile plumage of the Black-fronted Tern gives conflicting evidence of relationship.

CONCLUSION

From the information we have brought together, we are satisfied that the Black-fronted Tern is not a racial variant of the Whiskered Tern and that, despite some similarity of behaviour and plumage, it does not meet the criteria for *Chlidonias* either. As *Sterna albostriata,* it has tempted us to speculate, as early writers did, on an affinity with the Kerguelen Tern. The resemblances seem to be close, even to sharing a shape and length of bill and tail that are not typical of *Sterna.* However, heeding Murphy's (1938) warning against jumping to conclusions on the relationships of the black-capped terns based on adults in breeding plumage, we have tried to examine other aspects and hesitate to give a firm opinion. Far too much is not known about Southern Hemisphere terns, and, in particular, a thorough review is needed of the Kerguelen and Antarctic Terns. We think, however, that there is a *prima facie* case to investigate of possible affinity between the Kerguelen and Black-fronted Terns.

The changed status of the Black-fronted Tern raises its importance to that of an endemic New Zealand species. The completed and planned construction of hydroelectric dams across the shingle riverbeds of the South Island not only drowns the upstream parts of the bed but, by promoting downstream the consolidation by plants of bare ground normally scoured by floodwater, deprives the Black-fronted Tern of the extensive bare shingle their breeding colonies use. As an endemic species, its case is strengthened to retain its habitat if the rivers are to be changed excessively.

ACKNOWLEDGEMENTS

We are grateful to F. C. Kinsky for helpful comment on a draft of this paper and to P. M. Sagar, C. R. Veitch and M. F. Soper for thier fine photographs.

LITERATURE CITED

ALEXANDER, W. B. 1928. Birds of the ocean. New York: Putnam's.
BAILEY, A. M.; SORENSEN, J. H. 1962. Subantarctic Campbell Island. Proc. Denver Mus. Nat. Hist. 10: 1-305.
BROWN, B.; HABRAKEN, A. 1979. Whiskered Tern on Lower Waikato River. Notornis 26: 195-197.
DEMENTIEV, P. G.; GLADKOV, N. A. 1951. Birds of the Soviet Union. 3: 1-680. Israel Program for Scientific Translation. Jerusalem: 1969.
DWIGHT, J. 1901. The sequence of moults and plumages of the Laridae (gulls and terns). Auk 18: 49-63.
FALLA, R. A. 1937. B.A.N.Z. Antarctic Research Expedition 1929-31. Reports. Series B. 2: 1-288.
FINSCH, O. 1870. Uber die Vogel Neu-Seelands. J. f. Orn. 18: 241-256; 321-377.
HEATHER, B. D.; JONES, E. B. 1979 The Whiskered Tern in New Zealand — first records. Notornis 26: 185-195.
KINSKY, F. C. (Convener). 1980. Amendments and additions to the 1970 Annotated Checklist of the birds of New Zealand. OSNZ (in press).
LALAS, C. 1979. Seasonal movements of Black-fronted Terns. Notornis 26: 69-72.
MEES, G. F. 1977. The subspecies of **Chlidonias hybridus** (Pallas), their breeding distribution and migrations (Aves, Laridae, Sterninae). Zool. Verh., Leiden. 157: 1-64.
MURPHY, R. C. 1936. Oceanic birds of South America. 2 vols. New York: Am. Mus. Nat. Hist.
MURPHY, R. C. 1938. Birds collected during the Whitney South Sea Expedition. 37. On pan-antarctic terns. Am. Mus. Nov. 977: 1-17.
OLIVER, W. R. B. 1955. New Zealand birds. 2nd ed. Wellington: A. H. & A. W. Reed.
PARMELEE, D. F.; MAXSON, S. J. 1974. The Antarctic Terns of Anvers Island. Living Bird 13: 233-250.
PIERCE, R. J. 1974. Presumed attempted breeding of the White-winged Black Tern in New Zealand. Notornis 21: 129-134.
SAGAR, P. M. 1978. Breeding of Antarctic Terns at The Snares Islands, New Zaland. Notornis 25: 59-70.
SAUNDERS, H. 1876. On the Sterninae, or terns, with descriptions of three new species. Proc. Zool. Soc. Lond. 1876: 638-672.
SAUNDERS, H. 1877. Reports on the collection of birds made during the voyage of H.M.S. Challenger. 5. On the Laridae collected during the expedition. Proc. Zool. Soc. Lond. 1877: 794-800.
SERVENTY, D. L.; SERVENTY, V.; WARHAM, J. 1971. The handbook of Australian sea-birds. Sydney: A. H. & A. W. Reed.
SHARPE, R. B. 1879. An account of the petrological, botanical and zoological collections made in Kerguelen's land and Rodriguez during the Transit of Venus expeditions 1874-1875. Phil. Trans. Roy. Soc. 168 (extra vol.): 101-162.
STEAD, E. F. 1932. The life histories of New Zealand birds. London: Search Pub. Co.
VOLKERS, F.; DE VRIES, G. 1946. Veranderingen in plantengroei en vogelstand tijdens en na de inundatie der Eempolders. Ardea 34: 268-270
WATSON, G. E. 1975. Birds of the Antarctic and Sub-Antarctic. Washington: Amer. Geophys. Union.

C. LALAS, *Portobello Marine Laboratory, P.O. Box 8, Portobello, Dunedin;* B. D. HEATHER, *10 Jocelyn Crescent, Silverstream.*

★

SHORT NOTE

UNIDENTIFIED TERNS

On 15 December 1979 at 26°41'S 176°03'W, I recorded three terns, which appeared about the size of, or slightly larger than, the White Tern *(Gygis alba)*. They had grey upper surfaces, whitish under surfaces, black caps with white foreheads, and dark bills. The birds, which showed no interest in the ship, were flying directly on a course of about 190° true and at a height of about 100 feet.

JOHN JENKINS, *14 Lochiel Road, Remuera, Auckland.*

NESTLING FOODS OF THE SOUTH ISLAND FERNBIRD
(Bowdleria punctata punctata)

In the course of a study (by MB) of population dynamics and territory size of the South Island Fernbird, new information on the food of nestlings has been obtained. The study area is a 1 km fringe of coastal land verging on the Invercargill estuary (46°27'S 168°19'E).

Nest 1978/22 contained three eggs which hatched on 17/1/79. At 0700 hours on 20/1/79 an adult was seen feeding the chicks. At the next visit at 2030 hours on 22/1/79 the nest had been raided (predator unknown), and three gizzard linings (measuring 10 x 8 x 8 mm approximately) with contents remained in the nest. Examination (by AM) of the contents revealed a varied diet consisting mainly of spiders (Araneida), caterpillars (Lepidoptera) and plantbugs (Hemiptera). Other arthropods and seeds were also present in lesser numbers (Table 1). The food ranged in size from about 1 mm (mites) to 20 mm (caterpillars).

TABLE 1 — Species composition and the number of foods fed to three nestling Fernbirds.

Food items	Gizzard number I	II	III	Total (n = 3)
Blattodea				
Blattidae				
Celatoblatta notialis	1	0	1	2
Hemiptera				
Aphrophoridae				
Carystoterpa fingens	1	2	2	5
Nabidae indet.	4	3	4	11
Coleoptera Ad. indet.	2	1	2	5
L. indet.	0	0	1	1
Diptera Ad. indet.				
Stratiomyiidae Ad.				
Odontomyia sp.	0	0	1	1
Calliphoridae Ad. indet.	1	1	0	2
Tipulidae Ad. indet.	0	0	1	1
Lepidoptera Ad. indet.	1	1	1	3
Nymphalidae L.				
Argyrophenga antipodum	1	3	2	6
Noctuidae L. indet.	1	2	2	5
indet. L.	9	7	7	23
Amphipoda indet.	0	1	1	2
Acari indet.	0	0	3	3
Araneida				
Lycosidae indet.	18	33	27	78
Thomisidae				
Diaea sp.	7	4	4	15
Theridiidae ? indet.	11	9	8	28
Opiliones indet.	0	2	0	2
Seeds indet.	2	1	3	6

MAIDA BARLOW, *38 Filleul Street, Invercargill,* and ABDUL MOEED, *Ecology Division, DSIR, Private Bag, Lower Hutt.*

SEABIRDS OBSERVED BETWEEN SYDNEY AND BUENOS AIRES

By A. E. F. ROGERS

ABSTRACT

Records were kept of seabirds seen during 30 watches, totalling about 45 hours, on a voyage from Sydney to Buenos Aires via New Zealand and the Straits of Magellan. Results are presented in the form of an annotated species list.

Passage movements of *Puffinus griseus* and *Pterodroma lessonii* were observed, and records of *Pterodroma axillaris, P. inexpectata, Puffinus bulleri* and *P. puffinus* appear to be of distributional significance. A probable sight record of *Pterodroma magentae* is discussed in detail.

INTRODUCTION

From 25 November to 26 December 1970 I kept a daily record of the seabirds observed from the MV *Achille Lauro* as it voyaged from Sydney (Australia) to Southampton (England) via New Zealand and the Straits of Magellan. Because most trans-Pacific sea traffic to and from Australasia follows the more conventional routes to Panama and North America, seabird information for this southern passage is scarce. Records were kept for transects between New Zealand and the Straits of Magellan by W. R. Colbeck (SV *Discovery*) and A. M. Lysaght (SS *Sydney Star*) in 1931 and 1936 respectively but were unpublished (Sir Robert Falla, pers. comm.). More recently, information was collected both north and south of the Antarctic convergence during the research cruises of the USNS *Eltanin* (Szijj 1967, Watson *et al.* 1971, Harper unpubl.) and in Chilean waters by Lathbury (1972), Jehl (1973) and Brown *et al.* (1975). This paper adds the observations made during the section of the voyage between Sydney and Buenos Aires, that is, in the southern oceans south of approximately latitude 35°S. Details of the whole voyage were lodged with the Royal Naval Bird Watching Society and have been summarised by Bourne & Dixon (1975).

METHODS

I made most observations during periods of continuous watching using 10 x 50 binoculars from a lower deck on the side of the ship affording the best light conditions. I did little serious recording from the stern because excessive vibration nullified any advantage of the wider field of view. Individual watches averaged about one hour, daily totals averaged 2¼ hours. Apart from two days of icy winds and fog, weather conditions were generally good and seas slight.

NOTORNIS 27: 69-78 (1980)

TABLE 1 — Date, mean position and duration of sea watches.

WATCH NUMBER	DATE	MEAN POSITION	DURATION (HOURS)	REMARKS
1	25 Nov	50 km E of Sydney	1.5	
2	25 Nov	34°48'S 154°02'E	1.0	
3	26 Nov	36°54'S 160°51'E	1.0	
4	26 Nov	37°40'S 163°28'E	1.25	
5	27 Nov	39°49'S 171°22'E	1.0	
6	27 Nov	40°08'S 172°35'E	1.0	
7	27 Nov	40°26'S 173°25'E	0.5	
8	27 Nov	Off Stephens Is.	1.0	Western Cook Strait
9	28 Nov	Leaving Wellington	1.0	Eastern Cook Strait
10	28 Nov	41°47'S 175°23'E	3.0	
11	28 Nov	42°48'S 177°50'E	0.5	
12	28 Nov(R)	45°07'S 176°30'W	1.6	*Day Repeated*
13	28 Nov(R)	45°46'S 174°33'W	1.0	" "
14	28 Nov(R)	46°04'S 172°51'W	1.0	" "
15	29 Nov	47°44'S 163°08'W	1.0	
16	29 Nov	47°54'S 161°40'W	1.0	
17	30 Nov	48°54'S 151°08'W	1.0	
18	1 Dec	48°54'S 139°27'W	1.0	
19	2 Dec	49°02'S 127°49'W	1.0	
20	3 Dec	49°40'S 116°00'W	1.0	*Fog 3 & 4 Dec.*
21	5 Dec	51°18'S 93°48'W	1.0	
22	5 Dec	51°30'S 90°40'W	1.0	
23	6 Dec	52°06'S 80°08'W	2.25	
24	6 Dec	52°15'S 77°20'W	1.0	
25	7 Dec	80 km W of Punta Arenas	3.0	Straits of Magellan
26	7 Dec	25 km E of Punta Arenas	2.0	" " "
27	8 Dec	48°47'S 65°04'W	2.0	Atlantic Ocean
28	8 Dec	47°29'S 63°59'W	1.0	" "
29	9 Dec	41°37'S 59°07'W	1.0	" "
30	9 Dec	40°37'S 58°18'W	1.0	" "

I was familiar with many of the species seen from experience gained during two years of offshore trips in Sydney coastal waters. However, several new species were encountered and Alexander (1963) and King (1967) were used for identification. Many birds cannot be specifically identified from a large fast-moving ship and in general these have been omitted from the results. Where such a record is included the uncertain identification is made clear.

RESULTS

About 45 hours of observations were made during 30 watches at sea, while ashore at Punta Arenas and while in the estuary of the Rio de la Plata. Details of the sea watches are listed in Table 1, the mean positions having been calculated from the noon position of the vessel and its speed. It was unfortunate that our approach to the Chilean coast and entry into the Straits of Magellan occurred during darkness.

Distribution of the more numerous pelagic species is summarised in Table 2 and discussed in more detail in the following annotated species list.

MAGELLAN PENGUIN *Spheniscus magellanicus*

Only three small parties were seen; possibly an indication of the difficulty of observing penguins from a large ship.

WANDERING ALBATROSS *Diomedea exulans*

Although only small numbers were seen this was the most widely distributed species and the only one recorded in more than half of the watches.

BLACK-BROWED MOLLYMAWK *Diomedea melanophrys*

Seen in only very small numbers in the Pacific but common in the Straits of Magellan and abundant in the Atlantic on 8 December. Typical of that day was a single sweep of the horizon during watch 28 when 102 were counted. As these are summer records this distribution probably reflects the relative distances to the nearest breeding colonies. Bartle (1974) has shown *melanophrys* to be rare in the Cook Strait region in summer.

GREY-HEADED MOLLYMAWK *Diomedea chrysostoma*

Johnson (1965) stated that in Chilean waters *D. chrysostoma* is normally outnumbered by *D. melanophrys* by a ratio of 10:1. On 6 December when approximately 300 km from the Chilean coast, I recorded up to 40 *chrysostoma* without a definite record of *melanophrys*. Unfortunately no inshore observations could be made because our approach to the Straits of Magellan occurred during darkness.

WHITE-CAPPED MOLLYMAWK *Diomedea cauta cauta*

Only 6 birds seen, all in the Cook Strait region.

TABLE 2 — Distribution of more numerous pelagic species.

SPECIES	WATCH NUMBER																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Spheniscus magellanicus																									6	4	7			
Diomedea exulans	2	1		1	2			1		2	2			1	2		1		1			3	1	8			1	2		
melanophrys				2									1						1				(1)		200+	10	500+	500+	4	4
chrysostoma																							30+	2						
c. cauta							1	4		1																				
c. salvini												3+	2	1																
Macronectes spp.							1	3	12		5	5	1												6		1	3	1	
Daption capense									6					1																
Pterodroma macroptera	40+	20+	15+	10+						70+	5+			1															(1)	
lessonii													5	4	2	1	2	4	7	1			1							
incerta																													35+	8
inexpectata			(2)										1		1	1	1		1											
nigripennis		(1)	10+	2																										
Pachyptila spp.					4	1				40+		8+	4	3	25	15	7	1	1				30+				50+	30+		
Procellaria cinerea																							20+							
aequinoctalis																							10+	1			20+	50+	3	
Puffinus bulleri					6	40+				3	6+																			
gravis																												1	30+	5
griseus	1											35+	40+	40+	40+						1+		2							
Pelagodroma marina										1		200+	30+																	
Stercorarius skua						1								1	1										150+	4			1	
spp.		1																									1		30+	15+

Note Numbers in brackets indicate probable rather than certain identification.

SALVIN'S MOLLYMAWK *Diomedea cauta salvini*
Seen only east of New Zealand.

GIANT PETREL *Macronectes* spp.
All birds seen were dark plumaged and no attempt was made to distinguish the northern and southern species.

CAPE PIGEON *Daption capense*
Not recorded in the South American sector, which agrees with Jehl (1973), whose results indicated that the nominate race does not move north into Chilean waters until the austral autumn.

GREY-FACED PETREL *Pterodroma macroptera*
Common in the western Tasman Sea with the highest count recorded on watch 1 between 30 and 70 km off the coast of New South Wales. Present in decreasing numbers eastwards on watches 2, 3 and 4 but not seen on 27 November in the outer approaches to Cook Strait.

WHITE-HEADED PETREL *Pterodroma lessonii*
Seen consistently over a wide range of longitude from 174°W to 80°W, a distribution matched only by *Pachyptila* spp. All the *lessonii* seen on 28 (repeated) and 29 November were clearly moving in the same S-SW direction as the Sooty Shearwaters *(Puffinus griseus)* (see below); those seen further east had no consistent flight direction.

ATLANTIC PETREL *Pterodroma incerta*
Common on 9 December in association with *Puffinus gravis* and *Stercorarius* spp. A few of the birds had noticeably fresh brown plumage in comparison with the majority which looked faded.

MOTTLED PETREL *Pterodroma inexpectata*
The records between 163°W and 128°W apparently extend considerably the range of this species as defined by Watson *et al.* (1971). The two birds seen on watch 3 in the Tasman Sea were almost certainly *inexpectata,* having dark leading edges to the underwings and a dusky area on the belly, but they were seen too briefly for confirmation.

MAGENTA PETREL *Pterodroma magentae*
On 28 November (repeated) at 46°04'S 172°51'W, about 400 km SE of the Chatham Islands, I recorded a *Pterodroma* with the following description. " Similar in size and colour of upperparts to *inexpectata* but with dusky underwing, apart from a very faint paler narrow central stripe. Head, neck and throat, possibly also upper breast, darkish grey, uniform with upperparts; remaining underparts white." The bird was seen at a distance of about 250 m; it was flying in roughly the same direction as the ship but was not attracted to it. At the time of observation I considered it to be probably a Soft-plumaged Petrel *(P. mollis)* because of the dark underwings, but recorded it as unidentified because the occurrence was well outside the normal range known at that time. Later, this tentative identification assumed some

credibility when I learned that the range of *mollis* had been extended to the New Zealand region with records at the Antipodes Islands (Warham 1969).

Bourne & Dixon (1975) suggested, however, that the description agreed best with that of the then lost Magenta Petrel. I had not considered this possibility and found it difficult to investigate because of the scarcity of information on *magentae*. Certainly the description of the type of *magentae* given by Bourne (1964) was close to that of the bird I observed, especially the dark upperparts, head and underwing, and the white breast and belly. On the other hand, the size seemed to conflict since *magentae* is stated to have similar dimensions to the large gadfly petrels of the *macroptera-lessonii-incerta-solandri* group whereas the bird I saw appeared only a little larger than *inexpectata*.

The problem would have remained unresolved had this paper not been delayed until after the rediscovery of the Chatham Island Taiko or Magenta Petrel (Crockett, *Notornis* in prep.). Dr Peter Harper (pers. comm.) referring to an earlier draft said that he had questioned the *mollis* record even before seeing the photographs of the rediscovered *P. magentae*. "I believe you saw *magentae* on 28 November, because your description fits the bird quite well."

On this advice, I contacted David Crockett for first-hand information and opinion. He replied "It is highly likely you did see a Magenta Petrel . . . and if you reconsider your opinion in light of the current rediscovery and can reconcile your observations and your mental image with the enclosed photograph, then you would be justified in your identification as *magentae*."

The photograph taken by R. N. Thomas of Auckland shows a Magenta Petrel in the hand with one wing held extended, and the head, underparts and underwing clearly visible. It bears a striking resemblance to my mental picture of the bird I saw, particularly the solid dark head and contrasting white underparts. The undersurface of the primaries and secondaries appears pale grey in this photograph. However, Crockett comments that these areas are "silvery grey and highly reflective depending on the angle relative to the source of light." At the time of observation I noted that the wing was not uniformly dark and this may have been a function of this reflection. I have had similar experience in the field with *P. macroptera*, which has a dark underwing that can appear pale in certain light conditions.

The bird in the photograph appears smaller and more compact than *macroptera* and this is confirmed by Crockett (pers. comm.) who gives the length of *magentae* as about 38 cm; about 3 cm less than *macroptera*. I would have classified the bird I saw as a medium-sized gadfly petrel with dimensions perhaps in the range 34-35 cm. Unfortunately, no other species were present at the time of observation

to allow an accurate size comparison. It was certainly smaller than the many *macroptera* seen on the previous day.

In the Pacific region, only three *Pterodroma* spp., *magentae, alba* and *rostrata* have a dark head similar in colour to the upperparts and also a dark underwing and white underparts. *P. alba* and *rostrata* are very similar in general appearance and can be ruled out of the present observation because of their sooty brown coloration, whereas the bird I saw was sooty grey. Moreover, both are species of tropical and subtropical seas and their occurrence at 46°S in subantarctic waters would be exceptional. In light of the discovery on the Chatham Islands the position would be quite credible for *magentae.*

I have discussed this observation at some length so that readers can make an independent evaluation. I believe the evidence is strong enough for a sight record of the Magenta Petrel, probably the first recorded occurrence away from the Chatham Islands since the original records in 1867.

COOK'S PETREL *Pterodroma cookii*

On watch 4 in the Tasman Sea, I recorded a *Pterodroma* similar in size and general appearance to *P. nigripennis* but with a pale grey crown, and a white underwing apart from a very narrow black line along the leading edge. I considered this bird to be a Cook's Petrel.

BLACK-WINGED PETREL *Pterodroma nigripennis*

Observed only in the Tasman Sea.

CHATHAM ISLAND PETREL *Pterodroma axillaris*

On 28 November (repeated) when about 120 km SE of the Chatham Islands (45°07'S 176°30'W), I observed a single *Pterodroma* closely resembling *nigripennis* in size and plumage. However, as it approached it was clearly seen to have black axillaries and was identified as a Chatham Island Petrel. This appears to be the first record of this species away from its breeding grounds.

PRIONS *Pachyptila* spp.

Widely distributed in the Pacific Ocean and South American offshore waters.

FAIRY PRION *Pachyptila turtur*

During watches 7 and 8 when approaching Stephens Island many thousands of prions were observed. All those seen at close range had broad tail bands and were identified as *P. turtur* in view of the large colony breeding on that island.

GREY PETREL *Procellaria cinerea*

At least 20 were seen in association with *Diomedea chrysostoma* and *Procellaria aequinoctialis* during watch 23 when about 300 km off the Chilean coast. This species was not recorded by either Jehl (1973) or Brown *et al.* (1975). It did not follow the vessel.

WHITE-CHINNED PETREL *Procellaria aequinoctialis*

Fairly common in South American offshore waters: not recorded in the Straits of Magellan.

FLESH-FOOTED SHEARWATER *Puffinus carneipes*

Surprisingly, only one definite record, a single bird during watch 10.

WEDGE-TAILED SHEARWATER *Puffinus pacificus*

Two were recorded on the first watch when still just within sight of the coast of New South Wales.

BULLER'S SHEARWATER *Puffinus bulleri*

The observations made on watches 5, 6 and 10 agree with the summer distribution given by Jenkins (1974). The birds seen during watch 11 extend this range by a further 120 km south-eastward.

GREAT SHEARWATER *Puffinus gravis*

Present over a wide range of latitude in the south Atlantic Ocean, also being recorded north of Buenos Aires to approximately 8°S on 17 December.

SOOTY SHEARWATER *Puffinus griseus*

Observations during watches 12-15 and other casual sightings indicate that for about 30 hours on 28 (repeated) and 29 November there was a continuous S-SW passage of this species at a rate of about 40 birds per hour. During this period the ship traversed about 1000 km. If it is assumed that all birds passing within 2 km of the ship were observed and that the passage was continuous during the 20 daylight hours of the period, it can be calculated that up to 200 000 birds could have been involved. From the direction of flight and the southerly position (45-47°S) this passage would appear to comprise subadult birds making a late return to the breeding grounds on the subantarctic islands to the south of New Zealand. This would be consistent with the findings of Richdale (1963) who showed that, in the Foveaux Strait colonies, adults returned in late September but large numbers of non-breeding birds did not appear until the onset of egg-laying in late November. The passage was in a discrete band because no birds were seen on the previous day and there were no further positive sightings until approaching the Chilean coast.

SHORT-TAILED SHEARWATER *Puffinus tenuirostris*

A party of about 10 was recorded during the first watch when still within sight of the New South Wales coast.

MANX SHEARWATER *Puffinus puffinus*

A single bird was seen at 48°50'S 65°10'W on 8 December, close to the southern limit of this species' distribution.

WHITE-FACED STORM PETREL *Pelagodroma marina*

Present almost continuously in twos and threes during watch 12,

which was centred about 120 km SE of the Chatham Islands. Smaller numbers were seen on watch 13 when about 250 km from the islands but none on watch 14 when about 370 km distant. These figures probably indicate foraging range since it is likely that these birds came from breeding colonies in the Chatham Group.

DIVING PETREL *Pelecanoides* sp.

Diving Petrels were seen only in the Straits of Magellan. They were more numerous east of Punta Arenas, with about 50 seen in small groups during watch 26. In the western Straits about 10 were recorded during watch 25. Although no attempt was made to separate the species, they were probably *P. magellani,* based on the specimen evidence of Humphrey *et al.* (1970).

BIGUA CORMORANT *Phalacrocorax olivaceus*

Occasional birds seen in the Rio de la Plata and in the docks area at Buenos Aires.

KING CORMORANT *Phalacrocorax albiventer*

BLUE-EYED CORMORANT *Phalacrocorax atriceps*

At least two *P. atriceps* were present among a group of about 100 *albiventer* on a disused jetty at Punta Arenas, specific determination being judged by the extent of the white on the cheeks. Cormorants were common in the vicinity of several rocky islands during watch 25 but were too distant for accurate identification. Four *albiventer* were seen during watch 26.

SOUTHERN GREAT SKUA *Stercorarius skua lonnbergi*

Common in the Straits of Magellan east to Punta Arenas. The individual recorded during watch 6 in the western approaches to Cook Strait was seen to pursue a Buller's Shearwater down on to the water and force it to disgorge.

SKUAS *Stercorarius* spp.

The bird seen on watch 27 and several of those present during watches 29 and 30 appeared rather slender, flew with a tern-like flight and were probably *longicaudus.* The remainder were of heavier build and were considered to be *parasiticus.* The bird on watch 2 was a pale phase *parasiticus.*

SOUTHERN BLACK-BACKED GULL *Larus dominicanus*

Common in New Zealand coastal waters, in the Straits of Magellan and along the Rio de la Plata.

RED-BILLED GULL *Larus novaehollandiae*

Common in New Zealand coastal waters.

BROWN-HOODED GULL *Larus maculipennis*

Only a few of a group of about 30 at Punta Arenas had reached full breeding plumage; most had the faint outline of the dark head

just appearing. One bird had a noticeably rosy tinge on the underparts. Fairly common along the Rio de la Plata.

DOLPHIN GULL *Gabianus scoresbii*

The only record was a group of six at Punta Arenas.

SOUTH AMERICAN TERN *Sterna hirundinacea*

Common in the Straits of Magellan especially east of Punta Arenas, with about 400 seen during watch 26. West of Punta Arenas about 50 were recorded on watch 25.

ACKNOWLEDGEMENTS

I am grateful to David Crockett and Peter Harper for permission to include their comments on *Pterodroma magentae* and for their advice on other aspects of this paper. I also wish to thank J. A. Bartle and Barrie Heather for assistance in finalising the manuscript.

LITERATURE CITED

ALEXANDER, W. B. 1963. Birds of the ocean. London: Putman.
BARTLE, J. A. 1974. Seabirds of eastern Cook Strait, New Zealand, in autumn. Notornis 21: 135-166.
BOURNE, W. R. P. 1964. *The relationship between the Magenta Petrel and the Chatham* Island Taiko. Notornis 11: 139-144.
BOURNE, W. R. P.; DIXON, T. J. 1975. Observations of seabirds 1970-72. Sea Swallow 24: 65-88.
BROWN, R. G. B.; COOKE, F.; KINNEAR, P. K.; MILLS, E. L. 1975. Summer seabird distributions in Drake Passage, the Chilean Fjords and off southern South America. Ibis 117: 339-356.
HUMPHREY, P. S.; BRIDGE, D.; REYNOLDS, P. W.; PETERSON, R. T. 1970. Preliminary Smithsonian Manual. Birds of Isla Grande (Terra del Fuego). Washington DC: Smiths. Inst.
JEHL, J. R. 1973. The distribution of marine birds in Chilean waters in winter. Auk 90: 114-135.
JENKINS, J. A. F. 1974. Local distribution and feeding habits of Buller's Shearwater. Notornis 21: 109-120.
JOHNSON, A. W. 1965. The birds of Chile and adjacent regions of Argentina, Bolivia and Peru. Vol. 1. *Buenos Aires: Platt Establicimentos Graficos S.A.*
KING, W. B. 1967. Preliminary identification manual. Seabirds of the tropical Pacific Ocean. Washington DC: Smiths. Inst.
LATHBURY, Sir G. 1972. HMS "Endurance" — passage to the Antarctic — October 1969-May 1970. Observations of seabirds. Sea Swallow 22: 10-15.
RICHDALE, L. E. 1963. Biology of the Sooty Shearwater **Puffinus griseus.** Proc. Zool. Soc. Lond. 141: 1-117.
SZIJJ, L. J. 1967. Notes on the winter distribution of birds in the western Antarctic and adjacent Pacific waters. Auk 84: 366-378.
WARHAM, J. 1969. University of Canterbury Antipodes Island Expedition 1969. Antarctic 5 (6): 282.
WATSON, G. E.; ANGLE, J. P.; HARPER, P.C.; BRIDGE, M. A.; SCHLATTER, R. P.; TICKELL, W. L. N.; BOYD, J. C.; BOYD, M. M. 1971. Birds of the Antarctic and Subantarctic. Amer. Geog. Soc. Antarctic Map Folio 14.

A. E. F. ROGERS, *9 Golden Grove, Westleigh, NSW 2120, Australia.*

THE EFFECT OF ATTENDANCE BY THREE ADULTS UPON NEST CONTENTS AND CHICK GROWTH IN THE SOUTHERN GREAT SKUA

By ANTHONY J. WILLIAMS

ABSTRACT

A small proportion of Southern Great Skua *(Stercorarius skua lonnbergi*[1]*)* nests at Marion Island (46°54'S 37°45'E) are attended by three adults — a trio. The contents of the trio-attended nests and the growth of the three trio-attended chicks were studied in comparison with the contents of 16 nests and the growth of 23 chicks, attended by two adults. Eggs at two of the trio nests were laid exceptionally late in the season. No other difference in nest contents was found. Trio-attended chicks grew faster and probably attained independence with more substantial body reserves than chicks attended by two adults.

INTRODUCTION

Seabirds are essentially monogamous (Lack 1968), two parents — a duo — attending each nest. The sharing of parental duties by more than two adult seabirds has been reported in very few species. In all cases there were three birds — a trio — at the nest. Cullen (1957) reported three cases of young male Arctic Terns *(Sterna paradisaea)* forming triangular relationships with mated pairs and sharing incubation, and in one case feeding the young. Stonehouse (1960) reported a single case in which three King Penguins *(Aptenodytes patagonicus)* shared incubation and fed the chick. Plowden-Wardlaw (*in* Young 1978) found four trios of the Great Skua *(Stercorarius skua skua)*, all of which comprised two males and a female. The only seabird in which trios appear to be common is the Southern Great Skua *(Stercorarius skua lonnbergi)*.

Young (1978) has reviewed the distribution and frequency of occurrence of trios in the Southern Great Skua, to which must be added observations of trios at the Crozet Islands (Barre 1976, Derenne *et al.* 1976) and at Marion Island (this study). Young found that on temperate islands off New Zealand up to 67% of Southern Great Skua nests were attended by trios but that elsewhere the proportion of trios was very small. The sexual role of skuas in trios remains largely unknown. Evidence from South Georgia and Signy Island suggests that some trios may be polygamous (Bonner 1964, Burton 1968), but until the sexual role of birds in trios is fully established it is safer to treat trios as being formed of a mated pair with a " helper." In trios

1 This is the New Zealand nomenclature. The author prefers to call the form involved the Subantarctic Skua (**Catharacta antarctica lonnbergi**)

all three adults share territorial defence (Young 1978; pers. obs.), and in at least some trios all three adults may share incubation and chick-feeding (Guthrie-Smith *in* Young 1978). The effect such sharing of duties among three adults might have upon aspects of the breeding biology, such as the timing of egg-laying and the growth of the chicks, has hitherto been unrecorded.

At Marion Island (46°54'S 37°45'E) about 400 Southern Great Skua nests are occupied annually (Williams *et al.* 1979). Three nests attended by three adults have been found, although almost certainly more occur. In the austral summer of 1976-77 I monitored the nest contents and growth of chicks at three trio nests and at 16 nests attended by duos. This paper reports the effect attendance by a trio of adults had upon the time of egg laying, egg size, egg mortality, chick growth and chick survival.

METHODS

The nests were checked daily from before laying began until after laying ceased, and again from a few days before hatching was expected until it was completed. When first found, eggs were weighed and measured and an identifying number was written on the shell. Chicks were weighed and measured within 24 hours of hatching and were given a paint mark on the culmen to distinguish siblings. Chicks were weighed daily for the first 25 days and thereafter on every fifth day of age until they died or could escape capture by flying (from about 50 days after hatching). All weights were recorded with the egg or chick held in a bag of known weight using an appropriate Pesola spring balance. Measurements of the tarsus, manus (the unfeathered wing distal to the carpal joint), culmen and, once it had developed, the longest primary were made on every fifth day of age.

RESULTS

In 1976 the mean date on which Southern Great Skuas at Marion Island completed their clutch was 9 November, and in two breeding seasons (1974-75 and 1976-77) 70% of all eggs were laid in the period 2 to 14 November (Williams, in press a). Only one trio clutch was completed in this period and at the other two trio nests the eggs were laid late in the season after all duo clutches had been completed. The territories of all skuas were searched regularly throughout the laying period and it is certain that the laying dates of trio clutches are for first clutches and are not for replacement eggs.

Eggs laid in trio nests tended to be larger and heavier than those in duo nests but the difference was not significant (Table 1). Laying, laying to hatching, and hatching intervals were similar at trio and duo nests (Table 1).

Chicks hatched at trio nests did not differ significantly in body weight or in appendage lengths from chicks at duo nests within 24 hours of hatching (Table 2).

TABLE 1 — The weight of eggs (g) and the duration of egg-period events (days) at Southern Great Skua nests at Marion Island attended by two and by three adults.

	Nests attended by two adults			Nests attended by three adults			
	n	Mean ± SD	Range	X	Y	Z	Mean ± SD
Egg weight							
First laid egg	16	111.0 ± 8.5	101–129	115	107	121	114.3 ± 7.0
Second laid egg	16	109.9 ± 9.0	99–126	118	105	113	112.0 ± 6.6
Laying date of second egg	13	9XI	23X–27XI	10XI	30XI	19XII	27XI
Laying interval	13	2.8 0.4	2–3	3	3	3	3
Laying – hatching interval							
First laid egg	8	30 ± 0.3	30–31	31	30	30	30.3 ± 0.6
Second laid egg	8	28 ± 0.7	28–30	29	30	–	29.5
Hatching interval	8	2 ± 0.7	1–3	1	3	–	2

TABLE 2 — Body weight (g) and appendage lengths (mm) of Southern Great Skua chicks of known age (days) reared by A) *three adults*, B) *two adults and* C) *two adults but hatched from eggs of heavier than mean egg weight.*

	At hatching[1]		10 days old		20 days old		30 days old		40 days old		50 days old	
	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD
Body weight												
A)	5	80.6±6.1	3	408.0±20	3	920.7±34	3	1462±19	3	1711±98	3	1818±67
B)	23	77.4±6.2	18	322.5±44	21	788.0±136*	14	1198±127**	16	1466±141*	16	1517±115**
C)	8	81.5±5.5	8	354.9±48	10	841.4±100	7	1268±93**	6	1537±134	8	1483±75**
Tarsus length												
A)	5	26.5±2.2	3	48.5±4.0	3	75.3±3.0	3	80.5±1.0	3	79.9±1.3	2	81.1±2.8
B)	23	27.1±1.3	18	46.8±2.5	19	66.6±4.4**	16	76.4±3.2*	15	80.1±1.9	14	79.1±1.5
C)	8	27.0±1.4	7	48.1±2.2	8	69.5±3.2*	6	78.6±1.8	5	81.0±1.9	6	79.3±1.7
Manus length												
A)	5	25.5±2.3	3	45.9±3.4	3	90.0±2.6	3	133.0±1.7	3	150.7±0.6	2	150.0±4.2
B)	23	24.2±1.2	15	42.6±3.8	19	82.2±12.3	16	120.0±8.4*	15	143.3±6.9	10	150.4±7.1
C)	8	24.7±1.3	8	45.6±3.1	8	90.4±5.7	6	126.7±2.5	5	145.2±7.3	3	155.7±7.5
Culmen length												
A)	5	18.2±0.5	3	28.0±0.2	3	38.8±1.6	3	47.9±0.1	3	52.3±1.9	3	53.8±0.5
B)	17	18.1±0.5	16	27.2±1.0*	19	36.5±1.8*	15	44.5±3.2	16	49.3±2.1	15	50.9±1.9*
C)	8	17.9±0.6	8	27.7±1.0	8	37.8±1.0	6	46.9±1.3	5	50.2±1.6	6	51.5±2.4
Longest primary												
A)		-		-		-	3	79.0±6.0	2	141.0±0	2	204.0±9
B)		-		-		-	16	70.1±1.9	12	123.5±19	10	174.8±20*
C)		-		-		-	7	82.1±11	3	145.1±9	4	174.0±26

[1] Within 24 hours of hatching. Data in A:B and A:C were compared using Student's t test * = $P < 0.05$ ** = $P < 0.01$

At one trio nest two chicks were reared, although only one individual was regularly caught for weighing and measuring. At the other two trio nests only one chick was reared: at one nest one egg failed to hatch; at the other, the younger chick died within three days of hatching. At duo nests the number of chicks in a brood does not affect the growth of chicks until after they are 40 days old (Williams, in press a). It was therefore considered valid to combine data from trio chicks reared in one- and two-chick broods and to compare them with similarly combined data from duo one- and two-chick broods.

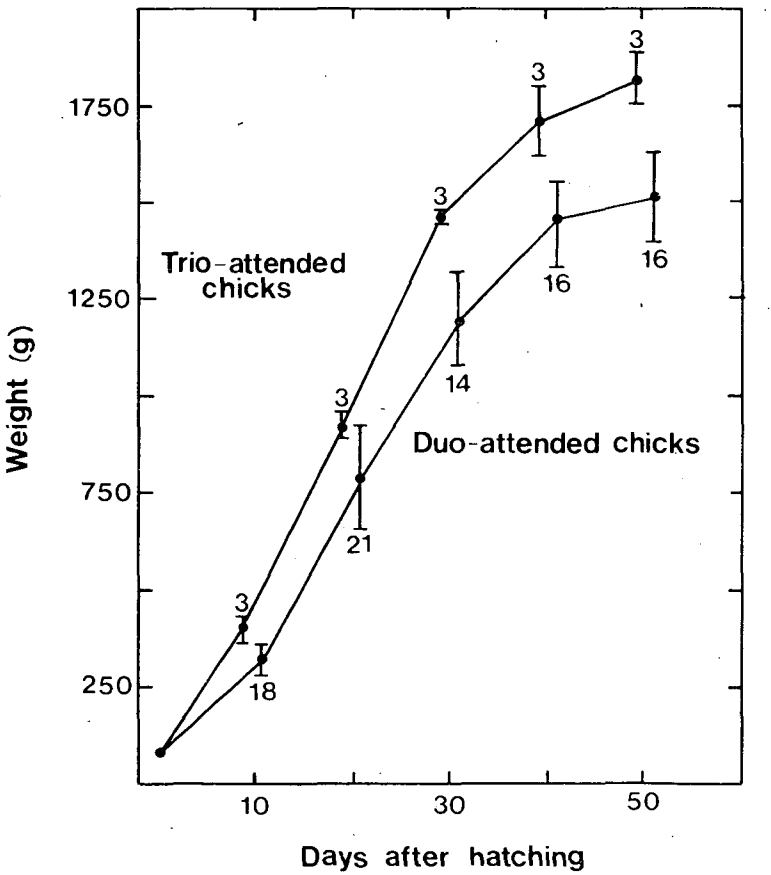


FIGURE 1 — Body weight curves for Southern Great Skua chicks attended by three and by two adults. Mean points are joined. Each bar represents one standard deviation from the mean. Numbers denote sample size. For clarity the data are displaced slightly with respect to the lower scale.

Trio chicks were significantly heavier than duo chicks at between 10 and 50 days after hatching (Fig. 1, Table 2), and the tarsus, manus and culmen measurements of trio chicks showed that these appendages were normally longer, sometimes significantly so, than those of duo chicks of the same age (Table 2). However, as skua chicks hatched from eggs heavier than the mean egg weight grow faster than those from lighter eggs (Williams, in press b), these differences might merely reflect the tendency for trio eggs to be relatively larger than duo eggs.

Growth of trio chicks was therefore also compared with that of duo chicks hatched from eggs of heavier than the mean egg weight (Table 2). This comparison showed that trio chicks were superior in weight to the duo chicks irrespective of the original egg-weight of the chicks. The difference in the weight and size of trio and duo chicks seems therefore to be directly related to the number of adults attending the chicks.

Breeding success at trio nests was not markedly different from that at duo nests: one of six trio eggs and four of 22 duo eggs failed to hatch: an egg mortality of 16.6% and 18.0%; and one of five trio chicks and three of 15 duo chicks died: a chick mortality of 20% in each case.

DISCUSSION

Attendance at the nest by three, rather than two, adults had a noticeable effect on only two of the studied aspects of Southern Great Skua breeding biology: the growth of the chicks and the timing of egg-laying.

The growth of chicks attended by three adults was faster than that of chicks attended by two adults, especially during the latter part of the chick-rearing period. At nests where two adults raised two chicks the chicks lost weight after they were 40 days old. At a nest attended by three adults at which two chicks were raised at least one of the chicks continued to increase in weight after it was 40 days old. Guthrie-Smith (*in* Young 1978) observed that all three adults attending a trio nest in New Zealand fed the chicks. The same situation probably applied to trio nests at Marion Island although, because the adults were not marked, this was not definitely known. Presumably, because three adults can obtain and present more food to their chicks, trio chicks receive more food and can therefore grow faster than those fed by only two adults. This difference will be most critical and so of most advantage to trio chicks in the latter stages of the chick-rearing period when the demands of the chicks are greatest and when the evidence suggests that two adults have difficulty in providing sufficient food for two chicks.

All the skua chicks whose growth was monitored and which survived until they were 40-50 days old were considered healthy and all probably attained independence. The appendage measurements suggest that there was no marked difference in size at this stage between

trio- and duo-reared chicks. The difference in weight, which was highly significant between trio and duo chicks at 50 days old (Table 2), is therefore likely to reflect body condition and food reserves rather than size. If this is so, trio-attended chicks should attain independence with considerably larger reserves and in better overall condition than those reared by two adults. This should lead to trio chicks having a better chance of survival in the period immediately following independence from the parents. The accelerated growth of the appendages of trio-reared chicks further suggests that the overall body growth is completed earlier, and that trio chicks may therefore attain independence in a shorter time than duo chicks.

Most skuas are absent from Marion Island in the winter, but adult birds return in August or September and most territories are occupied from late September onwards (Williams, in press a). Two of the trios studied reoccupied their territories at the same time as adjacent pairs. The third trio was late in occupying its territory, and eggs at this nest were the last of all eggs to be laid. The relationship between adults in trios is probably more complex than that between monogamous birds and this may result in delayed laying.

The number of trio nests studied was too small for firm conclusions to be made about the effect attendance by three adults may have upon the aspects of breeding biology studied here. The indications are that the effect may be greatest on the growth rate of the chicks. How typical this is, and the long-term effect this may have, will best be studied in the New Zealand region where the proportion of trio-attended nests is greatest.

ACKNOWLEDGEMENTS

Scientific research at the Prince Edward Islands is carried out under the auspices of the South African Scientific Committee for Antarctic Research. Financial and logistical support from the South African Department of Transport is gratefully acknowledged. I thank A. E. Burger and P. D. Shaughnessy for criticism of an earlier draft of this paper.

LITERATURE CITED

BARRE, H. 1976. Le Skua Subantarctique **Stercorarius skua lonnbergi** (Mathews) a l'Isle de la Possession (Iles Crozet). Comm. Nat. Fr. Res. Antarct. 40: 77-103.

BONNER, W. N. 1964. Polygyny and super-normal clutch size in the Brown Skua. Br. Antarct. Surv. Bull. 3: 41-47.

CULLEN, J. M. 1957. Plumage, age and mortality in the Arctic Tern. Bird Study 4: 197-207.

DERENNE, P.; MOUGIN, J. L.; STEINBERG, C.; VOISIN, J. F. 1976. Les oiseaux de l'isle aux Cochons, Archipel Crozet (46° 06' S, 50° 14' E). Comm. Nat. Fr. Res. Antarct. 40: 107-145.

LACK, D. 1968. Ecological adaptations for breeding in birds. London, Methuen.

STONEHOUSE, B. 1960. The King Penguin, **Aptenodytes patagonica**, of South Georgia. I: Breeding behaviour and development. Falkld. Is. Dep. Surv. Sci. Rep. 23: 1-81.

WILLIAMS, A. J. in press a. Aspects of the breeding biology of Subantarctic Skua at Marion Island. Ostrich.

WILLIAMS, A. J. in press b. Egg weight variation and its effect on the breeding biology of the Great Skua. Emu.

WILLIAMS, A. J.; SIEGFRIED, W. R.; BURGER, A. E.; BERRUTI, A. 1979. The Prince Edward Islands: a sanctuary for seabirds in the Southern Ocean. Biol. Conserv. 15: 59-71.

YOUNG, E. C. 1978. Behavioural ecology of **lonnbergi** skuas in relation to environment on the Chatham Islands, New Zealand. N.Z. J. Zool. 5: 401-416.

ANTHONY J. WILLIAMS, *FitzPatrick Institute, University of Cape Town, Rondebosch 7700, South Africa.*

SHORT NOTES

INLAND BREEDING OF BLACK-BILLED GULLS IN SOUTHERN HAWKES BAY AND NORTHERN WAIRARAPA

Throughout the 1960s, varying numbers of Black-billed Gulls *(Larus bulleri)* were seen on the bed of the Manawatu River between Dannevirke and the Manawatu Gorge. During the 1970s, these gulls have bred, several times at least, on this stretch of the river and also in the Pahiatua district further south.

The small North Island population of the Black-billed Gull breeds wholly on the coast, except for a few on the southern shore of Lake Rotorua. On 29 January 1969, however, I found a small colony with 7 nests and 11 half-grown chicks at the mouth of the Waimarino River at the southern end of Lake Taupo between Motuoapa and Turangi. I have not seen them there since, but they may well have bred elsewhere in the district, where there are few observers. Records in *Notornis* over the years show that the Black-billed Gull breeds usually at estuary mouths from Gisborne to Porangahau and in recent years in the eastern Bay of Plenty and at Miranda, Firth of Thames. These breeding sites are more characteristic of the Red-billed Gull *(L. novaehollandiae)*.

The following are, as far as I am aware, the first North Island records of the Black-billed Gull breeding on inland shingle riverbeds in the manner of the gull's main population in the South Island. Many hundreds of Black-billed Gulls from the South Island spend the winter on the Manawatu/Wellington west coast and at Lake Wairarapa. Are these new colonies, then, offshoots of South Island birds or of those that breed on parts of the Hawkes Bay coast?

This inland breeding may now be regular. To draw attention to it in case it becomes more widespread on the suitable rivers of the eastern and southern North Island, these notes are brought together to record such events as are known.

On 18 November 1972, during a survey for dotterels, H. Elder and S. Quin found a small colony on the Manawatu River near the Ballance bridge east of the Manawatu Gorge. The colony contained 30 nests, mostly with 2 eggs. On 16 December, L. Gurr and S. Quin counted 32 empty nests, 6 nests with 2 eggs either infertile or hatching, some 30 chicks, and 55 adults.

In late October 1975, R. L. Cotter of Ruawhata recorded a colony on an island in mid-stream of the Mangatainoka River, about 3 km upstream of the Pahiatua bridge. No notes were kept. When a similar colony was reported in October 1976, the site was visited on 18 October by R. N. & S. D. Cotter and M. L. Falconer but all nests had been destroyed by floodwaters. On 1 January 1978, R. L. Cotter

recorded 10 empty nests, 4 eggs, and 2 dead chicks. Other chicks were probably present because the adult gulls were aggressive, many arriving from further downstream. Pied Stilts *(Himantopus leucocephalus)* were nesting on the same mid-stream island. On 8 January, the Cotters, M. L. Falconer, and A. Gollop found 14 empty nests, 1 nest with 2 eggs, and 1 with a rotten egg, 8 large downy chicks and 16 adults on the same island in the Mangatainoka River, together with nesting stilts.

On 28 October 1976, L. Gurr counted up to 60 adults at the Pahiatua sewage ponds, finding 3 empty nests and 11 with eggs. On 26 September 1978, R. N. & S. D. Cotter counted over 200 Black-billed Gulls at the Pahiatua sewage ponds and on 16 October found 17 nests, 26 eggs, and 41 birds in one of the ponds, which was empty except for seepage water.

On 7 December 1977, a colony was found by J. R. Drake and M. R. Menzies on the riverbed at Oringi, about 10 km south of Dannevirke, with 20 nests, 33 eggs, and 41 adults. This colony was destroyed by an unknown cause (not flooding), but on 21 December a second, larger colony was found several kilometres downstream at Kumeroa with 80 nests, about 27 small chicks and over 100 eggs. On 29 January 1978, over 60 chicks were thought to have been successfully raised, and on 11 February R. A. Creswell and S. Creswell (nee Quin) found only 19 juveniles and 18 adults still present.

Floods in November and December 1978 prevented a thorough search of the riverbed, but on 20 January 1979 a colony was found about 5 km upstream of the 1977-78 site by V. Kappely of Woodville. There were 60-70 adults and 80-90 chicks, some still downy, others almost full fledged. These were watched for 3 weeks, and when last seen on 9 February by M. R. Menzies, had moved about ½ km downstream. About 80 chicks were thought to have been successfully raised.

In the 1979-80 season, the gulls again occupied the Kumeroa site of 1977-78. On 6 December M. R. Menzies and I counted 26 nests and 48 eggs. Pied Stilts (6 nests and 15 eggs) were on the same island and two Black-fronted Dotterels *(Charadrius melanops)* seemed to be breeding in the area. On the same day, we found a smaller colony at Oringi, containing 14 nests and 20 eggs, on the same site as the ill-fated colony of December 1977. Again this colony was destroyed by an unknown cause within a few days of its discovery.

Unfortunately, a flood on 28-29 December destroyed the Kumeroa colony, though 12 downy chicks were just mobile enough to survive. They were last seen on 30 December, 29 adults still being present. On 29 January 1980, no nests, chicks or adults were seen.

A flock of 80-100 non-breeding birds was seen on 16 December 1978 on the aero club's field just south of Dannevirke, and varying

numbers have been seen throughout the 1978-79 and 1979-80 summers near the new Dannevirke sewage ponds.

I am grateful to R. N. Cotter, S. Creswell and L. Gurr for permission to include their observations.

J. R. DRAKE, *170 High Street, Dannevirke.*

★

ARCTIC SKUAS CHASE WADERS AT MIRANDA

On the morning of 7 October 1979 at about 0720 hours I was at the Old Limeworks at Miranda, Firth of Thames, watching two Spur-winged Plovers *(Vanellus novaehollandiae)* in the company of about ten Pied Stilts *(Himantopus leucocephalus)*. They were feeding on the fringe of a small pool near the seashore.

Looking northwards I saw two skuas silhouetted against the low sunlight. I watched them through my telescope (20-45x) as they chased White-fronted Terns *(Sterna striata)* but was unable to identify them. They left the terns and flew towards me and I switched to binoculars (8x30) as they came closer. They crossed the far side of the pool about 10 m away, flushing two or three stilts. As they flew above me I had an excellent view of both birds. One was completely dark, the other having a collar of yellowish streaking, and each had sharply pointed tail-feathers projecting about 3 cm from the rest of the rounded tail, marking them as Arctic Skuas *(Stercorarius parasiticus)*.

They circled around the pond again, and as I watched, the paler bird swooped on a rising stilt. As it was hit, the stilt was jolted and I saw two white feathers come floating down, but its flight was not visibly affected. Because of the position of the stilt's body and the speed of the action I did not see what the skua had struck the stilt with.

Hearing the loud calling of a Spur-winged Plover behind me I turned to see the darker skua pursuing it over the shellbanks parallel to the shore for about 20 m and then out to sea. The other bird followed soon after, and I did not see any other skuas that day. I understand that there are very few records of skuas chasing other birds over land in New Zealand.

IAN SOUTHEY, *R.D. 3, Pukekohe.*

★

SEASONAL FLUCTUATIONS IN THE NUMBERS OF BAR-TAILED GODWITS ON NELSON HAVEN

The flock of Bar-tailed Godwit *(Limosa lapponica)* on Nelson Haven uses the salt flats on either side of Sewerside Drive as a high tide roost. During spring tides all the birds are found in this area as they have a preference for soft ground. Only once have they been seen on the Boulder Bank at spring tide and that was because of

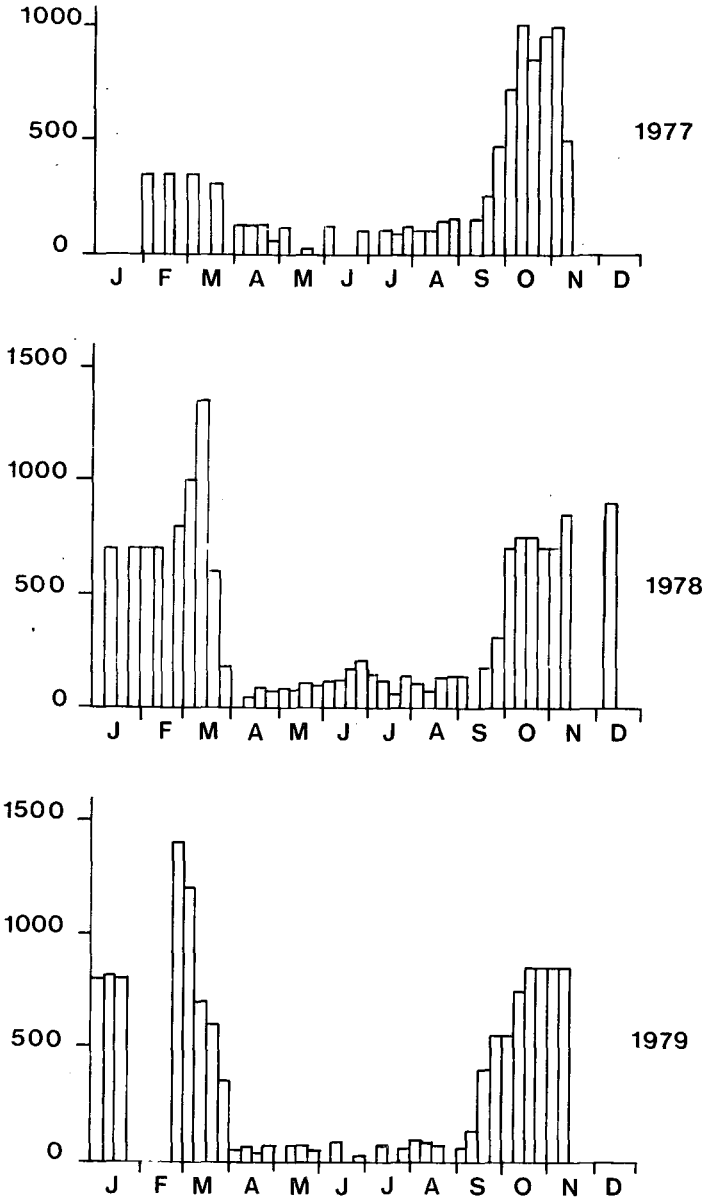


FIGURE 1 — The maximum number of Bar-tailed Godwit observed in Nelson Haven each week.

interference in their usual roosting areas. Occasionally on neap tides some godwits roost on small promontories round the Haven, and during heavy rains they move into the paddocks north of the Haven.

From February 1977 to October 1979 observations have been made several times a week throughout the year and almost daily during the spring and autumn migrations. Figure 1 graphs the highest count made during the four eight-day periods each month. The lack of a bar for a particular period signifies that counts were not made. The Nelson Haven flock reaches its New Zealand summer peak of some 800-900 birds during October and then does not vary to any marked extent until the autumn. In 1978 the first birds with breeding plumage were noted on 27 January and on 17 January in 1979.

In both 1978 and 1979 the flock numbers doubled briefly in early March and late February respectively. This increase of some 800 birds may have been missed in 1977 when observations were not so frequent. On 10 March 1978, more than 800 godwits flew up the Haven in four separate flights and joined the resident flock on the high-tide roost. The 1979 increase of some 600 godwits was accompanied by almost 100 Knots, many in breeding plumage. In both years, these extra birds had moved on in 2 or 3 days, and from then till the end of March the numbers decreased by 20 to 100 every day or so.

It seems probable that these dramatic increases are due to birds from the southern estuaries making a short stopover during their northward migration — however, a similar increase has not occurred during their return south in spring. Winter numbers fluctuate considerably, suggesting some movement between the Haven and Waimea or Motueka estuaries. An occasional coloured bird appears during winter, and in 1978 there were six noticeably coloured until the end of June.

The date of the spring increase has varied slightly over the three years. In 1977 the highest winter number increased by some 20 birds on 24 August — a bird with some colour was seen on the 30th. On 29 August a Curlew Sandpiper *(Calidris ferruginea)* with fading breeding plumage also appeared. In 1978 the increase was noted on 24 September and on 14 September in 1979. Each year there has usually been a daily increase until mid-October when they reach the summer number. The early increase in 1977 suggests that these birds may have been over-wintering on the northern estuaries and were experiencing an urge to fly south (Beth Brown, pers. comm.).

It would be interesting to know if the large sudden increase in Bar-tailed Godwit numbers noted at the autumn migration has its counterpart on other estuaries.

J. M. HAWKINS, *772 Atawhai Drive, Nelson.*

A GREAT KNOT IN MANUKAU HARBOUR

At Karaka shellbanks, Manukau Harbour, on 18 March 1979 while I was watching waders with M. S. Field and C. R. Veitch, my attention was taken by a medium-sized plump bird resting apart from others on a bank. Its in-between size and glimpses of its longish bill puzzled me until, as the tide fell and birds began to bathe, preen and feed, it flew showing white rump and white wing-bar and alighted in front of a flock of Lesser Knots *(Calidris canutus)*. Its identity then became clear, when observed in conjunction with the smaller birds. It was a Great Knot *(C. tenuirostris)*.

After a muddy stalk I was able to watch it closely through my x 15-60 telescope. It fed head down facing me, showing a very heavily streaked crown and mantle. The breast was so heavily spotted as to appear almost black, and there was some less dense spotting on the flanks. The remaining underparts were white. The back was grey, the short legs dull yellowish green, and the longish bill was slightly decurved towards the tip. The feeding action was very similar to that of the Lesser Knots. This bird was still present on 1 April 1979 when it was resting in a line of Least Golden Plovers *(Pluvialis fulva)* and Lesser Knots.

Great Knots are seldom seen in New Zealand, the first occurrence being in October 1967 (Andrew, *Notornis* 15: 207-210) at the Manawatu Estuary. Single birds were recorded in the Firth of Thames in March 1971, September 1972, and March 1973, with a pair there in February/March 1972, while a single bird was seen at Karaka in April 1972 (Class. Summ. Notes, *Notornis* Vol. 19 & 20).

BETH BROWN, *39 Red Hill Road, Papakura.*

★

WHITE-WINGED BLACK TERNS, NAPIER 1972

The following records belatedly the unusual build-up of White-winged Black Terns *(Chlidonias leucopterus)* that occurred at the Ahuriri Lagoons at Westshore, Napier, in the late summer and autumn of 1972; it also records the few notes we kept at the time.

In 1971, only one bird was present, from early February to late March, the last record being 20 March. It frequented the Harbour Board Marsh on the south side of the outfall channel. It was feeding on both 7 and 27 February along the muddy edge of the marsh, its bill straight down as it dipped and rose close to the water. On the 7th, when it reached a certain point it would climb well up into the wind, return at a height to the starting point, and then repeat the feeding method. It did this five or six times before coming to rest on a piece of board. After a short rest, it fed again, followed by

another rest. On the 27th, instead of rising into the strong wind and returning to its starting point, it merely turned and fed back low down, dipping and rising. It landed on the board with two Red-billed Gulls *(Larus novaehollandiae)*. Later, while resting on the bank, it made a threatening move toward a Red-billed Gull that walked past by stretching its neck and bill toward it. We described the bird's wings in flight as being fawn, paler in the centre and with a black edge on the secondaries. At rest, its bill was thick and blackish, the legs short and black, the head white with a black patch behind the eyes and a well-defined blackish line over the head, the breast and belly white. On 20 March, we saw the bill as red when the bird flew over us several times. As well as feeding low over the water as usual, it fed high up, apparently catching insects bigger than midges that were swarming about in whirling masses.

In 1972, our first sighting was of 5 birds on 3 January; 4 were over the Westshore ponds and one on the Harbour Board Marsh. On 22 January, 6 were at first on the ponds but later at rest together on a sand flat on the marsh. They did not rest long as some began moving about, waddling rather like pigeons on their short legs. They seemed to be taking food from the *Salicornia* plants and snapped their bills at any Pied Stilts *(Himantopus himantopus)* passing too near. We noticed a shallow tail-fork in flight. Their heads had a black band over the top from ear to ear and another down the back of the head. On 6 February, we found 6 together at the ponds; one was perched on a fence post, and the others were on the ground preening. Their heads looked black with a wide black line down the back of the neck. One flew and began hovering a metre or less above the water; it made a gentle splash dive and came up with a tiny fish; three more dives were unsuccessful. On 12 March we saw only one at the ponds.

On 15 April, during a census of waterbirds on the Ahuriri wetlands by Hawkes Bay members of OSNZ, we saw a total of 13 White-winged Black Terns spread out over the water upstream of the pump-house. Two were in full breeding plumage, the head and body black, the tail white, the wings dusky white above and black below with about 3 cm of white edge. Nine others had beginnings of black under the wings and were altogether darker grey than the birds seen on other occasions. The last two, seen well up the channel, were darker grey again but not black.

The final sighting was of 2 birds at the Harbour Board Marsh on 13 May 1972. Both were greyish white and therefore apparently different birds from the 13 of 15 April.

KATHLEEN TODD, *2/416E Heretaunga Street, Hastings;* JANET LLOYD, *St. George's Road South, R.D. 2, Hastings.*

WHY IS THE CHATHAM ISLAND FANTAIL *PENITUS*?

The scientific name of the Chatham Island Fantail is *Rhipidura fuliginosa penitus* Bangs 1911; and the significance of the trinomial still causes some perplexity, since Bangs nowhere explains why he chose it! The meaning of the common Latin adverb *penitus* with a short *e* is 'deep within' and its application in this context is hard to understand. The Chatham Island Fantail, far from being found 'deep within' New Zealand is, in fact, 'far without'; that is, some 400 miles east of Bank's Peninsula. Accordingly, Helen Oliver has suggested that Bangs' meaning was that " this race was smoky or dusky under the surface of the plumage." Does this not apply to all New Zealand fantails?

However, if the puzzling word is not *penitus* with a short *e* but *penitus* with a long *e,* it makes good sense, though the gender is wrong. With a long *e, penitus* is a rarely used adjective meaning 'tailed'; and derived from *penis,* which besides its more usual meaning, *membrum virile* as the dictionaries politely put it, originally meant 'tail'; for as Cicero says, *Caudam antiqui penem vocabant. Penitus* with a long *e,* therefore, is a synonym of the more widely used *caudatus;* and, if it was suggested by the conspicuously white tail of the Chatham Island Fantail, has the merit of aptness. This being so, since the gender of *Rhipidura* is feminine, *penitus* must be changed to *penita.*

It is curious that the marked subspecific differences of New Zealand fantails went so long unrecognised taxonomically. Yet when Hutton examined specimens taken in the Chatham Islands by Travers (1868-1871), he noted the purer white of the tail. It was left to an American taxonomist, Outram Bangs, in 1911, with only one skin for examination, to coin a name for the markedly distinct Chatham Island Fantail. Incidentally, in this designation the specific name *flabellifera* is mis-spelt *flabillifera.*

Then, after an interval of ten years, in a very terse announcement Bangs renamed the North Island Fantail *placabilis,* displacing the name *kempi* which had been already used for an Indian fantail. If Bangs wished to allude to the fearless curiosity of the North Island Fantail, his choice of the rather uncommon adjective *placabilis* is not wholly felicitous; for its basic meaning is not 'easily pleased' but 'capable of being placated'; and that implies not a 'wildness to be tamed' but a 'ferocity to be propitiated'. Did Bangs have a penchant for rare or unusual adjectives? Would not such simple descriptive words as *audax, confidens, amica* or even *amicissima* have served the purpose rather better?

All discerning visitors who have watched the Chatham Island Fantail on its native heath have no doubt about its distinctness. As Fleming remarked, " the white undertail was a conspicuous and constant feature in the field." While the tail may be marginally bigger, its whiteness may leave an exaggerated impression of size. Up in the

canopy of old and twisted ake-akes *(Olearia traversi)* on Pitt Island, a fantail's waving white tail inevitably attracted attention.

The isolation of the Chatham Island Fantail prompts speculation. If Kadavu, an island a mere 60 miles from Viti Levu, has bred a fantail, *R. personata,* which is so different from *R. spilodera* of the main Fijian islands that it has been accorded full specific status, why is the Chatham Island Fantail still a mere race ? Its closest kith and kin are a full 400 miles away. Do species evolve more quickly in the tropics ? Perhaps the cool winds of the Chatham Islands dampen evolutionary ardour. Or, should it be accepted as a full species ?

REFERENCES

BANGS, O. 1911. Proc. Biol. Soc. Washington. 24: 41.
BANGS, O. 1921. Bull. A.M.N.H. 44: 583.
FLEMING, C. A. 1939. Birds of the Chatham Islands. Emu 38: 506.
FLEMING, C. A. 1949. Pied Fantails. NZ Bird Notes 3: 188-190.
MAYR, E. 1945. Birds of the South West Pacific 139.
OLIVER, H. 1968. Annotated Index NZ Bird Literature. 182.

R. B. SIBSON, *26 Entrican Avenue, Remuera, Auckland.*

★

NOTES ON THE BREEDING OF THE BLACK-BELLIED STORM PETREL *(Fregetta tropica)* ON BIRD ISLAND, SOUTH GEORGIA 1973/1974

A nest site of the Black-bellied Storm Petrel *(Fregetta tropica)* was accidently found by R. Burton on Bird Island (54°00'S 38°00'W), South Georgia, during the austral summer of 1971/1972. During the 1973/1974 season, while I was on Bird Island working for the British Antarctic Survey, Cambridge, I found the same site occupied and made several observations which add to our sparse knowledge of this species. Previous work on the species is reported by Beck & Brown (1971).

The burrow entrance faced the south by the main stream coming from Wanderer Valley and was a little above sea-level. A map of Bird Island is given by Tickell (1968). The narrow straight entrance tunnel entered a chamber, but because Burton covered it with a wooden lid, no account of the original size of the chamber can be given.

An egg was laid on 20 December 1973 and was placed on a small bed of tussock grass *(Poa flabellata)*. No adult was obviously present when the nest chamber was photographed on 22 December, though one may have been present in the entrance tunnel whose situation was not known at the time. An adult was incubating the egg on the next day.

The egg hatched 35 days later on 24 January 1974 (cf. Beck & Brown 40, 45, and 38 days), and the chick was alone on the following day. It was well feathered by 25 March and weighed 112 g. Three days later it weighed 96 g and on 31 March 87 g. The culmen was then 15 mm, the tarsus 39 mm and the wing 169 mm. On 2 April

it weighed 81 g, and the wing measured 171 mm. It left the site that evening, 69 days after hatching (cf. Beck & Brown, 65 and 61 days).

Contrary to Beck & Brown, whenever the site was examined neither the parents nor the chick was facing the entrance tunnel. Perhaps human noise had caused the birds to do so in their case. The adult's call was never heard. The chick called in its early days when handled.

REFERENCES

BECK, J. H.; BROWN, D. W. 1971. The breeding biology of the Black-belled Storm Petrel **Fregetta tropica**. Ibis 113: 73-90.

TICKELL, W. L. N. 1968. The biology of the grand albatrosses **Diomedea exulans** and **Diomedea epomophora**. Antarctic Research Series Vol. III. American Geophysical Union.

D. TURNER, *Libyan Higher Institute of Technology, P.O. Box 68, Brack, Libya.*

★

GIANT PETREL IN FIJIAN WATERS

At 1500 on 6 August 1979 at 18°23'S 177°04'E, which is some 22 n. miles from the south-west corner of Viti Levu, a Giant Petrel (*Macronectes* sp.) with uniformly dark plumage and a light bill followed in the wake of the ship for about ten minutes.

This sighting supports the hypothesis that Giant Petrels have a " maximum northerly extension of range during August " made by Jenkins, Cheshire & Nesfield in " Some data on the distribution of the Giant Petrel in the Tasman Sea and the South-west Pacific," *Australasian Seabird Bull.* 8: 12-19.

JOHN JENKINS, *14 Lochiel Road, Remuera, Auckland.*

★

TWO MORE GIANT PETREL RECORDS FROM FIJI

Giant Petrels (*Macronectes* sp.) have only rarely been seen in Fiji, King (1967: 104) knowing of only two records, one of which was that of the Morgans (1965: 158) who saw an exhausted immature bird near Suva on 22 August 1961. I am not familiar with the other record. Two more definite records of immature Giant Petrels were made in Fiji in 1979.

During the first week of July a dying bird was found at Natadola reef on the south-west Viti Levu coast by Mr Kaliova Segaturaga. A photograph of its body was printed in the *Fiji Sun* newspaper on 18 July 1979.

On 11 August 1979 Mr Ian Goodlet was shown an exhausted bird captured by villagers of Namara on Waya Sewa island, one of the southernmost islands of the Yasawa chain, which lies north-west of Viti Levu.

The handful of records to date suggests that there may be a movement of immature Giant Petrels through Fiji in July and August.

LITERATURE CITED

KING, W. B. 1967. Seabirds of the Tropical Pacific Ocean. Smiths. Inst. Washington DC.

MORGAN, B.; MORGAN, J. 1965. Some notes on the birds of the Fiji Islands. Notornis 12: 158-168.

FERGUS CLUNIE, *Fiji Museum, P.O. Box 2023, Suva, Fiji.*

FOODS OF THE LONG-TAILED CUCKOO

Little is known about the diet of Long-tailed Cuckoos *(Eudynamis taitensis)* except that they eat insects and are also predatory on lizards and on other birds and their eggs (Oliver 1955, *New Zealand birds.* Reed, Wellington). Recently I examined the stomach contents (proventriculus plus gizzard) of two Long-tailed Cuckoos, both apparently adult.

The first stomach, from a bird collected in Auckland on 2 March 1978, contained a hymenopteran (7 mm long), a fragment from a large harvestman (Opiliones), and 15 seeds of *Acaena* (Rosaceae). There were large deposits of abdominal fat suggesting preparation for migration. The second stomach, obtained from Hokitika (no date), held two hemipterans (10 mm long), 43 green cockchafer beetles (*Pyronota,* 9 mm long), and six seeds of *Trifolium,* probably *pratense* (Fabaceae). Also there were a few small stones (1-2 mm across) and a tangled knot of fibrous rootlets (15 mm across).

These observations confirm that Long-tailed Cuckoos eat various arthropods. The presence of seeds is interesting. Perhaps they were ingested accidentally, but this is not necessarily so since close relatives of the Long-tailed Cuckoo eat berries and other fruits (Meise & Schifter 1972. In *Grzimek's animal life encyclopedia* vol. 8. Van Nostrand Reinhold, New York).

I thank Mrs M. J. A. Bulfin for identifying the seeds, Mr P. M. Johns for checking the arthropods, and Prof. W. C. Clark for obtaining the cuckoos.

B. J. GILL, *Department of Zoology, University of Canterbury, Christchurch.*

★

FOOD OF LONG-TAILED CUCKOO

The gizzard contents of a Long-tailed Cuckoo *(Eudynamis taitensis)* which crashed into a window in Birkdale on 6/4/79, were sent to Dr Charles Watt of the DSIR. He identified them as follows:

Auckland weta *(Hemideina thoracica)* 1F, 1 nymph.
Katydid *(Caedicia simplex)* 1 adult.
Smooth stick insect *(Clitarchus hookeri)* 4M, 3F.
Prickly stick insect *(Acanthoxyla prasina)* 1F.

This list may prove useful to anyone investigating the food of insectivorous birds in New Zealand.

SYLVIA REED, *4 Mamaku Street, Meadowbank, Auckland 5.*

SEABIRDS OFF RAOUL ISLAND

On 31 October 1979, *Marama* called at Raoul Island to embark three members of a Lands and Surveys party. The vessel was within three miles of the island for about two hours, during which the following birds were seen. Wedge-tailed Shearwater *(Puffinus pacificus)*: in sight throughout, the highest number seen together 40+. Kermadec Little Shearwater *(Puffinus assimilis kermadecensis)*: in sight throughout, the highest number seen together 11. Black-winged Petrel *(Pterodroma hypoleuca nigripennis)*: one was seen near the island, with a total of five birds seen during the approach to and departure from Raoul. I had not seen any Black-winged Petrels in the South-west Pacific for some months and considered these birds to be the first returning migrants. Kermadec Storm Petrel *(Pelagodroma marina albiclunis)*: one seen about one mile off Hutchison Bluff, when the very light rump of this subspecies was noted. Masked (Blue-faced) Booby *(Sula dactylatra personata)*: four birds, all of which appeared to be in adult plumage, fishing between Raoul and the Meyer Islets. Sooty Tern *(Sterna fuscata)*: nine birds seen. White-capped Noddy *(Anous tenuirostris minutus)*: three seen. Grey Ternlet *(Procelsterna cerulea albivitta)*: five seen.

On leaving, when 11.5 miles from Raoul towards Auckland, a Godwit thought to be *L. lapponica baueri* overtook the ship. It was flying at about 200 feet and appeared to be on the same course as we were.

REFERENCE

MERTON, D. V. 1970. Kermadec Islands Expedition Reports: A General Account of the Birdlife. Notornis 17: 147-199.

JOHN JENKINS, *14 Lochiel Road, Remuera, Auckland.*

★

RELAYING OF NEW ZEALAND PIGEON

In January 1979 I was spending some weeks on Maud Island. On 4 January, when working close to the old homestead, I noticed a New Zealand Pigeon *(Hemiphaga novaeseelandiae)* picking up fine sticks from the ground, flying up to a tree lucerne and then some 20 metres to an unkept hedge of taupata and mahoe. On inspecting the site, I discovered the start of a nest which as yet had no shape. It was about 3 m from the ground and 6 m from the house.

On the following day the pigeon was carrying sticks with some urgency. The sticks appeared to be carried only by the female. The male was nearby and chased any other pigeon which came into the vicinity.

On 6 January an egg was in the nest, but it was precariously positioned at the edge. Later in the morning the pigeon had put the egg back into the centre, but about midday it was found broken on

the ground below the nest. During the afternoon the pigeon added the odd stick. The following day it appeared to have deserted the nest.

On 8 January the pigeon was back on the nest and was adding the odd stick. This activity continued until the 18th when increased urgency began again with the pigeon active to and from the nest.

The following day the pigeon was covering the nest most of the time, but there was no egg when the nest was checked in the evening.

On 20 January the bird was sitting tightly all day. Although several visits were made to the nest, the bird was always present and it was not possible to confirm that the egg was present. The behaviour indicated that it was most probably present. The following morning it was definitely present and incubation was proceeding.

On 22 January the nest was tilted at a very dangerous angle and the egg was ready to fall out. I made the nest safe by fixing some old wire-netting under it. Unfortunately I left the island on 26 January and was not able to follow the nest to completion. When the nest was inspected about two months later, however, it appeared to have been successful.

As the pigeon takes some 28 days to hatch and a further 45 days to leave the nest (Oliver 1955, *New Zealand birds,* A. H. & A. W. Reed), it is unlikely that two broods would be raised in a season. However the above observation shows that relaying can occur some 14 days after an egg is lost early in incubation.

BRIAN D. BELL, *Wildlife Service, Department of Internal Affairs, Private Bag, Wellington.*

★

AN OBSERVATION OF AGGRESSION AMONG N.I. KOKAKO IN PUKETI FOREST

During a wildlife survey of Puketi Forest, Northland, in November 1979 four North Island Kokako *(Callaeas cinerea wilsoni)* were attracted to a taped recording of local dialect. One pair of Kokako, which had been singing about 100 metres away, responded to the Kokako tape by quickly moving through the forest canopy to the source of the "new song." After observing this pair for about a minute in the upper understorey on this ridge site, I again played the tape. A third bird replied from an adjacent valley to the north and within a minute had joined the pair above me. All three birds were seen to perch close together. Although the dense upper understorey and canopy — predominantly kauri *(Agathis australis)* and tanekaha *(Phyllocladus trichomanoides)* at the site — made observation difficult, contactual behaviour was apparent. The birds were quietly mewing and chirring.

The tape was played for a third time and a fourth Kokako replied from the area to the north from where the third bird had

come. Shortly afterwards this last bird arrived on the ridge. All birds moved about quite quickly in the upper understorey and canopy for about 30 seconds. A fight then broke out between two birds. One gave a distress call, and with much flapping, both birds fell some 10 metres to the ground locked in combat. Bills, feet and wings all seemed to be used although one seemed to use its wings to slow both birds' descent to the ground (fairly ineffectively). Although they landed barely two metres from where I stood, both birds seemed not to notice me and continued fighting on the ground for 5 seconds before parting and leaping up through the understorey. The northern pair then moved off down the side of the ridge towards the north while the other pair remained, both birds singing.

The ridge used as my observation point may also have been a territory boundary for the two pairs. The threshold for aggression in one or both of the combattants may have been lowered because of the onset of breeding. It is also possible that the use of the Kokako tape may have elicited abnormal behaviour in the birds.

A. J. SAUNDERS, *Wildlife Service, Department of Internal Affairs, P.O. Box 1146, Rotorua.*

★

HONEYEATERS FEEDING ON *PSEUDOWINTERA* — A NEW RECORD

On 30 May 1979, in the Akatarawas, at the southern end of the Tararua Forest Park, Bellbirds *(Anthornis melanura)* and Tuis *(Prosthemadera novaeseelandiae)* were observed feeding simultaneously on the ripe fruits of the lowland horopito *(Pseudowintera axillaris)*. No records are in the literature of honeyeaters or other birds feeding on *P. axillaris* fruit, but McEwen (1978) reported that New Zealand Pigeons feed on the fruit of *P. colorata* (McEwen, 1978. The food of the New Zealand pigeon *(Hemiphaga novaeseelandiae novaeseelandiae)*. NZ Jour. Ecol. 1: 99-108). From 1030-1230 on a fine day the two honeyeaters intermingled in the canopy of a hinau-kamahi-rimu forest (*Elaeocarpus dentatus-Weinmannia racemosa-Dacrydium cupressinum;* c. 550 m). Mature birds of both species were observed to alight on the branches of horopito, an understorey tree, and to consume its fleshy orange-red pea-sized berries. The bellbirds fed rapidly, e.g. one mature bird of undetermined sex ate six fruits in a 10-second period. The bellbirds generally fed on berries from the same branch, often a thin upper one, on which they were perched. An adult male tui perched on a more robust lower branch (c. 1.5 m off the ground) and reached for fruit on nearby branches. The tui consumed 12 berries over a two-minute period.

The only other edible fruits present were those of stinkwood *(Coprosma foetidissima)* which are also small, orange-red and fleshy.

During my observation, the birds ignored the coprosma fruit, preferring those of horopito.

The mature berries of *P. axillaris* are insipid. However when unripe, the fruits have a distinct camphor-like taste. Camphor and related defence compounds are common in the Australian flora, where in unripe fruits they serve to prevent premature consumption. Perhaps this camphor-like property in the young fruits of *P. axillaris* similarly ensures against premature feeding by meliphagids, a primarily Australian group.

Pseudowintera is the New Zealand member of the Winteraceae, generally considered the most primitive extant flowering plant family. Little is known of the modes of seed dispersal in this ancient group and further reports will contribute significantly to the study of plant-animal co-evolution.

S. A. NORTON, *Botany Department, Victoria University of Wellington, Private Bag, Wellington.*

★

DESTRUCTION OF BLUE DUCK HABITAT

A classic example of how favourable habitat can be quickly eliminated occurred in Otago during the major flood of 2 December 1979. Torrential rain fell along the Main Divide, with peaks at certain localities (Mt Cook reported 21 in. = 533 mm in less than 24 hours). Evidently a similar concentration occurred in the catchment of the Young River (near Makarora, head of Lake Wanaka). The south-branch riverbed and enclosing walls were completely scoured out from above subalpine scrubline to the confluence with the Makarora (in altitude from 3200′ to 1000′ — 975 m to 305 m).

Beech trees, logs, limbs, silt and other debris were strewn throughout the valley, including in places several metres inside the forest margins where no such flooding has occurred for more than a century. This flood was even more disastrous in this region than that of October 1978.

The river boulders were completely abraded of growth — gone are all traces of the mosses and algae which harboured caddis larvae and other sub-aquatic invertebrate foods of the Blue Duck *(Hymenolaimus malacorhynchos)*. The river looks raw and sterile. No ducks could be found on 7 January 1980 where formerly there had been at least three in the upper reaches. This is a serious loss in view of the scarcity of Blue Ducks in Mount Aspiring National Park.

It will be of some interest to see how long it takes for the river to return to suitable feeding condition and whether any Blue Ducks then return to it.

PETER CHILD, *10 Royal Terrace, Alexandra.*

LETTERS

20 January 1980

The Editor,

Sir,

By one of those strange coincidences I have just come across some very recently published corroborative evidence for my observation on the brood size of the North Island Kokako (*Notornis* 26: 318-319). Westerskov (*Forest and Bird* 13-3, August 1979) incorporates a translation of an 87-year-old paper by Reischek. At page 8, quoting Reischek in translation, he says, 'The bird was nowhere abundant and was observed in pairs or families consisting of male and female and *three to four* young ones' (my italics). This recently resurrected observation agrees with my sighting of a family party of six birds. It would seem from Reischek's paper that he was fairly familiar with the bird in the wild, even to the extent of making soup out of them (p. 9)!

JOHN H. HATCH

15 Jeffery Street, Hawthorn, South Australia 5062.

5 February 1980

The Editor,

Sir,

Black-winged Petrel behaviour at new breeding sites

In reply to the points raised by Thomas (1979, Black-winged Petrels in the Far North, *Notornis* 26: 352), I can confirm that the behaviour described in his note was regularly noted at the newly colonised breeding sites on Lord Howe Island by myself and other observers during the colonisation processes (Fullagar, McKean & Van Tets, 1974. 'Report on the birds' in Environmental survey of Lord Howe Island. Eds H. F. Recher & S. S. Clark. Sydney: Australian Museum. 86 pp.). On the basis of a few collected specimens, there was no evidence that any of the birds colonising had previously bred, and while the aerial behaviour described certainly occurs after egg-laying in established breeding colonies, I do not know whether it is carried out then by established breeding birds or only by non-breeding birds. It seems highly likely that the petrels *(Pterodroma nigripennis)* will eventually attempt to breed at the areas where they have been displaying in northern New Zealand.

JOHN L. McKEAN

CSIRO, Division of Wildlife Research, PMB 44, Winnellie, N.T. 5789, Australia.

REVIEWS

The birds around us. New Zealand birds, their habits and habitats by Geoff Moon. William Heinemann (NZ) Ltd. pp. 1-206.

Those who bought this book at the Book of the Month price of $15.95 are lucky. Even at the increased price since then, it will be money well spent.

The brief foreward is by the late Sir Robert Falla. There are 357 colour plates, illustrating 107 species of birds, arranged in the sequence of the *Annotated Checklist of the Birds of New Zealand.*

Geoff Moon, veterinarian turned bird photographer, a man of almost infinite patience when he wants to photograph a bird, is already renowned in New Zealand and overseas for his bird pictures. He has kept his text to a minimum, but it is adequate to explain his superb photographs. If he should not publish another book — and I hope there will be many more from his pen and camera — this volume, as well as those which preceded, will be monument to the patience, devotion and skill of one of the world's best photographers. The production is superb.

Buy it if you can. If you cannot (and as I write, three leading Christchurch booksellers are sold out), borrow it. Enjoy it, and count yourself lucky that we have a Geoff Moon to do for our delight what many of us cannot do for ourselves.

— RON SCARLETT

Waterfowl: ducks, geese and swans of the world by Frank S. Todd. Sea-World Press. Harcourt, Brace, Jovanovich, New York and London. $US45.00.

The city of San Diego in southern California must surely be the most outstanding in the world for seeing animals in almost ideal conditions of captivity: there is its Zoo, its Wild Animal Park and its Sea World, each enlightened in concept, brilliant in design and enviable in its record of animal health and breeding success. And the range of species held by the three organisations as a whole is superlative: almost every family of vertebrate — terrestrial, freshwater, marine, polar, temperate, tropical; most things from whales to hummingbirds, and even some invertebrates as well.

By no means least among the collections is that of waterfowl at Sea World. Only the Wildfowl Trust at Slimbridge rivals it in comprehensiveness and setting; in fact, those responsible for its research and management programmes call the Sea World collection " Slimbridge West " — a humorously affectionate unofficial title that not only pays tribute to the Trust but pretty accurately reflects the scope, quality and philosophy of Sea World's achievements.

The creator and curator of all this (as the dust jacket neatly puts it) is the author of this book; and Frank S. Todd has done an excellent job. *Waterfowl* is large and lavishly illustrated and cannot help but remind you of Forshaw's *Parrots of Australia* in that it, too,

is big and glossy and relies on colour photographs to depict the species and subspecies it deals with. According to the author, every one of the world's approximately 150 species and 250 subspecies *is* dealt with; and although I must confess that I haven't unduly gone out of my way to verify this in the main body of the text (a pretty daunting task, especially when there are taxonomic hassles to keep in mind), it certainly is true of Appendix 1, which is a concise reference guide to *all* the world's waterfowl, arranged according to the systematic scheme of Delacour and Mayr, and which includes summaries of distribution, nesting and status, both captive and in the wild — a tour de force in itself!

With an average of about three pictures per subspecies (five per species) it is obvious that habitats and behaviours are illustrated too; though, to complete the matter of illustrations, I must say that one criticism I am sure I won't be alone in making is that far too many are too small to be decorative, let alone useful (some are little more than 5 sq. cm in area), though the colour reproduction is uniformly very good indeed.

Now for the text: there are sixteen chapters, one for every Tribe (except the Anserini, the swans and true geese, which quite properly has two), one for the screamers (which, according to Todd, are waterfowl's closest relatives), a general introduction, a survey of the classification of the Family (Todd sticks closely to Delacour and Mayr, though he admits the advantages of Johnsgard's reorganisation, which he gives), a survey of captive display, maintenance and propagation, and finally, a discussion of the future of waterfowl in our exploited world. There are two appendices — the one I have already referred to and another on photographing waterfowl. A glossary, selected bibliography and an index conclude this comprehensive book.

But how reliable is the text; or is the book just a pretty face destined to grace coffee tables already braced to bear such monumentals as *Parrots of the World, Rails of the World,* etc? With a work as compendious as this by an author so experienced, it would need a brave and knowledgable waterfowl expert to tackle Todd on his text as a whole, and so I have taken a non-random sample, the waterfowl fauna of New Zealand, to see how that measures up as an indicator of the rest.

Black Swan: Todd says they were introduced to NZ "175" years ago. This *could* be a misprint for "115", which is correct. He states that more than 100 000 once occurred on Lake Ellesmere. Well, that's possible I suppose but one wonders where the figure originally came from. He has no figure for the usual clutch size in this species but 5-6 would be a satisfactory figure for NZ.

Canada Goose: I'm a little surprised that the author hasn't ascertained that at least one subspecies in NZ is the Giant Canada Goose — *B. canadensis maximus.*

Cape Barren Goose: The date of introduction to this country (successful, that is) was 1914, certainly not in the "late 1880s". It would not be regarded as a NZ resident or even occasional vagrant at present.

Paradise Shelduck: A weight range for females is given, strangely none for males. The commonest clutch sizes would probably be 9 and 10 rather than 8.

Grey Duck: There is no mention of their occurrence at the Kermadecs, Chathams and Snares. The clutch size range of "5-13" does encompass the most common which is probably 10.

Grey Teal: No clutch sizes are given. The "New Guide to the Birds of New Zealand" states 5-9.

Brown Teal: Todd says they occur on "the Barrier Islands"; "Great Barrier" would be correct. His clutch size is "3-4"; "5-7" would be better. Full marks to him, though, for being right up-to-date with the rediscovery of the Campbell Island teal. He comments that in *A. aucklandica chlorotis,* albinism is "not particularly uncommon". Is it right to single out this form among NZ waterfowl to mention Oliver's comments on this point ?

NZ Scaup: Todd states they occur on the Aucklands and the Chathams; they do not; and strictly the species name is *"novaeseelandiae"* not *"novae-seelandiae".* No clutch size is given; the *New Guide* states "5-8".

As is usual with such things, one could quibble about the estimates of numbers Todd has quoted for the NZ populations of scaup, blue ducks and brown ducks; however, whether these are the "best" figures or not, the point is at least made that concern should be felt about such species.

Two more criticisms and I have done: *no* NZ author has been included in the bibliography; this is surprising and rather disappointing when one recalls how often this country and its waterfowl conservation activities are mentioned in the text. And the spelling of Grzimek is not "Grizmek"; though anglo-saxons may perhaps be forgiven for refusing to believe that a name can exist without a vowel in its first three letters.

Well, even if the New Zealand errors, none of which are major, were representative of the sections dealing with the faunas of other regions, Frank Todd's batting average is still probably at least as good as most compilers of tomes like this. As an "overview" (revolting vogue word !) of the world's waterfowl it can be heartily recommended for its comprehensiveness, lack of jargon and general attractiveness (though I, for one, prefer books to be no wider than they are long). If you are an anseriphile and can afford it, you'd be a goose not to add it to your collection.

G. R. WILLIAMS