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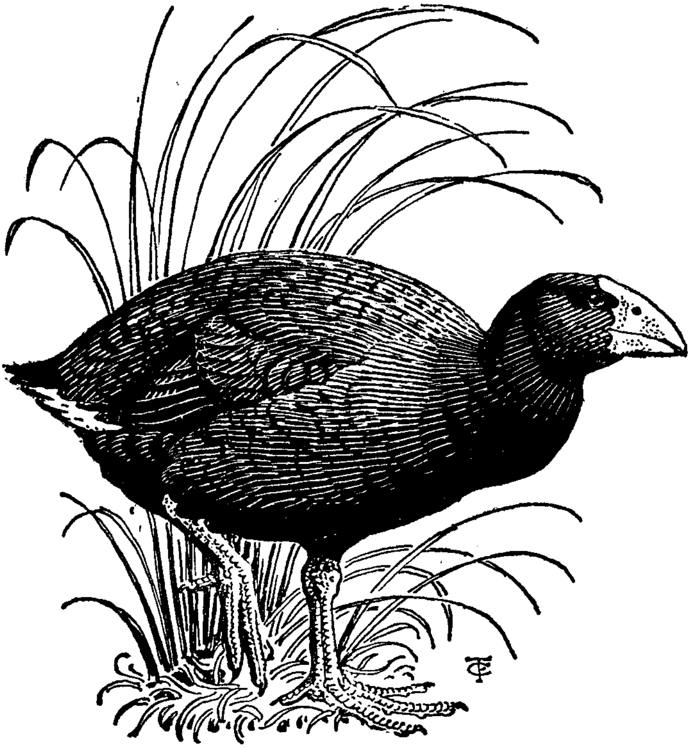

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COMMENTS ON THE IDENTIFICATION OF THE MAGENTA PETREL AND SIMILAR SPECIES

By D. W. EADES and A. E. F. ROGERS

In his reply regarding a sight record of the Magenta Petrel or Chatham Island Taiko *(Pterodroma magentae)* by Rogers (1980), Imber (1980) gave grounds for a re-identification of the bird as a Soft-plumaged Petrel *(P. mollis)*. He further stated that in his opinion an unusual petrel seen near the Chatham Islands by Roberts (1977) was in fact a Taiko. Although Rogers stated clearly that his record is open to speculation, the description and photograph of the bird seen by Roberts clearly preclude a further sight record of *P. magentae.*

The petrel described and photographed by Roberts shows several features that differ from those of *P. magentae.* Firstly, the undertail coverts were noted as " white mottled with brown, while the undertail was probably dark greyish brown or fuscous." These areas are evident in Roberts's photograph and appear as a large dark undertail area. Harper & Kinsky (1978) mentioned that *P. magentae* has " white undertail coverts " and showed them as such in their plate 18d. Secondly, Roberts described the underwing as " fuscous in the axillary and underwing coverts region, with an extensive sub-terminal white primary patch." He further stated that " at the base of the primaries, there was a series of alternating burnt umber, white and tawny areas giving a rather mixed colour pattern." Close examination of the photograph shows the large white primary patches and white greater primary coverts, the latter apparently with dark tips forming a dividing line across each wing patch, although somewhat obscured, possibly by reflection. In addition, some pale patches are evident on the median primary coverts. Most striking is the presence of large pale marginal and/or lesser covert areas (herein referred to as *marginal patches*) on the leading edge of the inner underwing, tapering outwards to near the carpal joint. In the photograph, these appear similar in colour to the white primary patches and are thus either very pale or white. Bourne (1964), describing the type of *P. magentae,* mentioned that the " underwing and axillaries are dark " and Harper & Kinsky concur. The illustration in Harper & Kinsky shows entirely dark underwing coverts, lacking pale primary or marginal patches.

Furthermore, a recent photograph of *P. magentae* in the hand, taken by R. N. Thomas at the Chatham Islands, confirms that *magentae* lacks any pale patches. The marginal, lesser and median coverts appear wholly dark grey and non-reflective, whereas the greater coverts and flight feathers are more silvery grey and reflective.

Roberts also mentioned that " in flight the short squarish tail was a prominent feature." Thomas's photograph of *P. magentae* shows that, viewed from the underside, the tail is obviously graduated, similar to that on skins of Grey-faced Petrel *(P. macroptera)* and Providence Petrel *(P. solandri).* This suggests that in the field *magentae* may show a relatively long, slightly wedge-shaped tail similar to *macroptera* and *solandri,* whereas the " short squarish tail " is closer to that of the Kermadec Petrel *(P. neglecta)* (DWE, pers. obs.).

Roberts made no mention of a dark thigh patch, a feature shown prominently in Thomas's photograph and also illustrated by Harper & Kinsky.

Imber suggested that the " lowering sun played tricks with the underwing pattern by causing reflections off the dark plumage," thus accounting for the white and pale patches described and shown by Roberts. The photograph clearly shows large white areas on the primaries and adjacent covert groups, together with a much darker, greyish area on the main underwing coverts tapering towards the body. The surrounding coverts and trailing edge are much darker again, and yet the pale marginal patches stand out on the leading edge of the wing.

Examination of skins and personal field experience of pterodromas with dark underwings have shown that, although much of the underwing can be highlighted, particularly the primary bases and greater coverts (often forming a pale line down the centre of the underwing), the almost non-reflective nature of the leading coverts (marginals, lessers and most medians) almost always forms the appearance of a thin dark contrasting line down the leading edge of the underwing, even in bright sunlight. For example, such an appearance was well demonstrated when DWE observed two light-phase Herald Petrels *(P. arminjoniana)* near Tahiti in June 1979, both birds showing strong reflection on all underwing areas except the narrow dark leading coverts. On occasion, these leading coverts may be subject to slight reflection (though still appearing as a dark strip), but this reflection is uniform across the area and would be unlikely to form the almost symmetrical, curving, pale marginal patches so evident in Roberts's photograph. Thus, even if the primary patches, central underwing coverts and surrounding areas were partly highlighted, the much darker leading coverts were not, and it must be concluded that the pale marginal patches were in fact present and not just a function of reflection.

Of the characters shown in Roberts's photograph, the combination of mainly white underparts and a dark underwing with white primary patches is sufficient to eliminate all *Pterodroma* species except *neglecta* and *arminjoniana.* The head pattern and dark undertail of Roberts's bird are features common to intermediate-phase plumage of both species, leaving only the underwing pattern to provide clues to the bird's identity.

The underwing pattern as depicted in Roberts's photograph is similar to that of an intermediate-phase *neglecta* photographed by Nakamura & Tanaka (1976) in having large white marginal patches and divided white primary and covert patches. The latter feature was also noted by DWE on light- and intermediate-phase *neglecta* (identified by white primary shafts) seen some 700 km east of the Kermadec Islands in May 1979.

P. arminjoniana also exhibits large white marginal and divided white primary and covert patches, as shown in a light-phase bird photographed by Warham (1959, Plate 14, Fig. 3). It differs from *neglecta* in having white bases to the greater coverts which form a tapering line extending from the primary coverts inwards to near the body, close to the trailing edge of the wing (see Harper & Kinsky). The greyish tapering band on the main coverts of Roberts's bird is suggestive of *arminjoniana* but perhaps not pale or clear enough to eliminate the possibility of reflection.

On the evidence given above, we conclude that the petrel seen by Roberts was not *P. magentae.* We believe that it was more likely *neglecta* or *arminjoniana,* as Roberts himself suggested, but given the available information, a definite identification cannot be reached.

As is evident from Imber's discussion, *P. magentae* and *P. mollis* are likely to be confused and we here summarise the main points for differentiating between these two species at sea. Harper & Kinsky give the length of *mollis* as 33 cm and that of *P. macroptera,* a key comparison species in the New Zealand area, as 41 cm. Crockett *(in litt.)* states that *magentae* is about 38 cm long, and it is thus roughly intermediate in size. Both *magentae* and *mollis* have dark slate-grey underwings. However, *mollis* also shows some white on the leading edge as a marginal patch. This is illustrated for light-phase birds by sketches in Harper (1973) and in Harper & Kinsky, and is just evident in a photograph given by Sinclair (1978, Fig. 3). The prominent dark thigh patch of *magentae* is lacking in *mollis* (Sinclair, Fig. 3) and could prove to be a useful feature at close range. Other points include the more uniform, darker grey upperparts and throat of *magentae,* whereas *mollis* has a white throat and narrow dark collar (occasionally meeting in the centre of the breast). As noted by Imber, an appreciation of throat and collar patterns depends on good light conditions.

Finally, we urge observers to take field notes of a bird's " jizz " (a European term denoting distinctive structural appearance), particularly the wing-tail shape and proportions. Points to note include the degree of curvature shown by the leading and trailing edges of inner and outer wings, how far the carpal joints are held forward and the outer wing is swept back, and the shape and length of the tail. Head shape and body bulk are also important. Note that a bird's shape is likely to vary with changes in flight attitude, and these should be watched for so as to gain an overall impression of jizz. A quick sketch is often the most convenient way of recording such information. Recent experience in the Pacific by able observers has shown that some difficult *Pterodroma* species-pairs have quite distinctive jizz characteristics. In normal gliding flight, both *P. mollis* and *P. macroptera* hold their wings cocked well forward in a curve to the carpal joints, the outer wings being swept back.

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FIRST SIGHTINGS OF THE NORTH ATLANTIC (CORY'S) SHEARWATER *Calonectris diomedea* (Scopoli, 1769) IN AUSTRALASIAN SEAS

By GEOFFREY A. TUNNICLIFFE

ABSTRACT

The first sightings of the North Atlantic (Cory's) Shearwater, *Calonectris diomedea* (Scopoli, 1769), in the Australasian region were made 47-78 km off the Canterbury Bight on the east coast of the South Island, New Zealand. These birds were probably vagrants, and the species may also occur sporadically in Australian waters.

INTRODUCTION

The North Atlantic Shearwater *(C. diomedea)* has previously been recorded from the Australasian region only as a single dead specimen washed ashore in January 1934 near Foxton on the west coast of the North Island (40°27'S, 175°7'E) (Oliver 1934). This paper reports observations of *C. diomedea* from a research fishing vessel at sea off the Canterbury Bight on the east coast of the South Island on 7-9 June 1979.

From 27 May to 9 June 1979 I was on the Ministry of Agriculture and Fisheries research fishing vessel, the *W. J. Scott,* during a deepwater aimed trawling programme (ATP 13 project 9/1979) off the east coast of the South Island, an area where little information is available on the species composition, abundance or distribution of seabirds (see Bartle 1974). The *W. J. Scott* fished during daylight hours on 29 May-3 June and 7-9 June. Oceanographic data were recorded by the ship's crew during tows. On the first section of the cruise I spent 44 hours observing seabirds, and on the last three days at sea (when North Atlantic Shearwaters were under intermittent observation) 26 hours. Binoculars (8 x 30 mm and 16 x 50 mm) aided identification.

RESULTS

The weather was fine (Table 1) during the sightings, which enabled me to follow the birds' movements and to take photographs through a 135-mm lens (see Figures 1-3).

Field observations

North Atlantic Shearwaters were watched on three consecutive days for about 1.5 hours. I estimate that four birds were in the survey area and that I saw them altogether on at least 20 occasions.

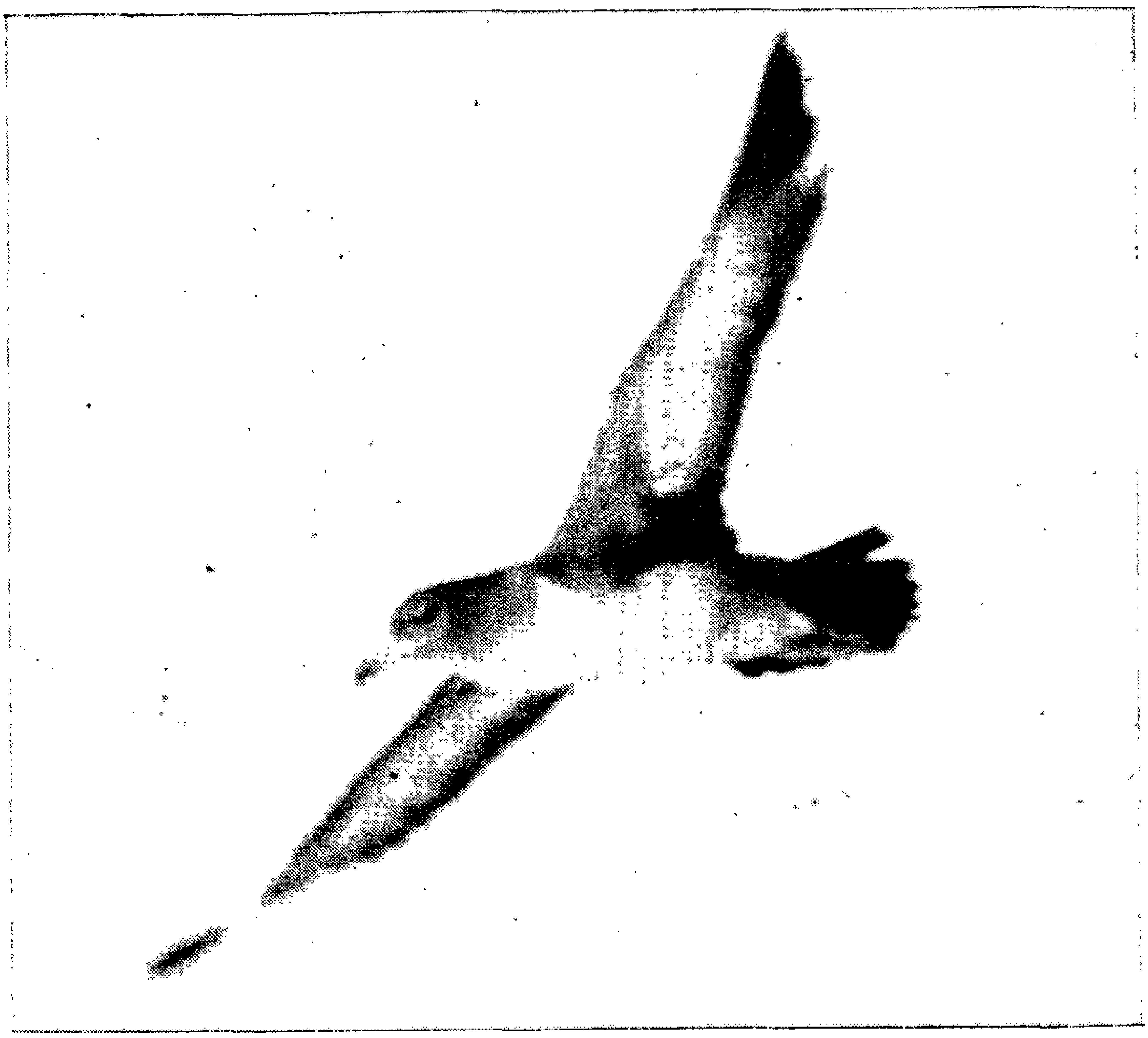

Figure 1: Note the inner underwing markings.

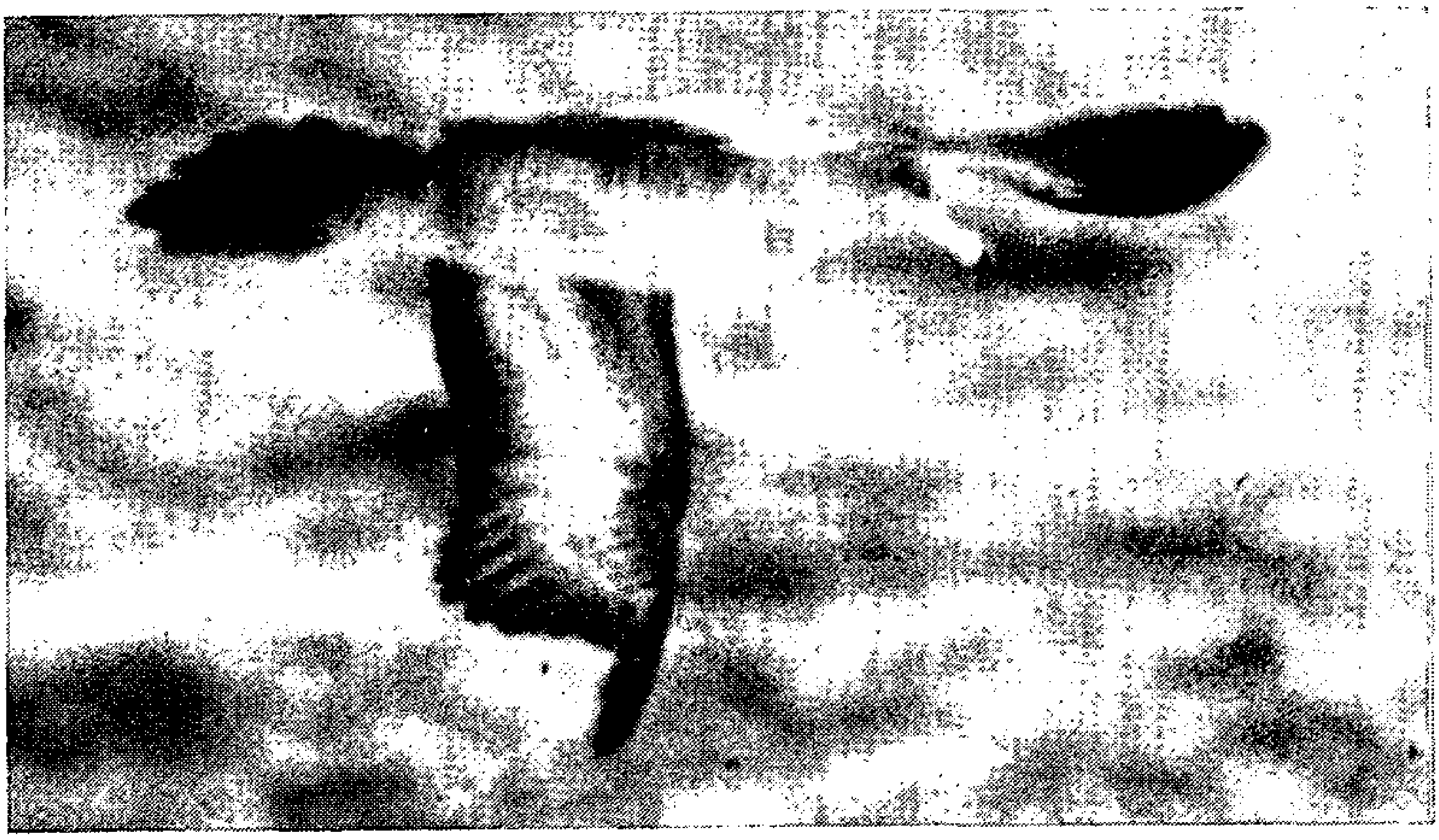

Figure 2: Note the barring on the neck and upper body.

FIGURES 1 & 2 — North Atlantic Shearwater **(Calonectris diomedea)** photographed in the Canterbury Bight, June 1979.

Photos: G. A. Tunnicliffe

The first single large shearwater was watched from 1325 h to 1345 h on 7 June 1979 at 44°41′ S, 172°29′ E (i.e. 51 km east of Waimate) as close as 6 m off the ship's stern. The following day a similar shearwater was seen at 1145 h at 44°17′ S, 173°17′ E (i.e. 78 km east of the Opihi River mouth), and from 1152 h to 1300 h, four further sightings were made. The birds' flight path was mostly confined to the ship's wake, where they often moved in twos. When about 20-30 m from the ship's stern they usually veered away 400 m or more behind the ship before rejoining it. Twice they fed on discarded offal 3-5 m from the stern. The ship was then about 47 km south-east of Akaroa Heads, the nearest to land the birds were seen. At 1050 h on 9 June 1979 a lone shearwater was seen briefly at 44°21′ S, 173°13′ E (i.e. 75 km east of Washdyke).

The first sightings provided limited opportunity for observation and photography and the following field information was assembled.

Description: Similar in size and appearance to the Grey Petrel *(Procellaria cinerea)*, but underparts of wings predominantly white. Back, throat and sides of neck, grey.

Behaviour: Unhurried effortless flight, gliding for long periods low over the sea with intermittent easy shallow wing-beats. The wings were held somewhat bowed, and the action was reminiscent of that of an albatross.

Closer observation and photography were possible on the four birds seen on 8 June, particularly when they fed on the ship's discarded offal. At close range the bill was pale yellow with a dark tip; feet light yellow; under surfaces of wing dark-edged; primaries dark with a hint of paler flecking on the back. In flight the wing tips dipped lower than the body (Fig. 2).

Colour photographs reinforced and extended the field description already assembled. Extra features recorded from the transparencies were as follows.

Underparts: Belly and centre of throat pure white; under tail-coverts white with some barring; rectrices, primaries and axillaries dark; leading and trailing margins of wings dark; dark band on trailing margin of wing uniform in width and merging with dark on remiges; feathers on patagium dark; anterior margin of wing between carpal

TABLE 1 — Oceanographic trawl data recorded on the fishing vessel W. J. Scott on Aimed Trawl Programme 13 Project 9/1979

Date	Sea surface temperature (°C)	Weather	Sea	Cloud	Wind direction	Wind speed (m.s^{-1})	Swell direction	Swell height (m)
7 June 1979	11.1	Fine	Moderate	2	SW	7.7	S	5
8 June 1979	11.0	Fine	Slight	1	NW	2.6	S	4
9 June 1979	10.7	Fair	Slight	7	SE	2.6	S	4

FIGURE 3 — North Atlantic Shearwater (centre) and Salvin's Mollymawk (**Diomedea cauta salvini**) on the stern wake of the **W. J. Scott.**

Photo: G. A. Tunnicliffe

joint and flight feathers a narrow dark border which narrowed and shaded into the dark flight feathers; dark on trailing margin of wing shading into lightly streaked central coverts.

Sides: Darker upperparts merged gradually with white underparts; sides of chin, lower neck, throat and upper body barred; lower flanks barred; lores and feathers around eyes mottled.

Upper parts: Forehead mottled; head, mantle and neck greyish brown; back darker sooty brown; primaries dark.

Identification

While at sea I tentatively identified the birds as North Atlantic Shearwaters from the photographs and description in Harper & Kinsky (1978). Comparison of my colour transparencies with study skins in the Canterbury Museum's collection (AV 1306, AV 1307) substantiated this identification, which was later confirmed by P. C. Harper, Peter Hayman (a British ornithologist well acquainted with North Atlantic Shearwater), and the OSNZ Rare Birds Committee. The birds could not be positively assigned to any one of the three subspecies of *C. diomedea.* It is likely, however, that they were either *C. diomedea diomedea* or *C. diomedea borealis,* subspecies which, according to Roux & Jouanin (1968), are inseparable in the field. The third subspecies, *C. diomedea edwardsii* can be distinguished by the darker coloration of its upper parts, its predominantly black bill, and its square-cut tail (Roux & Jouanin 1968), features which were not apparent on the birds I saw.

Two conspicuous features of the shearwaters seen, the markings on the inner underwing (Fig. 1) and the barring along the upper body (Fig. 2), are not noted or illustrated in several texts, e.g. Cramp & Simmons (1977) and Harper & Kinsky (1978). The Canterbury Museum's study skins confirmed the presence of barring on the lower neck but unfortunately the wings of these specimens are folded and fixed rigidly against the body, and so the plumage could not be fully examined. A suggestion of barring on the upper sides of the body is present in a sketch in Watson (1975, p. 143) but this is not clear because most of the body is concealed by the wing. An inner underwing pattern resembling that shown in Figure 1 is suggested in sketches of North Atlantic Shearwaters in Gibson-Hill (1976).

The plumage of the bird shown in Figure 1 is very like that of the Cory's Shearwater in Plate 20 of Roux & Jouanin (1968), which is photographed from a very similar angle. Noticeable differences are that in my figure the axillaries and upper sides of the body are dark, whereas in Plate 20 of Roux & Jouanin they are predominantly white but with a hint of dark on the plumage of the posterior flank. Roux & Jouanin, however, stated that Cory's Shearwater " never have dark markings on the axillaries or flanks." These discrepancies may in part be attributable to the position of the wing with respect to the sun, giving different patterns of shading in the photographs. Examination of a series of slides taken by J. Warham near the Salvage Islands of *Calonectris diomedea borealis* and discussion with P. Hayman convinced me that the underwing plumage markings shown in Figures 1 and 2 are within the range of variation of this species.

The birds reported here were probably prebreeders as the breeding season is from April to October (Zino 1971).

Discussion

Oliver (1934) predicted that the North Atlantic Shearwater may reoccur in New Zealand waters as he attributed its presence to prevailing mid-latitude westerly winds carrying the birds east from the Cape of Good Hope, where it had been occasionally recorded. Other records of Atlantic shearwaters and petrels in Australasian waters have also been attributed to these winds (e.g. Spencer 1962, Kinsky & Fowler 1973), and I believe this factor best explains the occurrence of North Atlantic Shearwater in New Zealand seas. Oliver's evaluation of North Atlantic Shearwater as a vagrant or straggler in New Zealand waters is therefore confirmed.

Although Mathews (1946), cited by Serventy *et al.* (1971), stated that the North Atlantic Shearwater's distribution includes south-western Australian seas, Serventy *et al.* (1971) noted that the birds have not been recorded in southern Australia.

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APPENDIX

Bird species recorded in Canterbury Bight from 29 May to 3 June 1979 and on 7-9 June 1979

Oceanic species

Wandering Albatross	**Diomedea exulans**
Royal Albatross	**D. epomophora**
White-capped (Shy) Mollymawk	**D. cauta cauta**
Salvin's Mollymawk	**D. c. salvini**
Black-browed Mollymawk	**D. melanophrys**
Buller's Mollymawk	**D. bulleri**
Northern Giant Petrel	**Macronectes halli**
White-chinned Petrel	**Procellaria aequinoctialis**
Westland Petrel	**P. westlandica**
Grey Petrel	**P. cinerea**
Sooty Shearwater	**Puffinus griseus**
Hutton's Shearwater	**P. huttoni**
Cape Pigeon	**Daption capense**
North Atlantic Shearwater	**Calonectris diomedea**
Fairy Prion	**Pachyptila turtur**
Storm Petrel	Species undetermined

Inshore species

White-flippered Blue Penguin	**Eudyptula minor albosignata**
Spotted Shag	**Stictocarbo punctatus**
Red-billed Gull	**Larus novaehollandiae**
Southern Black-backed Gull	**L. dominicanus**
Black-fronted Tern	**Sterna albostriata**
White-fronted Tern	**S. striata**

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SHORT NOTE

BIRD DISPERSAL OF *Pseudowintera* SEED

Since the publication of my note (Norton 1980, Honeyeaters feeding on *Pseudowintera* — a new record, *Notornis* 27: 99-100) that Tuis *(Prosthemadera novaeseelandiae)* and Bellbirds *(Anthornis melanura)* feed on the fruits of horopito *(Pseudowintera axillaris)*, I have received additional unpublished reports of birds feeding on *Pseudowintera.* I thank those who have allowed me to record their observations here.

Of particular interest is that the Stitchbird *(Notiomystis cincta)*, now severely endangered and restricted to Little Barrier Island, was seen in late March 1978 eating ripe fruits of *P. axillaris* along the Herekohu-Hauturu ridge at or above 2000 ft (M. J. Imber, NZ Wildlife

Service). Therefore, all three of New Zealand's honeyeaters are known to eat *Pseudowintera* fruit.

In late March 1980, I watched Silvereyes (*Zosterops lateralis,* recently self-established) feeding on *P. axillaris* fruits in a mixed podocarp/*Metrosideros robusta* forest, c. 100 m, Orongorongo Valley, Rimutaka Range. Faecal samples of two introduced species, the Blackbird *(Turdus merula)* and the Song Thrush *(Turdus philomelus),* also studied in the Orongorongo Valley, were found to contain *P. axillaris* seeds (B. M. Fitzgerald, Ecology Division, DSIR, Lower Hutt).

Yellow-crowned Parakeets *(Cyanoramphus auriceps)* have been seen feeding on *P. axillaris* fruit in Pureora Forest (J. Leathwick, Forest Service, Rotorua).

In addition to McEwen's (1978, The food of the New Zealand pigeon *(Hemiphaga novaeseelandiae novaeseelandiae), NZ J. Ecol.* 1: 99-108) report of the New Zealand Pigeon consuming the fruits of *Pseudowintera colorata,* Tuis were observed feeding on *P. colorata* on Mt Misery, Nelson Lakes National Park, at c. 1500 ft in a *Nothofagus fusca/ N. menziesii*/mixed podocarp forest (M. N. Clout, Ecology Division, Nelson).

In the " Pikiariki Rd. study area at Pureora Forest over the June/July period 1979, *P. colorata* comprised an average 6.4% of [the North Island Kokako *(Callaeas cinerea wilsoni)*] diet " (R. Hay, Internal Affairs, Rotorua).

There are no records of birds feeding on the fruits of the third species of *Pseudowintera, P. traversii,* a small shrub confined to a dozen or so high montane/subalpine sites in western Nelson. The berries of all three species are fleshy and contain several small (1-2 mm) seeds. *P. axillaris* has pea-sized orange-red fruits. *P. traversii* has pea-sized deep blue-black fruits and those of *P. colorata,* dark purple-black, are slightly larger.

Pseudowintera, endemic to New Zealand, is a member of the Winteraceae, generally regarded as the most primitive extant plant family. The fossil record of *Pseudowintera* goes back at least to Oligocene (c. 30-35 million years ago) (Fleming, 1962, New Zealand biogeography — a paleontologist's approach. Tuatara 10: 53-108), well before the probable arrival of birds to New Zealand in Miocene (c. 25 million years ago) (Fleming, 1962, History of the New Zealand land bird fauna. Notornis 9: 270-274). *Pseudowintera*-like pollen *(Pseudowinterapollis)* has recently been recorded as far back as the Cretaceous (Mildenhall and Crosbie, 1979. Some porate pollen from the upper Tertiary of New Zealand. N.Z. Journal of Geology and Geophysics 22: 499-508). Other plants (e.g. podocarps and *Myrsine*) with seeds or fruits suited for bird dispersal also occupied New Zealand before frugivorous birds were present. By what means were these seeds dispersed?

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BIRD DISTRIBUTION IN TONGARIRO NATIONAL PARK AND ENVIRONS — JANUARY 1982

By J. G. INNES, B. D. HEATHER and L. J. DAVIES

On 11-15 January 1982, on OSNZ field study course, based on accommodation at Erua, was attended by 47 people. The weather was fine and with only light winds throughout the five full days of field work. Effort was applied mainly to boosting the bird mapping scheme of the Tongariro National Park authority within the Park boundaries and on adjacent lakes, canals, and open country, and in forests geographically an integral part of the Park landscape. The water birds of southern Lake Taupo from Tokaanu Bay to Motuoapa were also studied.

The Spur-winged Plover *(Vanellus miles), the* Australian Coot *(Fulica atra australis)*. the Spotless Crake *(Porzana tabuensis)* and the Shoveler *(Anas rhynchotis)* were new species to the district, according to the combined Park/Massey University list we began with. However, the Spotless Crake and the Shoveler are not new in fact. B. D. Heather recorded several Spotless Crakes at Rotoaira in May 1974, as shown on the map in Bull *et al.* (1978), and R. W. Jackson, A. Palliser and G. Pearson (pers. comm.) recorded four Shoveler on Rotoaira on 1 July 1978. In general, the species seen and their abundance were largely as expected. However, the various habitat types of the Park and its surroundings are so extensive that a very fit group would need to spend many weeks before the exact status of some species could be really known.

Particular attention was paid to the distribution and breeding status of the Dabchick *(Podiceps rufopectus)* and the Banded Dotterel *(Charadrius bicinctus)*.

Course members noted with some concern that the part of the Erua State Forest east of Highway 4 and, above all, the Rangataua State Forest (now part of Karioi State Forest), which occupies most of Ruapehu's southern slopes, are not part of the Park. These forests, which may or may not remain in their present form, hold a more varied and abundant bird life than any part of the Park.

OPEN WATERS AND MARSH

All open waters in the district were visited, including Lakes Rotoaira and Rotopounamu; the 7-year-old hydro lakes Te Whaiau and Otamangakau and their associated canals; the Tongariro mountain lakes; the Tama lakes; the twin lakes of the Rotokuru Ecological Area in Karioi State Forest; the Rangataua lakes near Ohakune; Lake Otamataraha near Karioi; as well as the sewerage oxidation ponds at

Tokaanu and Ohakune, and Tokaanu Bay and Motuoapa on Lake Taupo. Access to the hydro lake Moawhango, near Waiouru, was refused by the Army.

In general, the open waters south of the mountains were of little interest, except that the Ohakune sewerage pond held a large flock of Paradise Shelduck *(Tadorna variegata),* seen elsewhere on the hydro access road to the Whakapapa River (21 birds), at Erua (4) and on a farm pond at Horopito (13). The hydro lakes had little cover on their margins, being suited mainly to Black Swan *(Cygnus atratus)* and the hybrid Grey x Mallard Ducks *(Anas platyrhynchos* X *superciliosa)* now so commonplace on New Zealand waters and facetiously but rather more accurately called " Grallards " by NZ ornithologists. A surprising number of Pied Stilts *(Himantopus h. leucocephalus)* were using these lakes, but apart from 2-3 juveniles, there was no sign that they may have bred there. Stilt numbers were 14 at Te Whaiau and 120+ at Otamangakau; elsewhere were only 18+ at Rotoaira. Otamangakau held the only flock of Shoveler (45), elsewhere seen only at Rotopounamu (1) and Tokaanu (10). The stark straight margins of the hydro canals between Te Whaiau and Rotoaira were not suitable for water birds, except for some Pied Stilts and Banded Dotterels at the exit from Otamangakau and two pairs of New Zealand Scaup *(Aythya novaeseelandiae)* near the entry into Rotoaira.

The stable levels and well-vegetated margins of Rotoaira, Rotopounamu, Rotokuru and Taupo make these lakes very suitable for water birds. The Spotless Crake was recorded at five well-spread localities on Rotoaira. The New Zealand Scaup was common on Rotoaira (410 + 4 ducklings), Tokaanu Bay (27 + 4 ducklings), and Motuoapa (40 + 5 ducklings), with only 12 elsewhere (6 on Rotopounamu and 6 on Otamangakau). On 1 July 1978, R. W. Jackson, A. Palliser and G. Pearson (pers. comm.) recorded 30 on Rotopounamu and 1000+ on Rotoaira. The Australasian Bittern *(Botaurus stellaris poiciloptilus)* is well known as a bird of Tokaanu Bay, Lake Taupo; for example, Jackson, Palliser & Pearson on 1/7/78 saw nine in full view on mudflats off the mouth of the tailrace canal. This time, it was recorded at Tokaanu and Rotoaira. A bird seen at Otamangakau, which had only a few inadequate reedbeds, may have come from nearby Rotoaira. Black Swans certainly move between these two lakes, most of the 130 birds counted being, on the day, at the south end of Otamangakau. But these were few compared with the 2000+ seen at Tokaanu. The same two lakes had roughly equal shares of the 300+ " Grallard " Ducks counted. The Welcome Swallow *(Hirundo tahitica neoxena)* was seen mostly at Rotoaira and Otamangakau, but some were breeding under the bridge at Te Whaiau.

The three, possibly four, Australian Coots on the lower Rotokuru Lake in Karioi State Forest are new to the region. Coots have not been reported from Lake Taupo, and so it is open to conjecture whether they have come from the Rotorua district or the Wanganui district.

Few Pukekos *(Porphyrio p. melanotus)* were seen south of Tokaanu, only two or three at each of Rotoaira, Otamangakau, and Otamaraha. The Spur-winged Plover was recorded at three places — 4 at Tokaanu sewerage ponds, 3 at Te Whaiau, and 5, possibly 8, at Otamangakau. It is presumably more widespread on farms in the district. None was in juvenile plumage.

Three colonies of the Black-backed Gull *(Larus dominicanus)* are known, one near the Tama lakes on Ruapehu, and two east of Ruapehu, low on the fan between Waikato and Whangaehu Rivers and high on the fan of the Makahikatoa Stream.

One Caspian Tern *(Hydroprogne caspia)* was seen on Rotoaira, a bird without a full black cap.

Remarkable at Tokaanu was the distribution of small shags. On 14 January, whereas the Little Shag *(Phalacrocorax melanoleucos brevirostris)* was found mostly on Tokaanu Bay (for example, 34 roosting on the jetty), the tailrace canal from the powerhouse was being used almost exclusively by Little Black Shags *(P. sulcirostris)*, at least 120 birds, most of which were roosting on the boom near the mouth. Others were at the powerhouse itself, many were flying back and forth along the canal, and flocks of all sizes were feeding in their characteristic synchronised way. This canal, despite its severe straight lines, has acquired margins of raupo and several pairs of Dabchicks were using it as well as shags and swans.

Fernbirds *(Bowdleria punctata)* were abundant around Lake Otamangakau and in suitable habitat — raupo with some manuka — around Lake Rotoaira. One high-altitude individual was seen from the track to Taranaki Falls near the Chateau, at about 1200 m. Fernbirds were found in pockets in the impressive open Park heathland that can be seen from the road east of National Park township, but they were abundant in the flaxy swamps beside and over the road from Erua Camp itself. This survey did not record Fernbirds on the eastern flank of the National Park. Neither our nor Park records note the occurrence of Fernbirds south of the Mt Ruapehu summit and within the discreet boundary formed by State Highways 1 and 49.

Dabchicks: Apart from one bird seen repeatedly on Rotokuru, the Dabchick was confined, as expected, to Rotopounamu, Rotoaira, and the southern end of Lake Taupo, where raupo beds and other cover are plentiful. Both Rotoaira and Tokaanu Bay were surveyed by boat as well as on foot. On Rotopounamu, 11 birds and 2 chicks were counted, compared with 6 birds seen in July 1978 by A. Palliser (pers. comm.). On Rotoaira, 11 birds were seen, compared with 20 by A. Palliser in July 1978. On Tokaanu Bay, 74 adults were seen, but only one juvenile; single birds and pairs were well spaced out, and many birds were probably missed in the well-flooded raupo, where one bird with two small chicks was seen and others may have had chicks or eggs. On the tailrace canal were at least 6 birds, one pair with two small chicks; two adults were almost at the powerhouse. All birds were in good " breeding " plumage; many, however, were in small flocks indulging in vigorous display but apparently not in breeding pairs. On this stretch of Lake Taupo, A. Palliser in July 1978 recorded 126 birds, and so winter flocking may show the true number of birds.

OPEN COUNTRY BIRDS

Open country in the form of tussockland, low scrub, scoria and pumice-sand occurs extensively around and east of the central volcanoes, to the north-west around Mangatepopo and further north around Lake Otamangakau. Pockets of open country also occur in the mainly forested western and southern areas of the park. Representative open areas were visited throughout the park region, although steep slopes above the limit of vegetation, 1850 m, were not covered.

Five small passerines — Pipit *(Anthus novaeseelandiae)*, Skylark *(Alauda arvensis)*, Redpoll *(Carduelis flammea)*, Chaffinch *(Fringilla coelebs)* and Blackbird *(Turdus merula)* were commonly reported from open country throughout. Pipits were more widespread than Skylarks. Based on the National Park's bird-mapping-scheme squares (2000-metre grid), Pipits were noted in 41 squares and Skylarks in 30 squares. In places well away from tall vegetation, such as mountain slopes above the bushline and eastern scoria flats, only Pipit, Skylark and Redpoll were present. Thus large tracts of land had few birds. In desolate areas, where the predominant vegetation was tussock grasses and alpine herbs, a search of small patches of low scrub could produce a Chaffinch, or more rarely a Hedge Sparrow *(Prunella modularis)*. Interestingly there was a sprinkling of Hedge Sparrow reports from open areas up to 1380 m in central, western and southern parts of the Park, usually adjacent to tall vegetation. This easily overlooked species is probably more common in the region than our scattered sightings suggest. Although the Blackbird was rated as relatively common, the Song Thrush *(Turdus philomelos)* was rarely seen.

Certain species were found only around the boundary of the park in the vicinity of farm paddocks, on land opened up by hydro and forestry development, on roadsides and at settlements. White-backed Magpie *(Gymnorhina hypoleuca)*, Starling *(Sturnus vulgaris)* and Yellowhammer *(Emberiza citrinella)* were commonly reported from these man-modified sites, and the few sightings of Myna *(Acridotheres tristis)*, House Sparrow *(Passer domesticus)* and Greenfinch *(Chloris chloris)* were similarly distributed.

Of the larger and non-passerine species, Harrier *(Circus approximans)* and Black-backed Gull *(Larus dominicanus)* were frequently seen flying over open country throughout. The White-faced Heron *(Ardea novaehollandiae)* was seen beside Lakes Rotoaira and Otamangakau and also in open country near the Whakapapa River hydro intake. Much interest centred on the New Zealand Falcon *(Falco novaesee-*

landiae), but it was seen only from the Mangatepopo track and Tama Lakes track, both locations being near Mt Ngauruhoe.

Despite the large areas of scrub and rough grassland available as habitat, Californian Quail *(Lophortyx californicus)* were relatively uncommon. The few and widely scattered Californian Quail reports came from near dense cover well away from the very open central areas of the park. The only sighting of Pheasant *(Phasianus colchicus)* was at the foot of Ketetahi Track in the Okahukura Bush area.

Banded Dotterel: Likely habitats east of Ruapehu and in the high open country of the Park were sampled for this species because much has been suspected but little known of its status in the Park and in the Rangipo Desert east of the Park. Park records show that a few birds have been seen in summer on the summit of Tongariro and on Scoria Flat and near Tukino Village on the slopes of Ruapehu. Oliver (1955) mentioned a summer sighting high on Tongariro. Sibson (1958) recorded reports of about 20 on the Chateau golf links in November 1957 and of a pair near the summit of Tongariro in January 1957. C. Ogle (*in litt.* to JGI) saw 7 birds near Blue Lake in December 1962 and a further 6 there in March 1973. He also recorded 8 birds just east of the Te Mari Crater in January 1963. Banded Dotterels were therefore known to be summer visitors to the Park.

In this study none was seen, however, in a search of the summit craters and slopes of Tongariro, and none was seen near the Tama Lakes.

On the eastern slopes 7 birds, all adults, were found at 1330 metres in the bed of the Mangatoetoenui Stream, which had the only flowing water seen at this altitude. These birds seemed to be in a loose flock, not attached to territories. The ridges and slopes sampled above this stream had no dotterels. When the Waikato River was followed from the barren terrain of its headwater gullies and ridges to its junction with the Tukino Road and the Desert Road, dotterels were seen in parties of 2,1,2,2,2,1,2, and 2, mostly on the broad pumice/scoria fan between 1100 and 830 m, from which arise the Waikato River and the northernmost tributary of the Whangaehu River. No dotterels were on the open pumice flats of the dry " stream " next north of the Waikato (Tangatu Stream). About 20 were on open flats beside the junction of Tukino and Desert Roads; all were in pairs, and one small chick was seen. The Whangaehu River was sampled from the Wahianoa Aqueduct north for some 7 km; 26 adult dotterels were seen, all in pairs, and 4 chicks. During a vehicle traverse of the very broad fan marked as headwaters of the Makahikatoa Stream, 5 dotterels were seen, even though water was not available on the fan, which looks inhospitable.

By extrapolation from the 70+ birds seen, a rough estimate would give a likely maximum of 200 breeding birds in the district. Elsewhere, 3 dotterels were seen at Lake Te Whaiau and 10 at Lake Otamangakau, but these birds did not seem to be breeding, and three of them were in that uncertain plumage with double shoulder-tabs and no breastbands which bedevils anyone trying to define Banded Dotterel plumages according to age.

FOREST BIRDS

All forest types in and surrounding the Tongariro National Park were visited to some extent during the survey. Large, intact, podocarp/beech or mixed beech forests held the greatest diversity of species. Smaller islands of mountain beech in the east of the Park and of mixed beech in the west of the Park held populations of more common species only.

The Chaffinch was the most consistently widespread forest bird. Other introduced species which penetrated native forests regularly were Blackbird, Redpoll and Hedge Sparrow.

Grey Warbler *(Gerygone igata)*, Fantail *(Rhipidura fuliginosa)*, Pied Tit *(Petroica macrocephala toitoi)*, Silvereye *(Zosterops lateralis)* and Rifleman *(Acanthisitta chloris granti)* were abundant in many different forest types, although each species was more or less abundant in certain areas in a fashion defying generalisation, considering our short survey period and the varied approach by different members of the survey.

Whitehead *(Mohoua albicilla)* were scattered throughout both native and exotic forests in the vicinity of the Park but were most regularly seen in the large southern forest block east of Ohakune that includes Karioi State Forest.

However, of most interest were the disjunct distributions of Kaka *(Nestor notabilis)*, parakeet (*Cyanorhamphus* sp.) and North Island Robin *(Petroica australis longipes)*.

Only two populations of Kaka are extant in the Park region, both in large indigenous forest blocks. One is in podocarp/hardwood and podocarp/beech forest on Mt Pihanga and Mt Kakaramea and the second is mainly in the podocarp/red and silver beech forest type of Rangataua State Forest (now part of Karioi State Forest). These two populations are separated by the length of the Park. One Kaka was seen in mountain beech forest from the Blythe Track near the Ohakune Mountain Road. Park records for this species extend west to the Makotuku Stream. Garrick (1980) did not see or hear Kaka during his survey on a transect just west of this stream.

Yellow-crowned Parakeets *(C. auriceps)* were positively identified in the indigenous remnants of Karioi State Forest and on the southern slopes of Mt Pihanga. Most (13 of 16 map squares) parakeet records could not be identified to species. As with Kaka, nearly all records were from the slopes of Mt Pihanga and Mt Kakaramea and from western Karioi State Forest. Parakeets were also heard in Erua State Forest east of the Ohakune/National Park road just north of the Makatote railway viaduct.

Distribution patterns for both these species were strikingly echoed by records in the Tongariro National Park mapping scheme. Karioi and Erua State Forests adjacent to the Park have a vital role to play in the conservation of these two species in the region. This is an interesting illustration that the Park is not a self-contained ecosystem and that the Park boundaries do not necessarily delimit an area of relevance to the movements of its wildlife.

Robins were mapped from the eastern edge of beech forest in Karioi State Forest; from Erua State Forest east of the Ohakune/National Park road; from a tiny (about 2 ha) forest remnant south-west of Lake Otamangakau; from Mt Pihanga and from two locations just inside Park northern boundaries. Seemingly small populations in scattered localities is a typical pattern for this species in other parts of the North Island. Park records show that the Robin is also present in the Chateau area and near Ohakune.

ACKNOWLEDGEMENTS

We wish to thank staff of Tongariro National Park for their encouragement, especially Senior Ranger Bill Cooper, who gave the survey much help. We thank also the other 44 members of the OSNZ field study week, whose work is described here.

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SHORT NOTE

A NEW BREEDING SPECIES FOR CENTRAL OTAGO: BLACK-FRONTED DOTTEREL

On 19 July 1980, my wife and I saw the first Black-fronted Dotterel *(Charadrius melanops)* for the Central Otago region at the confluence of the Clutha and Manuherikia Rivers, Alexandra. It was still there on 27 July.

On 11 November 1980, during one of our usual surveys of stretches of the Manuherikia River in the Galloway district (a few kilometres upstream from Alexandra), we found one bird feeding on the water's edge near breeding Pied Stilts *(Himantopus h. leucocephalus)*, South Island Pied Oystercatchers *(Haematopus ostralegus finschi)* and Black-billed Gulls *(Larus bulleri)*. We thought then that it was probably the same bird as that of July but later realised it probably was not.

In a rather hasty walk down this 4-km stretch of the river on 13 November I saw four of the dotterels and so decided to investigate more thoroughly next year.

On 18 October 1981, Margaret and I found three pairs and a single bird. The nest of one pair was on a shingle bank 23 metres from the river and 5 metres from a likely feeding area of muddy shallows. It contained a full clutch of three, measuring 29.5 x 21.1, 28.2 x 21.5, and 28.7 x 21.4. Egg colouring agreed with descriptions in Frith (1969) and elsewhere. Next day, in a further 5-km stretch above this, we found two more pairs, and on the 29th, one of these was seen with a one-day-old chick.

Later on the 29th we found one of the original pairs with a chick about 3 days old, and on 5 November the third pair with a nest and full clutch. These eggs measured slightly smaller: 28.2 x 20.9, 27.6 x 21.4, and 28.5 x 21.5. Their colouring was almost identical to that of the first clutch. On 22 November, this pair was found 100 metres downstream with two chicks about a week old. Their third egg, evidently infertile, was still in the nest.

On 11 November, in a 5-km stretch near Omakau, one further pair was seen with a chick. The full total was thus 13 adults, two pairs with nests, and three other pairs with chicks.

Later we covered other likely stretches of the river upstream from Becks as well as closer to Alexandra, with negative results. In all, about 31 km of the river have been examined.

On 15 November, we walked about 16 km of the Kyeburn River from Dansey's Pass Road bridge to the Kyeburn confluence with the Taieri River. We considered this a possible site because of its being more or less in a direct line between the South Canterbury rivers (Opihi and Orari) where these dotterels occur and the Manuherikia. However, although some of the habitat looked good, we found no Black-fronted Dotterels.

Since both of our nests had full clutches when located, we were unable to determine the incubation period; the literature references seem conflicting: Frith (1969) gives " about 18 days "; Hadden (1973) gives 25-26 days for one nest in the Wairarapa; none of the 18 cards in the OSNZ Nest Record Scheme gives a complete observation; and the *New Guide* and other references that I have ignore the topic.

Our limited observations so far show that the breeding site of each pair seemed to be associated, perhaps by favouring a similar breeding habitat on the river, with Pied Stilts — either within or adjacent to scattered stilt colonies of 2-10 pairs.

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LEACH'S STORM PETRELS (Oceanodroma l. leucorhoa) PROSPECTING FOR NEST SITES ON THE CHATHAM ISLANDS

By M. J. IMBER and T. G. LOVEGROVE

ABSTRACT

In November 1980, two Leach's Storm Petrels of the typical subspecies were discovered on Rabbit Island, Chatham Islands (44°14'S, 176°16'W), engaged in prebreeding activity. They were captured, examined, photographed, banded and released. The flight calling of one was recorded on tape. Their nocturnal activity continued until observations ceased. A subsequent check indicated that no chick was reared. Possibly they were of the same sex, and possibly there were only two. This is the first record of prospecting for nest sites in the Southern Hemisphere by this strictly Northern Hemisphere breeding species.

INTRODUCTION

The storm petrels (Hydrobatidae) are divisible into three predominantly short-legged northern genera, typified by *Oceanodroma,* and five long-legged southern genera of which only *Pelagodroma,* other than tropical *Nesofregetta,* has established itself transequatorially (Jouanin & Mougin 1979). *Oceanodroma* species are restricted as breeders to the Northern Hemisphere, the tropics, or the north-west coast of South America. Leach's Storm Petrel, *O. l. leucorhoa* (Vieillot), breeds on islands in the North Pacific and North Atlantic Oceans, mainly between 40°N and 70°N (Cramp & Simmons 1977), but a few *leucorhoa* and smaller sometimes darker subspecies breed at lower latitudes in the eastern Pacific (Ainley 1980). The typical race migrates south to winter in the tropics (Murphy 1936, Crossin 1974). It straggles rarely further south: Bierman & Voous (1950) reported a single sighting at 57°40'S, 5°E in Antarctic seas; but there have been only three previous records from New Zealand, all storm-driven waifs found dead (Oliver 1955, Fooks 1978, Veitch 1980). There are no previous reports known to us of Leach's Storm Petrels voluntarily making landfall in the Southern Hemisphere.

Rabbit Island (44°14'S, 176°16'W) of approximately 5 ha, which is among the smallest of the Chatham Islands, lies off the north-west tip of Pitt Island (Fig. 1). It is crowned by 1-2 ha of windswept scrub, mainly *Olearia traversii* up to 4 metres high, which is surrounded by *Poa* tussocks, *Carex trifida* sedges, and Chatham Islands sowthistles *(Embergeria grandifolia)* forming low cover or thickets up to 0.6 metres high. Despite the name of the island, it has no introduced mammals.

NOTORNIS 29: 101-108 (1982)

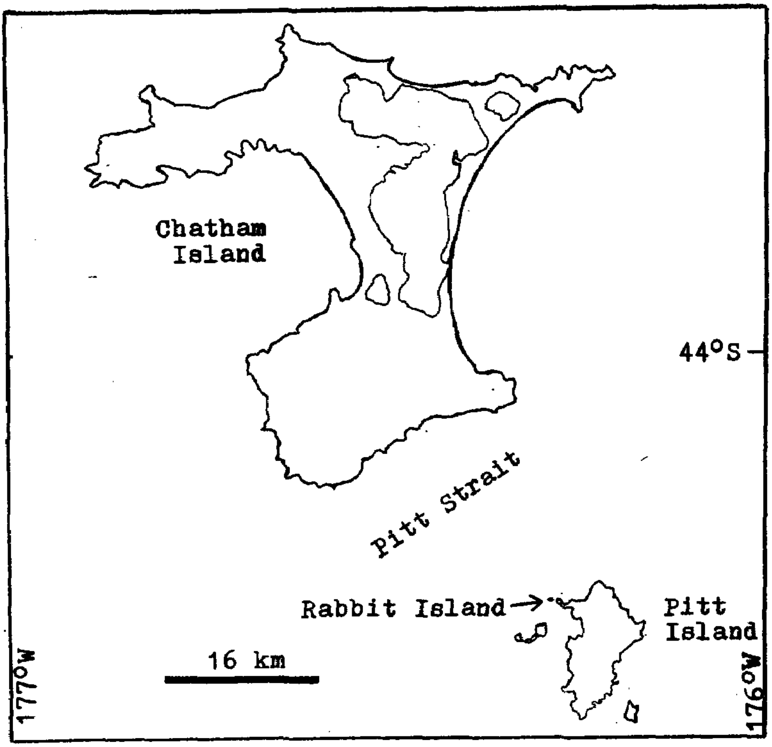

FIGURE 1 — Map of the Chatham Islands showing the location of Rabbit Island

Little ornithological study has been done on Rabbit Island. Nevertheless, the Whitney South Sea Expedition collected nestlings of White-faced Storm Petrels *(Pelagodroma marina)* there in March 1926 (Murphy & Irving 1951). Two diurnal visits, neither lasting more than a few hours, have been made by Wildlife Service officers in the last 15 years (D. V. Merton, unpubl. rept., Internal Affairs Dept. files). Chatham Islanders take muttonbirds *(Puffinus griseus)* from the colony of several hundred pairs (M. Dix, pers. comm.). It was on the basis of a report of an unusual, large, white-bellied petrel handled recently by a muttonbirder that we landed on Rabbit Island on 31 October 1980, in connection with the current search for a nesting place of the Chatham Island Taiko *(Pterodroma magentae)*.

FIELD OBSERVATIONS

Daytime searches, being for Taiko, concentrated on the larger burrows that might be used by a large *Pterodroma.* At night we used a spotlight to identify petrels flying over and made ground searches all over the island. We thus assessed the breeding population of petrels as comprising many hundreds of pairs of White-faced Storm Petrels, Fairy Prions *(Pachyptila turtur)* and Sooty Shearwaters *(Puffinus griseus)*, over 100 pairs of Grey-backed Storm Petrels *(Garrodia nereis)* and Broad-billed Prions *(pachyptila vittata)* and a few pairs of Common Diving Petrels *(Pelecanoides urinatrix)*. No evidence for breeding of any *Pterodroma* species was found.

On our first night ashore we heard a brief call, a quiet cackle, which we recorded as possibly a Little Shearwater *(Puffinus assimilis)* flying over some distance from us. Next evening, 1 November 1980, at 2330 h, MJI was standing by an area of knee-high *Cyperus - Embergeria* vegetation when he heard the quiet cackle again. This time, however, the source was close by and obviously in this dense vegetation. It did not now sound like a Little Shearwater. After careful stalking, he caught a white-rumped, black storm petrel. Apart from astonishment, his first impressions were as follows: The legs were not long with pale webs as expected *(Oceanites)* but short, quite small, and black *(Oceanodroma* or *Hydrobates)*. The underwing was all dark (not *Hydrobates*). The rump patch was somewhat divided and the tail forked. It therefore seemed to be Leach's Storm Petrel.

Back at camp, TGL avers, MJI announced his return thus: " I haven't got the Taiko but I think I've got the consolation prize." The bird was measured and weighed (Table 1), photographed (Fig. 2-4), sketched (Fig. 5), fully described, banded and released.

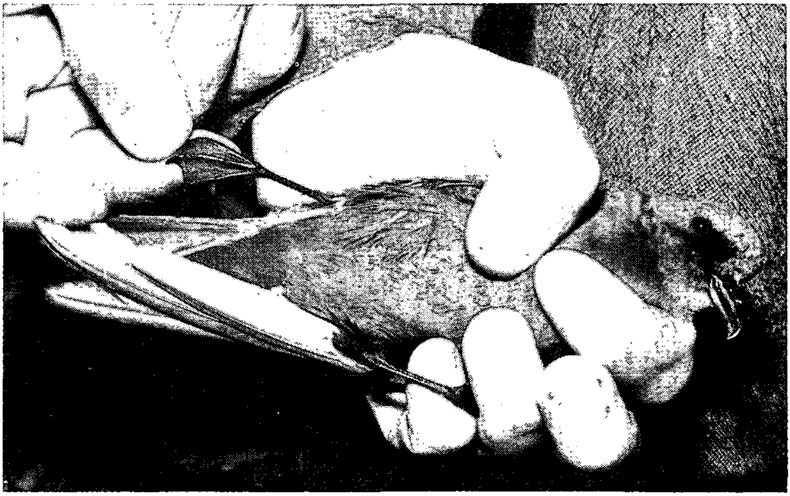

FIGURE 2 — Ventral view of bird 1. Note the small black feet with short tarsi, the restricted amount of white on the flanks, and the high forehead

Photo: T. G. Lovegrove

FIGURE 3 — Dorsal view of bird 1. Note the upperwing bar, the rump patch, and the forked tail

Photo: T. G. Lovegrove

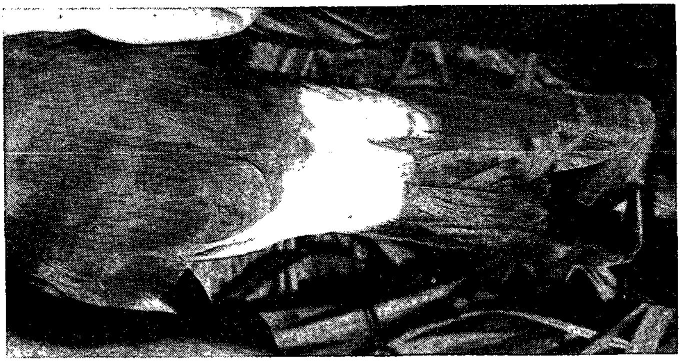

FIGURE 4 — Close-up of the rump and tail of bird 1. Note the dark tips to the distal upper tail-coverts and the darker central coverts tending to divide the white rump.

Photo: T. G. Lovegrove

The bird was in fresh plumage except for very few old feathers on the back. The incubation patch was downy. General colour was greyish black above, darkest on the quill feathers, brownish black below, and with an upperwing bar (Fig. 3) of greyish brown, which at first glance seemed to be caused by fading. The white rump patch (Fig. 3, 4, 5a) was divided only distally, hardly extended at all on to the flanks (Fig. 2), and had dark tips and shafts to some of the distal, outer upper tail-coverts (Fig. 5a); the central upper tail-coverts were dark grey, thus dividing the rump patch distally. The call, uttered from the ground by this bird, began with *kuk-kuk,* running into a ' chuckle ' or ' giggle ' on an ascending then descending scale. As we discovered later, this bird was very discreet with its calls. Subsequently we heard presumably the same individual (bird 1) calling again from the same patch of vegetation on the nights of 5/11 and 10/11 (our last night of that visit). On the last night it was uttering the churring call (see below).

Between midnight and about 0200 h on 5 November, the chuckling call of a Leach's Storm Petrel was heard near our camp, coming from a bird flying over a patch of vegetation similar to that in which the first capture had been made. Its call was noted as *kuk-ku-huk* - giggle. At about 0230 h, when the chuckling had ceased, a quite different call was heard from deep in the vegetation: a prolonged loud churring on a slowly rising pitch, regularly interspersed with *ik* (possibly inhalations). This call was easily traced to a 0.5-metre-long burrow from which MJI drew an unbanded Leach's Storm Petrel. This one, bird 2, was also measured, weighed (Table 1), and sketched (Fig. 5b) but not photographed. It was also banded and released.

TABLE 1 — *Measurements (mm) and weight (g) of two live Leach's* Storm Petrels captured on Rabbit Island, Chatham Islands, in November 1980

	Bird 1	Bird 2
Culmen	17.2	16.5
Tarsus	24.6	24.2
Mid-toe and Claw	25.6	24.9
Wing	154	158
Tail: centre	61	66
outer*	83	79
Depth of fork	22	13
Weight	49.5	47

* base of central to tip of outermost

Bird 2 was entirely in fresh plumage and had a downy incubation patch. As well as being more vocal than bird 1, it struggled incessantly during handling; whereas bird 1 had been docile. Their rump patches are compared in Fig. 5: that of bird 2 was more completely divided, but the tips and shafts of the distal upper tail-coverts were less dark. The wing bar, noted as fawn brown, was considered to be more prominent in bird 2.

On the nights of 7/11 and 8/11 a bird, presumably bird 2, was again heard calling in flight over the same area near our camp, but it was not heard calling from the ground again. On 7/11, a sound recording of its flight call was made on a Uher Report 4000 tape recorder. Recordings were also made of White-faced Storm Petrels and Grey-backed Storm Petrels, whose calls are made only from the ground and usually from the nest. These latter recordings both have the flight call of a Leach's Storm Petrel, presumed to be bird 2, audible in the background. These tapes have been deposited in the sound library of the Wildlife Service in Wellington.

We left Rabbit Island on 11 November 1980. At that time we could be sure of only two Leach's Storm Petrels visiting this island. Assuming that the calls heard later from the two areas of activity came from the birds caught in those two areas, our handling of them

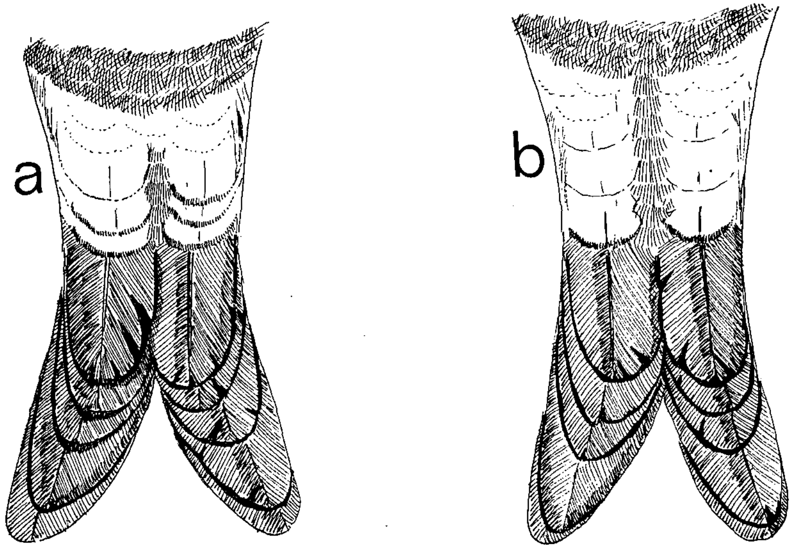

FIGURE 5 — Semi-diagrammatic sketch of the rumps of two Leach's Storm Petrels, Rabbit Island, 1-5 November 1980. Drawn by T. G. Lovegrove.
a: Bird 1. b: Bird 2.

had had little effect on their behaviour, except that bird 2 seemed more reluctant to land and apparently had deserted the burrow in which it had been caught. As prebreeding petrels are known to be very sensitive during the early stages of occupation of a burrow (pers. obs.), the desertion was to be expected. At the time of our departure there was no indication of pairing. As we could not sex them, we can only speculate that they were of the same sex.

Between 3 and 9 April 1981 MJI visited Rabbit Island again. In the area where bird 1 had been active, the sowthistles had died down, leaving bare areas of the sandy soil. Attempted burrows of White-faced Storm Petrels, and possibly of the Leach's Storm Petrel, had collapsed, and there was evidence of successful breeding only of Grey-backed Storm Petrels, nesting in the *Carex* tussocks. In the area that had interested bird 2, MJI examined the burrow in which the bird had been found and all burrows nearby. This area had more substantial, deeper soil suitable for successful burrowing. The only evidence he found was that several White-faced Storm Petrels had fledged. Thus, actual breeding by the Leach's Storm Petrels in the 1980-81 summer is improbable.

No visit was made in the 1981/82 summer but we hope that a further investigation may be made in 1982/83.

DISCUSSION

Back in New Zealand, we consulted the literature to check our preliminary identification. In every respect the two birds fitted the descriptions of the typical subspecies (Murphy 1936, Cramp & Simmons 1977, Ainley 1980), and their measurements lie between the average and the upper end of the range reported (see also Crossin 1974). The culmen of bird 1 actually lies beyond the range for North Atlantic birds reported by Cramp & Simmons (1977) but within the range for central Pacific non-breeding birds reported by Crossin (1974). Their calls were also typical.

However, the birds were fully acclimatised to the reversed Southern Hemisphere seasons. They were in fresh plumage, whereas in the central Pacific, where North Pacific populations spend the winter, " Extensive body molt of the contour feathers in the nominate race begins in November . . ." (Crossin 1974). The breeding season in the Northern Hemisphere begins in April with the first peak of aerial activity reached in May (Cramp & Simmons 1977). Corresponding activity at Rabbit Island was displaced by 6 months. It is interesting that petrels can make such a switch, and it may help our understanding of successful transequatorial shifts, such as those of White-faced Storm Petrels, Soft-plumaged Petrels *(Pterodroma mollis)*, and Little Shearwaters in the Atlantic Ocean.

We doubt that there is a breeding population of Leach's Storm Petrels in the Southern Hemisphere. If these two birds came from the north, it seems more likely that they had hatched in the North

Pacific than the North Atlantic, because of relative proximity. Possibly a meteorological event such as a cyclone displaced some birds southwards from the equatorial zone in the Pacific Ocean, where they reach at least 16°S (Crossin 1974). Nevertheless, the two Australian specimens, from the southern and western coasts of Australia, are both suggested as having come from the North Atlantic via the Cape of Good Hope (Serventy *et al.* 1971, J. Warham, pers. comm.). Leach's Storm Petrel is known to reach the seas off the Cape of Good Hope (Cramp & Simmons 1977, Avery 1981).

It is worth noting that, despite considerable beach patrolling in New Zealand since 1950, R. A. Falla's 1922 specimen from Muriwai Beach stood as the sole record until 1978 when two were found (Fooks 1978, Veitch 1980), one blown inland. Conceivably there is a connection between the two 1978 corpses (April, August) and the two live birds at Chatham Islands in 1980. The second Australian specimen was found in April 1978 (J. Warham, pers. comm.).

It is also worth considering the abilities of Procellariiformes to communicate, or at least to interact, at sea. Normally when one observes petrels at sea they seem to be ignoring one another, unless food is involved. Yet two storm petrels, possibly of very few in the South Pacific south of, say, 30°S, managed to find each other at a 5-ha island. If two can do this, and if ironically they happen to be of the same sex, will they be able to attract a mate or mates before they give up or die?

ACKNOWLEDGEMENTS

We thank M. Dix, who transported us on this trip and on many other occasions among the Chatham Islands and who supplied valuable information on the birdlife of Rabbit Island.

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ROOSTS AT FORAGING SITES IN BLACK-BILLED GULLS

By ROGER M. EVANS

ABSTRACT

Diurnal roosts of Black-billed Gulls *(Larus bulleri)* were found at 37% of inland foraging sites during the breeding season. Roosts were most common and commuting between colony and foraging groups least common far (>5 km) from the colony. Selective use of roosts far from the colony is energetically efficient and may help to maintain local population densities at levels sufficient to permit efficient search for food by means of local enhancement.

INTRODUCTION AND METHODS

Diurnal aggregations of gulls at roosts on or near inland foraging sites are common, but little information about these roosts has been reported. Quantitative data are lacking on roost occurrence and size and on their relationships to active breeding colonies. Whether or not the distance between foraging sites and colonies affects roosting behaviour is not known but could be important to an understanding of the overall foraging system of gulls and similar species (Ward & Zahavi 1973).

Black-billed Gulls *(Larus bulleri)* are particularly well suited to an examination of roosting behaviour because they are gregarious and conspicuous and commonly breed and feed inland in accessible agricultural regions (Stead 1932). I examined roosts at foraging sites of this species during the breeding season of 1979. Most of the observations reported here were from birds foraging out from two successful colonies on the Ashley River, near Christchurch. Supplementary data are included from four unsuccessful colonies on the Ashley River and from two successful colonies on the Hurunui and Conway Rivers. No obvious differences that could be attributed to the different populations were noted, and data for all are lumped in the analyses.

At each of 71 foraging sites, I estimated the number of gulls foraging and the number roosting to about the nearest 25 birds for groups of less than 100 and to the nearest 50 for larger groups. If the birds were spread out, full counts were made. For analyses, the observations at a given site on a given day were taken as the unit of measurement, each being considered one " site-day." Data were obtained for a total of 125 site-days (mean of 1.76 site-days per site from the 71 sites sampled). I counted the numbers of gulls arriving at foraging sites during 37 continuous watches, totalling 18.4 h at 26 different foraging sites. The colony used by birds from a given foraging site was determined by direct observation of birds flying between the two locations. Distances between foraging sites and home colonies were obtained from topographic maps.

RESULTS AND DISCUSSION

Roosts were present at foraging sites on 34 of 125 site-days (37.4%). When roosts were present, significantly more than half (68%, $X^2 = 11.64$, $p < .001$) of the gulls were at the roost, and the rest were foraging (Table 1).

The proportion of foraging sites containing roosts increased significantly ($X^2 = 6.87$, d.f. = 2, $p < .04$) with distance from the colony, from a low of 13 of 55 sites (23.6%) at 0 to 5 km to a maximum of 10 of 11 sites (90.9%) at more than 10 km from the colony (Table 1). The mean number of birds present at sites not containing roosts dropped markedly at distances greater than 5 km from the colony ($X^2 = 13.01$, $p < .001$ for sites <5 km *versus* sites >5 km, median test). Beyond 5 km from the home colony, sites with roosts contained significantly more gulls ($X^2 = 7.72$, $p < .01$) than sites without roosts.

The number of flocks arriving at foraging sites was significantly and negatively correlated with distance from the colony (Fig. 1). This trend persisted throughout the season, but was particularly clear during the latter part of the season when foraging sites over the entire range of from less than 1 km to over 11 km from the colony were in use (see solid circles in Fig. 1).

The proportionately greater use of roosts at foraging sites located far from the colony (>5 km) and the high rate of commuting between colonies and closer foraging sites indicate that, when colonies are nearby, Black-billed Gulls return to the colony between active bouts of feeding rather than rest at roosts on or near the foraging area. More time and energy would be required to commute between a colony

TABLE 1 — Numbers of Black-billed Gulls (mean ± SD) present at foraging sites in relation to distance from the home colony

Distance	Mean no. gulls at sites with roosts				Without roosts	
from Colony	n[1]	at roost	foraging	total	n[1]	foraging
0-5 km	13	126±74.0	94±80.8	220±128.0	55	176±127.5
5-10 km	11	144±81.5	13±30.4	157±78.3	25	70±76.6
> 10 km	10	122±87.6	72±74.9	194±148.7	11	83±58.2

[1] n refers to the number of foraging site-days included in the sample. The number of gulls seen at a given site when first censused on a given day provided the data for one foraging site-day.

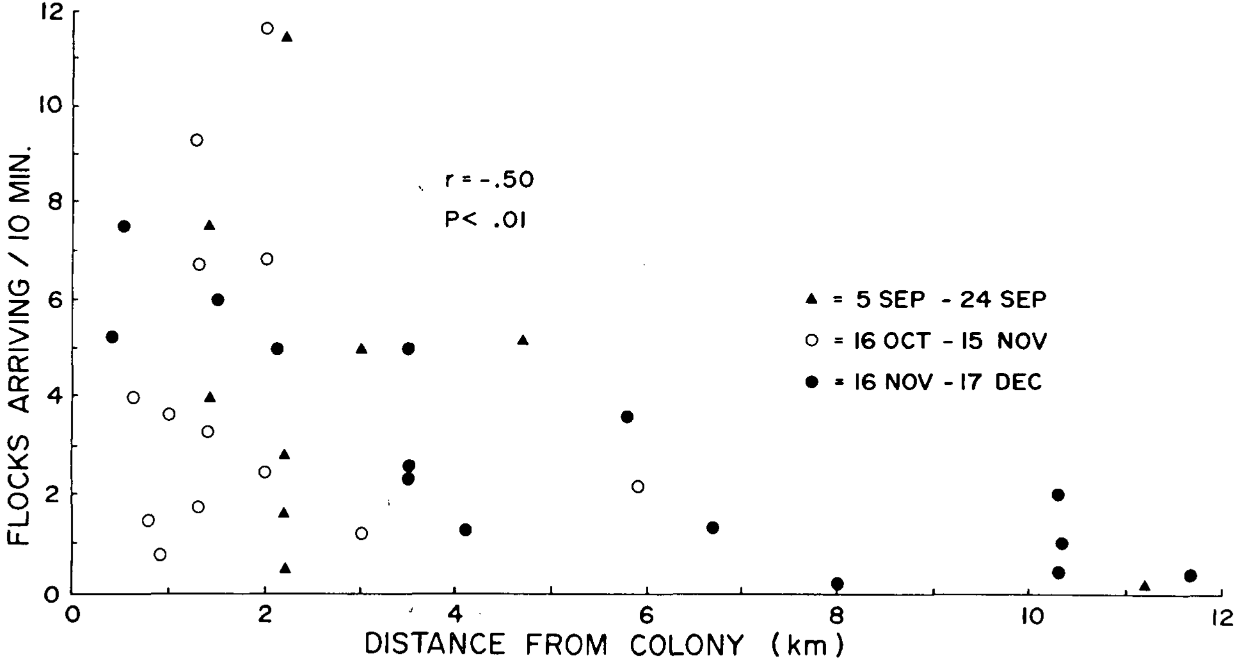

FIGURE 1 — The rate at which Black-billed Gull flocks arrived at foraging sites in relation to distance to the home colony

and more distant sites; hence periodic resting at nearby roosts rather than at the more distant colony would be energetically efficient for birds foraging far from the colony.

The presence of roosts primarily at foraging sites some distance from the colony could also be relevant to the efficiency with which Black-billed Gulls locate food. Individuals of this species, like many other conspicuous gulls and seabirds, commonly find food by cuing to the location of others already actively foraging (Stead 1932, Hoffman *et al.* 1981, pers. obs.). This form of " local enhancement " (Thorpe 1963) is necessarily most effective when local populations of foragers are large. Near a large breeding colony, the presence of the colony should alone be enough to maintain a large local population for locally enhanced search for food. Results of this study suggest that roosts could maintain large local populations when gulls forage far from the breeding colony. I have suggested (Evans 1982) that breeding colonies of Black-billed Gulls may function as " assembly points " where dispersed foragers reunite for subsequent group foraging. The results reported here suggest that this interpretation may also apply to diurnal roosts of this or similar species.

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SHORT NOTE

KERMADEC STORM PETREL

On 10 October 1981 at 35° 43'S 155° 50'E, four White-faced Storm Petrels *(Pelagodroma marina)* flew close to the ship. They all had white rumps which were as white as the under surfaces of their bodies. This suggests that they were of the subspecies *albiclunis.* I have never seen four *albiclunis* together before, nor have I seen them away from the Kermadec Islands.

JOHN JENKINS

THE RELATIONSHIPS OF THE NEW ZEALAND WRENS (ACANTHISITTIDAE) AS INDICATED BY DNA-DNA HYBRIDIZATION

By CHARLES G. SIBLEY, GORDON R. WILLIAMS and
JON E. AHLQUIST

ABSTRACT

The relationships of the New Zealand Wrens have been debated for a century but up to 1981 it has not been clear to which suborder of the Passeriformes they should be assigned. Comparisons between the single-copy DNA sequences of *Acanthisitta chloris* and those of other passerine birds indicate that the Acanthisittidae are members of the suboscine suborder Oligomyodi, and that they are sufficiently distant from other suboscine passerines to warrant separation as an Infraorder, Acanthisittides.

INTRODUCTION

The endemic New Zealand family Acanthisittidae contains four species in two genera. The Rifleman *(Acanthisitta chloris)* occurs commonly in many parts of the North and South Islands, and Stewart Island, and on some offshore islands. There are no recent records of the Bush Wren *(Xenicus longipes)*, which once occurred on all three main islands. If not now extinct it occurs only in a few remote forested areas. The Rock Wren *(X. gilviventris)* inhabits rocky terrain in the subalpine and alpine zones of the main South Island mountains, and the Stephens Island Wren *(X. lyalli)*, known only from that small island, has been extinct since 1894.

The Rifleman was described as *"Sitta chloris"* by Sparrman in 1787 and was assigned to various other genera, including *Motacilla, Sylvia,* and *Acanthiza,* until 1842 when Lafresnaye erected the genus *Acanthisitta.*

The distinctive characters of the New Zealand Wrens were discovered by Forbes (1882), who found that the syrinx is located in the bronchi and lacks intrinsic muscles. These conditions are known otherwise only in some of the suboscines. Forbes concluded that the "Xenicidae" must be related to the New World tyrannoid suboscines, to the Old World Pittidae, or to the Philepittidae of Madagascar, although the New Zealand Wrens differ from these groups in several other characters. In spite of important differences, Forbes considered the acanthisittids to be allied to the New World suboscine manakins

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(Pipridae) and tyrant flycatchers (Tyrannidae), and to the Old World pittas and philepittas. Forbes (1882) proposed the family name "Xenicidae" for the New Zealand Wrens, but Sundevall (1872) had used " Acanthisittinae," which takes precedence as the basis for the family name.

Furbringer (1888) included *Xenicus* in his "Oligomyodi" with *Pitta* and the Neotropical tyrannoids, and suggested that their wide geographic distribution attests to their extreme age and accounts for their anatomical diversity.

Sclater (1888) reviewed Forbes' study and concluded that " the Xenicidae must be held to be more nearly allied to the Pittidae than to any other Passerine form yet known. But they have only 10 rectrices instead of 12 — the normal Passerine number, and the scutellation of the tarsus is different." Sclater placed the " Xenicidae " between the Pittidae and the broadbills (Eurylaimidae) and Gadow (1893) inserted the " Xenicidae " between the Pittidae and the Tyrannidae.

Pycraft (1905) examined the pterylography, ear region, tarsal scutellation, rhamphotheca, muscles, syrinx and skeleton of *Acanthisitta* and found that some of the " extremely interesting facts " he discovered were in "conflict with the statement made by Forbes." Pycraft differed from Forbes in finding what he thought to be an intrinsic syringeal muscle that " ends, in the form of very degenerate fibrous tissue, on the third bronchial ring." Forbes had reported that, in *Xenicus,* these fibres terminated before reaching the top of the " syringeal box." Ames (1971) showed that the muscle described by Pycraft was the extrinsic M. tracheolateralis and that there are no intrinsic syringeal muscles in either *Acanthisitta* or *Xenicus.*

Pycraft (1905: 608) also described the unusual structure of the ear opening in *Acanthisitta* which is a " narrow horizontal slit " behind the eye that gives access to a pocket-like chamber extending downward to the opening of the auditory meatus.

Pycraft concluded that the skull of *Acanthisitta* " appears to agree most nearly with that of the Synallaxine birds " (p. 615) and its "nearest allies . . . are the Furnariidae [=Neotropical ovenbirds] . . . the same form of the maxillopalatine processes and the schizorhinal nares is present in all the Furnariidae " and in *Acanthisitta* (p. 619). But Pycraft remained in a quandary because the syrinx of *Acanthisitta* " and other small features . . . prevent the introduction of [*Acanthisitta* and *Xenicus*] into the Furnariidae." The haploophone syrinx, " the peculiar aural apertures and the primitive condition of the *deltoides major* muscles, forms a combination . . . to justify the formation of a separate family . . ."

The following year Pycraft (1906) published a study of the osteology of the tracheophone passerines and included the " Xenicidae " in his suborder Tracheophoneae (=Formicariidae, Dendrocolaptidae, Furnariidae, Conopophagidae, Xenicidae). But the " Xenicidae " have a haploophone [= bronchial] syrinx, and so Pycraft decided that they " would appear to be at the bottom of the tracheophone stem, the members of which split up into holorhinal and schizorhinal types " (p. 157). Thus, in spite of several major discrepancies, Pycraft viewed the New Zealand Wrens as " more or less nearly related " to the Synallaxinae, one of his subfamilies of the Neotropical Furnariidae.

The anatomical studies of Forbes and Pycraft had brought them to substantially different conclusions. They agreed only that the New Zealand Wrens are not oscines and that they deserve recognition as a family. But Forbes thought they were related to the Neotropical tyrannoids and the Old World suboscines, and Pycraft allied them to the New World furnarioids.

Since 1906 the data and opinions of Forbes and Pycraft have been variously interpreted by avian systematists, as the following brief reviews will demonstrate.

Mathews (1927) divided the four species of New Zealand Wrens into three families, Acanthisittidae, Xenicornithidae, and Traversiidae, and placed them between the Pittidae and the Atrichornithidae.

Wetmore (1930), who took " the work of Hans Gadow " as a starting point, placed the " Xenicidae " in the " Superfamily Tyrannides " between the Pittidae and the Philepittidae. The same arrangement was used by Wetmore in his later editions (e.g. 1960).

Stresemann (1934: 845) recognised a Superfamily " Haplophonae " in which he placed the Old World families Acanthisittidae, Philepittidae, and Pittidae, and the New World tyrannids, piprids, cotingids, and phytotomids.

Oliver (1945) observed that the vomer of *Acanthisitta* is distinctive in form and unlike that of *Pitta,* although the " maxillopalatines are entire in both genera."

Mayr & Amadon (1951: 12) viewed the external similarities between the New Zealand Wrens and some of the Neotropical " Tracheophonae," for example, *Conopophaga,* as due to convergence, rather than to close relationship. In their classification they placed the " Xenicidae " in the " Tyrannoidea (Haploophonae) " with the pittas, philepittas, and New World tyrannoid families, thus following Forbes (1882) and Stresemann (1934). Berndt & Meise (1960) also associated the " Xenicidae " with the pittas, philepittas, and the New World tyrannoids.

Sibley (1970) found that the electrophoretic pattern of the egg-white proteins of *Acanthisitta* differed " in many ways from those of the New World non-oscine groups," and suggested that the true relatives might be the oscines. Sibley (1970: 39) noted that " the egg-white patterns are useful in suggesting lack of relationship and in demonstrating the cohesion of a closely related group but they cannot, alone, provide a firm basis for suggesting an alliance between groups for which there is no other evidence of relationship." Sibley concluded that the evidence, from all sources, indicated " that it is improbable that the Eurylaimidae, Acanthisittidae and Pittidae are closely related to one another."

Ames' (1971) study of the passerine syrinx included comparisons between the syringes of *Acanthisitta* and *Xenicus*, and those of many other groups of passerines. Ames confirmed Forbes' (1882) descriptions and concluded (p. 155) that " The . . . genera *Xenicus* and *Acanthisitta*, were placed by Forbes (1882) in the " Oligomyodae " (the Tyrannoidea of later writers) solely on the basis of the insertion of the syringeal muscles . . . . These two peculiar genera show no clear relationship to any New World tyrannoid group. Without knowledge of other anatomical and behavioral features it is unlikely that the true position of the Acanthisittidae can be determined."

In 1974 Feduccia published the first of a series of papers on the morphology of the avian bony stapes (columella). He examined the stapes in " more than 1000 species " of birds and found that "most of the non-passerine orders," and the entire " oscine passerine assemblage " have a " primitive," reptile-like, stapes " with a flat footplate, and a straight bony shaft." The major groups of suboscines, however, have a stapes " characterized by a large bulbous footplate area perforated usually by one large (often one large and one small) fenestra . . . ." This " derived " condition was found in the Eurylaimidae, the Pittidae, and in all of the New World suboscines.

Feduccia (1975a) found that *Acanthisitta* has a stapes which is " typically oscine, but with a shaft relatively more robust " than those of undoubted oscines. Feduccia concluded that " additional *new* evidence will be needed to draw conclusions of the relationships of the New Zealand wrens, but . . . I suggest that their closest living relatives are to be found among the oscines."

Feduccia (1975b) next assembled his data on the avian stapes in a comprehensive study. With reference to the New Zealand Wrens he wrote (p. 29) that although " possession of the primitive condition of the stapes . . . does not prove . . . oscine affinities, it suggests that they are not close allies of the modern suboscines, or at least would have had to evolve before the derived stapes type." Feduccia (1975b: 33) concluded that " it is improbable that . . . *Acanthisitta* is a suboscine."

In 1977 Feduccia presented a " new model for the evolution of the perching birds," based mainly upon the morphology of the stapes. His new classification split the traditional Passeriformes into two orders. The suboscines became the " Tyranniformes " which, Feduccia suggested, had shared a common ancestor with another new order of non-passerines, the " Alcediniformes" (bee-eaters, kingfishers, motmots, todies, trogons). Feduccia placed the typical oscines in his restricted order Passeriformes because " the oscines and suboscines could not have shared a common ancestor." With this conclusion, Feduccia put aside his earlier caution and declared the Acanthisittidae to be oscines, hence to be included in his order " Passeriformes." He speculated (p. 27) that the ancestors of the oscines might be " the primitive piciforms " or some group " intermediate between coraciiform and piciform birds . . ."

The " new model " of passerine phylogeny was soon questioned by Feduccia and his colleagues (Henley *et al.* 1978), who found that oscine spermatozoa have an "undulating membrane " and occur in precisely aligned " bundles," whereas the spermatozoa of the woodpeckers (Picidae) lack the undulating membrane, do not occur in precisely oriented bundles, and differ in other respects. Feduccia (1979) then used the scanning electron microscope to examine the spermatozoa of the suboscine Tyrannidae and found them " to have the sperm bundles characteristic of . . . the oscines." The scanning electron microscope also revealed " many differences, especially in the footplate region " between the stapes of suboscines and members of his " alcediniform " assemblage. He reported that the differences " do not argue for homology of the two and, in fact, would seem to indicate a high probability that the two morphologies evolved independently." Feduccia concluded (p. 694) that " it now seems . . . more probable that the order Passeriformes is monophyletic " although the " oscines and suboscines are very distinctive groups . . . separated by a broad and ancient evolutionary gulf."

Although Feduccia himself discovered the flaws in his " new model " of the passerine birds, he left the New Zealand Wrens among the oscines. However, Feduccia cast considerable doubt on the significance of the stapes as an index to relationships and, as noted above, showed (1975a) that the stapes of *Acanthisitta* actually differs from that in *all* other groups of passerine birds.

Wolters (1977), without explanation, gave the New Zealand Wrens their own suborder, Acanthisittae, between the suboscine Tyranni and the oscine suborder Passeres, and Mayr (1979) indicated his uncertainty by placing the Pittidae, Philepittidae, and Acanthisittidae in a " Suborder Incertae Sedis " between the New World Tyranni and the Australian Menurae. Sibley (1974), Feduccia (1975a), and Sibley & Ahlquist (in press, h) have provided evidence that the Australian lyrebirds (Menuridae) are oscines.

The taxonomic history of the Acanthisittidae demonstrates the difficulties encountered in the attempts to determine the phylogeny and relationships of birds using morphological characters. During the period from 1882 to 1975, there was a consensus that the New Zealand Wrens are suboscines, although there was a wide range of opinion within that boundary. Feduccia expanded the arena to include the oscines but the lack of confidence in any of the opinions noted above is epitomised by Mayr's (1979) assignment of the group to the limbo of " incertae sedis." After a century of study and debate we have returned to the starting point — the Acanthisittidae are passerine birds of unknown affinities.

In this paper we offer new data from comparisons of single-copy DNA sequences, which provide objective measurements of the degrees of difference between the genetic complements of different species. These data indicate that the Acanthisittidae are the only survivors of a lineage that probably branched from the other passerines in the Cretaceous. They are suboscines, but they have no close living relatives.

METHODS

We have used the DNA-DNA hybridization technique to examine the taxonomic relationships between the New Zealand Rifleman and other passerines. The genetic material, deoxyribonucleic acid (DNA), is a double-stranded molecule composed of linear sequences of four " nucleotides," which differ in the chemical structures of their nitrogenous bases, namely, adenine (A), thymine (T), guanine (G), and cytosine (C). In double-stranded DNA the bases occur as complementary pairs: an A in one strand pairs only with a T in the other strand, a G pairs only with a C. Genetic information is encoded in the *sequences* of the bases. The two strands of native DNA molecules will separate if heated in solution to c.100 °C, which dissociates ("melts") the hydrogen bonds between base pairs. Upon cooling, the double-stranded molecules reform because the complementary bases on the two strands reassociate. If the temperature is maintained at or near 60 °C, base pairing occurs only between *long* homologous sequences of nucleotides. This is because only long sequences of complementary bases have sufficient bonding strength to maintain stable duplexes at that temperature, and only homologous sequences have the necessary degree of complementarity. Thus, under appropriate conditions of temperature and salt concentration, the dissociated single strands of conspecific DNA will reassociate only with their homologous partners and the matching of complementary base pairs will be essentially perfect.

Similarly, if the single-stranded DNA molecules of two different species are combined under conditions favouring reassociation, " hybrid " double-stranded molecules form between homologous sequences. However, these hybrid molecules will contain mismatched base pairs because of the differences in their nucleotide sequences that have evolved since the two species diverged from their most recent common ancestor. The mismatched bases reduce the bonding strength holding the two strands together and cause them to dissociate at a temperature lower than that required to melt conspecific double-stranded DNA molecules. The reassociation of homologous sequences, and the decreased thermal stability of partly mismatched hybrid sequences, form the basis of the DNA-DNA hybridization technique.

The extent to which the bases in the homologous nucleotide sequences of any two single strands of DNA form complementary A-T and G-C pairs can be determined by measuring (1) the percentage of hybridization and (2) the thermal stability of the reassociated double-stranded molecules. Following is a synopsis of the technique, which is described in more detail by Sibley & Ahlquist (1981) and based on procedures described by Kohne (1970) and Britten *et al.* (1974).

DNAs of the species in Table 1 were obtained from the nuclei of avian erythrocytes, purified according to the procedures of Marmur (1961) and Shields & Straus (1975), and " sheared " into fragments with an average length of c.500 nucleotides by sonication.

The single-stranded DNA of the New Zealand Rifleman, which was to be " labelled " with radioiodine, was allowed to reassociate to a Cot of 1000 at 50 °C in 0.48M sodium phosphate buffer. (Cot = the concentration of DNA in moles/litre times the duration of incubation in seconds — Kohne 1970: 334.) This period of reassociation permitted most of the repeated sequences to form double-stranded molecules while the slowly reassociating single-copy sequences remained single stranded. The latter were recovered by chromatography on a hydroxyapatite column. This process produced a single-copy DNA preparation consisting of one copy per genome of each original single-copy sequence and *at least* one copy per genome of each different repeated sequence. Such a single-copy preparation contains at least 98%, and probably 100%, of the " sequence complexity " of the genome, i.e., the total length of *different* DNA sequences (Britten 1971). Kohne (1970: 334-347) has discussed the reasons for using only single-copy DNA in studies designed to determine " the extent of nucleotide change since the divergence of two species."

The single-copy DNA sequences of the New Zealand Rifleman were labelled with radioactive iodine (^{125}I) according to the procedures of Commorford (1971) and Prensky (1976). DNA-DNA hybrids were formed from a mixture composed of one part (=250 nanograms) radioiodine-labelled single-copy DNA and 1000 parts (=250 micrograms) sheared, whole DNA. The hybrid combinations were heated to 100 °C for 10 min to dissociate the double-stranded molecules into single strands, then incubated for 120 hours (=Cot 16 000) at 60 °C to permit the single strands to form double-stranded hybrid molecules.

The DNA-DNA hybrids were bound to hydroxyapatite columns immersed in a temperature-controlled water bath at 55 °C and the temperature was then raised in 2.5 °C increments from 55 °C to 95 °C. At each of the 17 temperatures the single-stranded DNA produced by the melting of double-stranded molecules was eluted in 20 ml of 0.12M sodium phosphate buffer.

The radioactivity in each eluted sample was counted in a Packard Model 5220 Auto-Gamma Scintillation Spectrometer, optimised for ^{125}I.

A computer program determined the best fit of the experimental data to one of four functions: (1) the Normal, (2) the dual-Normal, (3) the " skewed " Normal, or (4) a modified form of the Fermi-Dirac equation.

To obtain a comparison between the homologous DNA hybrid *(Acanthisitta chloris* x *A. chloris)* and each of the heterologous hybrids (e.g. *A. chloris* x *Pipra coronata,* etc.) we have used the $T_{50}H$ statistic of Bonner *et al.* (1981), which, in a normalised cumulative frequency distribution function, is the temperature in degrees Celsius at which 50% of the single-copy DNA sequences are in the hybrid form. The $T_{50}H$ (or $T_{50}R$) statistic was first suggested by Kohne (1970: 349). In the calculation of $T_{50}H$ it is assumed that all of the single-copy sequences in the genomes of each of the two species being compared have homologs in the other species, that all single-copy sequences potentially can hybridise with their homologs, and that all degrees of divergence can be detected. For DNA-DNA hybrids with normalised percentages of hybridization greater than 50%, $T_{50}H$ may be determined by a graphic extrapolation of the most linear portion of the cumulative (sigmoid) thermal dissociation curve to find the temperature corresponding to its intercept with the 50% hybridization level. All of the DNA hybrids in this study had percentages of hybridization above 50%. The delta $T_{50}H$ is the difference in degrees Celsius between the $T_{50}H$ of the homologous hybrid and the $T_{50}H$ of a heterologous hybrid. For additional discussion of $T_{50}H$, and other aspects of data analysis, see Sibley & Ahlquist (1981).

RESULTS AND DISCUSSION

Tables 1 and 2 and Figures 1 and 2 contain the data from the DNA-DNA hybrids between the radioiodine-labelled single-copy DNA sequences of *Acanthisitta chloris* and the DNAs of 57 other species. These include four species of New World suboscine tyrannoids, five species of New World suboscine furnarioids, two species of broadbills, three species of pittas, 41 species of oscines, and two species of non-passerines. Because only the DNA of *Acanthisitta* was labelled with radioactive iodine, the delta $T_{50}H$ values are distances between it and the other taxa, but not among the other taxa. Two species that have the same delta $T_{50}H$ values are phylogenetically equidistant from the labelled species, but may be any distance from one another which is equal to, or less than, their common distance from the labelled species.

From our comparisons of the DNAs of other groups, we have found that delta $T_{50}H$ values from c. 7-9 are usual between subfamilies, from 9-12 between families, 13-15 between superfamilies, 16-19 between suborders, and 20-25 between orders. These values are preliminary and subject to an error of c. ± 1.0 (Sibley & Ahlquist, 1980, 1981; in press, a-h).

Table 2 contains the averages, standard errors, and standard deviations for the $T_{50}H$ values of the DNA-DNA hybrids between

TABLE 1 — DNA-DNA hybridization values for comparisons between the New Zealand Rifleman and other species of birds. The abbreviations under the heading Group Index are: A=Acanthisitta, T=Tyrannoidea, F=Furnarioidea, E=Eurylaimidae, P=Pittidae, O=Oscine (Passeres), NP=Non-passerine.

COMMON NAME	SCIENTIFIC NAME	$\Delta T_{50}H$	GROUP INDEX
New Zealand Rifleman	*Acanthisitta chloris*	0.0	A
Ornate Umbrellabird	*Cephalopterus ornatus*	16.4	T
Blue-crowned Manakin	*Pipra coronata*	16.6	T
Chestnut-crowned Leaf-gleaner	*Automolus rufipileatus*	17.1	F
Black and Red Broadbill	*Cymbirhynchus macrorhynchos*	17.2	E
Barred Antshrike	*Thamnophilus doliatus*	17.2	F
Green Broadbill	*Calyptomena viridis*	17.4	E
Straight-billed Woodhewer	*Xiphorhynchus picus*	17.4	F
Yellow-bellied Elaenia	*Elaenia flavogaster*	17.7	T
Willow Flycatcher	*Empidonax traillii*	17.7	T
Dusky-throated Antshrike	*Thamnomanes ardesiacus*	17.8	F
Striped Leaf-gleaner	*Philydor subulatus*	17.9	F
Noisy Pitta	*Pitta versicolor*	18.2	P
Banded Pitta	*Pitta guajana*	18.3	P
Green Broadbill	*Calyptomena viridis*	18.4	E
Noisy Pitta	*Pitta versicolor*	18.5	P
Blue-headed Pitta	*Pitta baudi*	18.6	P
White-winged Chough	*Corcorax melanorhamphos*	18.6	O
Striated Pardalote	*Pardalotus striatus*	18.6	O
Chirruping Wedgebill	*Psophodes cristatus*	18.6	O
American Crow	*Corvus brachyrhynchos*	18.8	O
Australian Magpielark	*Grallina cyanoleuca*	18.8	O
Frilled Monarch	*Arses telescophthalmus*	19.1	O
Dusky Woodswallow	*Artamus cyanopterus*	19.1	O
Pale-billed Scrubwren	*Sericornis spilodera*	19.1	O
Lesser Bird-of-Paradise	*Paradisaea minor*	19.2	O
King of Saxony Bird-of-Paradise	*Pteridophora alberti*	19.2	O
Village Weaver	*Ploceus cucullatus*	19.2	O
Black-faced Woodswallow	*Artamus cinereus*	19.3	O
Brown Treecreeper	*Climacteris picumnus*	19.3	O
Fan-tailed Berrypecker	*Melanocharis versteri*	19.3	O
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	19.4	O
Mistletoebird	*Dicaeum hirundinaceum*	19.4	O
Splendid Wren	*Malurus splendens*	19.4	O
White-browed Scrubwren	*Sericornis frontalis*	19.4	O

COMMON NAME	SCIENTIFIC NAME	$\Delta T_{50}H$	GROUP INDEX
Western Thornbill	*Acanthiza inornata*	19.5	O
Varied Sittella	*Daphoenositta chrysoptera*	19.5	O
Chiffchaff	*Phylloscopus collybita*	19.5	O
Red-eyed Vireo	*Vireo olivaceus*	19.5	O
Eastern Yellow-robin	*Eopsaltria australis*	19.6	O
White-throated Warbler	*Gerygone olivacea*	19.7	O
House Sparrow	*Passer domesticus*	19.7	O
Lesser Whitethroat	*Sylvia curruca*	19.9	O
Willie Wagtail	*Rhipidura leucophrys*	20.0	O
Yap White-eye	*Rukia oleaginea*	20.0	O
Common Starling	*Sturnus vulgaris*	20.2	O
Silvereye	*Zosterops lateralis*	20.3	O
River Flycatcher	*Monachella muelleriana*	20.4	O
Common Bulbul	*Pycnonotus barbatus*	20.4	O
Clapper Lark	*Mirafra apiata*	20.5	O
Red-winged Blackbird	*Agelaius phoeniceus*	20.7	O
Oriental White-eye	*Zosterops palpebrosa*	20.8	O
Fairy-bluebird	*Irena puella*	20.9	O
Scarlet Robin	*Petroica multicolor*	20.9	O
Rufous Bristlebird	*Dasyornis broadbenti*	21.0	O
Skylark	*Alauda arvensis*	21.2	O
Little Grassbird	*Megalurus gramineus*	21.3	O
Song Sparrow	*Zonotrichia melodia*	21.7	O
Sacred Kingfisher	*Halcyon sancta*	22.5	NP
Downy Woodpecker	*Picoides pubescens*	25.4	NP

Acanthisitta chloris and the groups represented in Table 1. It is clear that *Acanthisitta* is a member of the suboscine suborder Oligomyodi, which also includes the New World suboscines, the broadbills, the pittas, and, presumably, the philepittids. *Acanthisitta* is distant enough from the other oligomyodian groups (Tyrannides) to be separated from them as an infraorder, Acanthisittides.

It is obvious that the delta T_{50}H values for the members of the groups in Tables 1 and 2 have narrow ranges. The nine values for the DNA hybrids between *Acanthisitta* and the New World suboscines range from 16.4 - 17.9, a difference of 1.5, and the 41 oscine values range from 18.6 - 21.7, a difference of 3.1. The New World suboscine values represent nine genera, at least three families, and two superfamilies, and the oscines represent 18 of the 54 living groups recognised as families by Wetmore (1960). The three broadbill values differ by 1.2, the four pitta values by 0.4. This clustering indicates that the members of each group are genetically equidistant from *Acanthisitta*. Each such cluster is a " relative rate test " (Sarich &

Wilson 1967) in which an external reference species (i.e. *A. chloris*) is used to compare the rates of evolutionary change in members of at least two taxa that diverged first from the external reference species and later from one another. The clustering of the species within each group indicates that the *average* rate of evolutionary change (=nucleotide substitution) has been the same in the lineages within each cluster since the time when the most recent common ancestor of the members of that lineage branched from the lineage that led to *Acanthisitta.*

These data also suggest that the *same average rate* of DNA evolution occurs in *all* lineages. This is indicated by the data for the nine New World suboscines and for those of the 41 oscines. The two major lineages of New World suboscines, the Tyrannoidea and the Furniarioidea, probably branched from one another at least 65 million years ago (mya) but, relative to *Acanthisitta,* their average $T_{50}H$ values differ by only 0.4 °C. Similarly, the 18 " families " of oscines represented in Table 1 probably diverged from one another at various times between c. 60 and 20 mya but, relative to *Acanthisitta,* the range of their $T_{50}H$ values is only 3.1 °C for the 41 species. Most, possibly all, of this variation may be due to experimental error. The same clustered patterns have been found in the DNA hybridization data for the ratites (Sibley & Ahlquist 1981), the Hawaiian honeycreepers (Sibley & Ahlquist, in press, a), and the Australian fairy-wrens (Sibley & Ahlquist, in press, h).

TABLE 2 — Group averages, standard errors (S.E.), and standard deviations (S.D.) for the delta $T_{50}H$ DNA-DNA hybridization values of the comparisons between the New Zealand Rifleman and the members of the other groups in Table 1.

DNA-DNA HYBRIDS	Delta $T_{50}H$	S.E.	S.D.
1. *Acanthisitta chloris* x *A. chloris*			
Four homologous hybrids.................	0.0	---	---
2. *A. chloris* x nine New World suboscines			
Four tyrannoids + five furnarioids......	17.3	±0.17	±0.5
3. *A. chloris* x four tyrannoids..............	17.1	±0.35	±0.7
4. *A. chloris* x five furnarioids.............	17.5	±0.18	±0.4
5. *A. chloris* x three broadbills.............	17.7	±0.35	±0.6
6. *A. chloris* x four pittas..................	18.4	±0.10	±0.2
7. *A. chloris* x 41 species of oscines........	19.8	±0.13	±0.8
8. *A. chloris* x two non-passerines (*Halcyon* and *Picoides*).........................	24.0	±1.42	±2.0

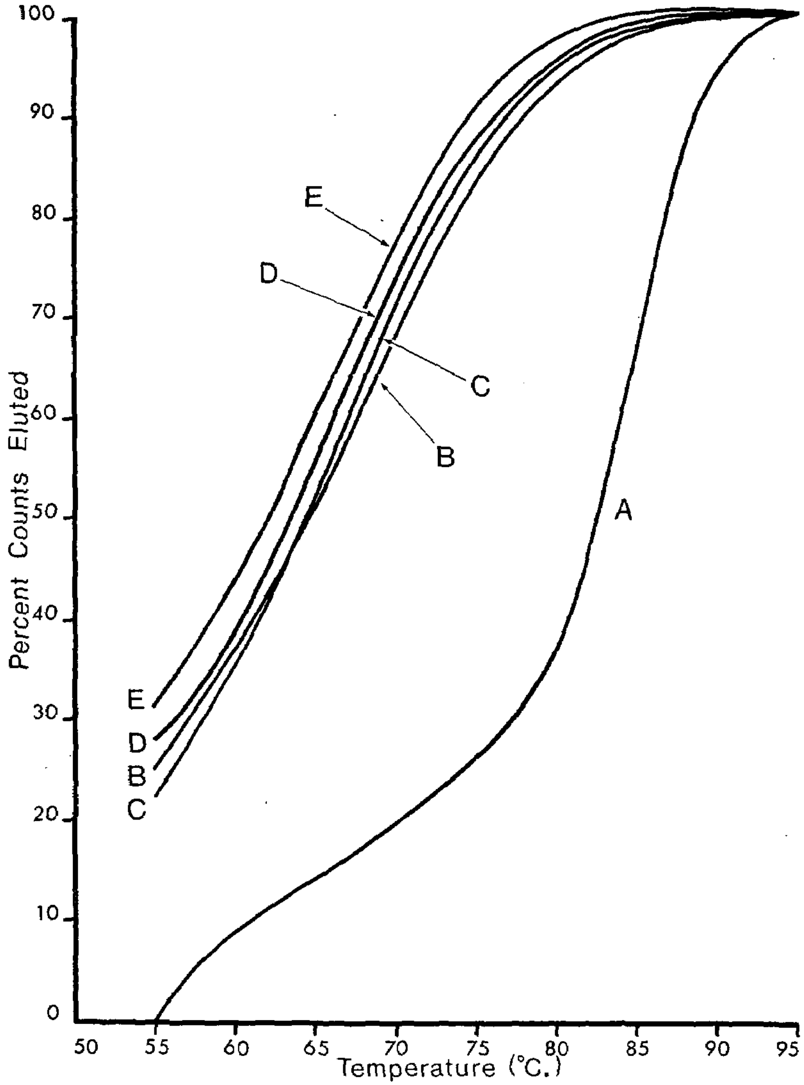

FIGURE 1 — Cumulative thermal dissociation curves of DNA-DNA hybrids in which the New Zealand Rifleman was the radioiodine-labelled species. Curve A is the average of four homologous hybrids; B= average of nine New World suboscines; C= average of three broadbills; D= average of four pittas; E= average of 41 oscines.

That DNA evolves at the same average rate in all lineages, may seem to disagree with our perception of the variable rates of evolution in morphological characters. However, since 1962 when Zuckerkandl & Pauling suggested that the amino acid sequences of proteins evolve at " constant " rates of change, the proposal that a " clocklike " rate of evolution occurs in both proteins and DNA has gained support from many studies. Fitch (1976), Wilson *et al.* (1977), and Doolittle (1979) have provided reviews.

The evidence indicates that each protein (hence each structural gene) evolves at its own rate and that the rates for different proteins differ up to c. 600-fold between the slowest histone and the most rapidly evolving immunoglobulin (Wilson *et al.* 1977: 610). An average protein molecule composed of 400 amino acids is coded for by a DNA sequence (a " gene ") of 1200 nucleotides. But the avian haploid genome contains c. 1.7 x 10^9 nucleotides, of which c. 60-70% are in the single-copy fraction as prepared for radioactive labelling. The DNA hybridization values are averages across this large number and so they reflect the net amount of nucleotide-sequence divergence due to the *average* rate of change in approximately one thousand million (10^9) nucleotides over long periods of time. Thus the uniform average rate of DNA evolution in different lineages is the statistical result of the averaging of large numbers of variables operating under the same, relatively narrow, constraints. Each nucleotide, and each gene, in each individual organism is evolving at its own rate, but when these many different rates are *averaged* over such a large number of events, and over time, the uniform *average* rate is the inevitable result. This problem has also been discussed by Sibley & Ahlquist (1981, in press, a).

Because the DNA hybridization values index the average rate of DNA evolution they are proportional to the relative times of divergence between the taxa being compared. Therefore, if the DNA delta values can be calibrated against an external dating source they will provide a measure of absolute time. In our study of the ratite birds (Sibley & Ahlquist 1981) we assumed that the divergence between the lineages that produced the living African ostriches and South American rheas began when the Gondwanaland rift between West Africa and Brazil became an impassable barrier. The minimum dating for this event was estimated as c. 80 mya and, since the ostrich-rhea delta $T_{50}H$ = 15.7, 1.0 delta $T_{50}H$ = c. 5 million years.

A similar calculation for the time of divergence between *Acanthisitta* and the other suboscines may be made by assuming that the ancestor of the New Zealand Wrens was a passenger on the drifting block that became New Zealand. The geological evidence indicates that the Tasman Sea opened up in the late Cretaceous, c. 80 mya (Fleming 1975: 16). The average delta $T_{50}H$ between *Acanthisitta* and the other suboscines = 17.7, thus 1.0 delta $T_{50}H$ = c. 4.5 million years. Considering the uncertainties in the assumptions these two values

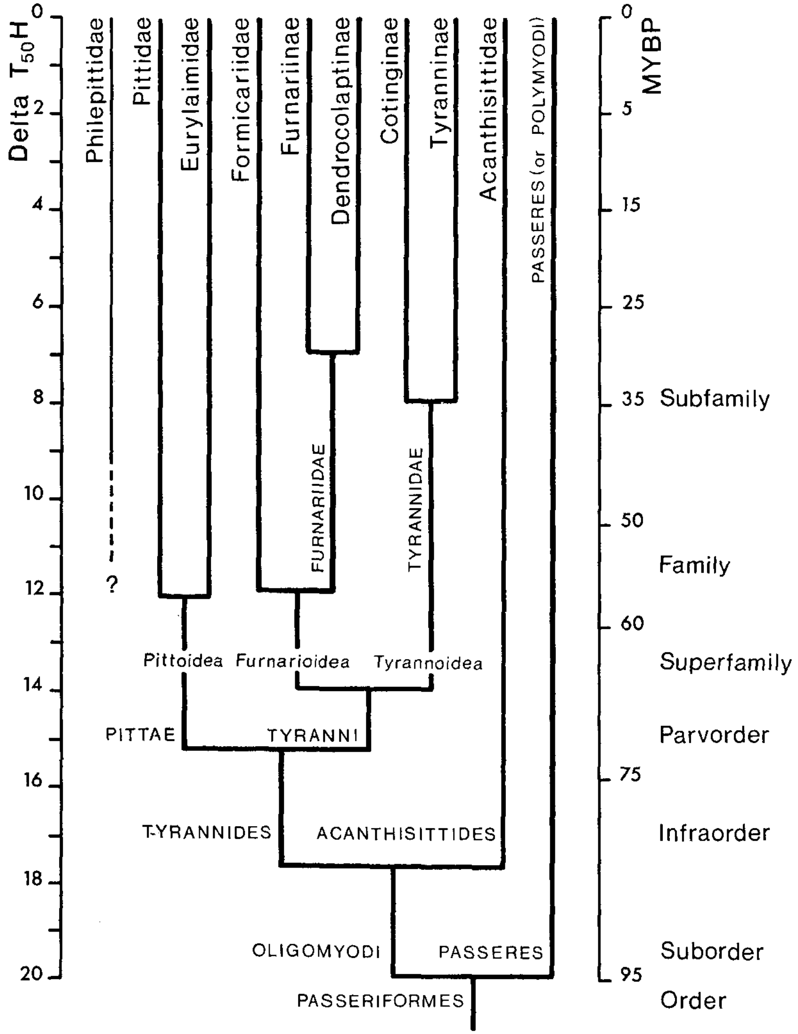

FIGURE 2 — Diagram based, in part, on the data in Tables 1 and 2 and Figure 1. The branching sequence within the Infraorder Tyrannides is based on an unpublished study in which the radioiodine-labelled DNAs of a tyrannid (**Elaenia**), a furnariine (**Automolus**), a dendrocolaptine (**Xiphorhynchus**), a pitta (**Pitta**), and a broadbill (**Calyptomena**) were used. The time scale is in millions of years before the present (MYBP).

are in excellent agreement, but both could be wrong and more and better geological and/or fossil dates of divergence are needed to obtain an accurate calibration of the delta $T_{50}H$ values.

If, for the moment, we accept an average value of 4.75 my = delta 1.0, we obtain a date of c. 70 mya for the separation of the pitta-broadbill lineage (Pittae) from the New World suboscines (Tyranni), c. 84 mya for the divergence between the Acanthisittides and the Tyrannides, c. 94 mya for the dichotomy between the Passeres and the Oligomyodi, and c. 115 mya for the divergence of the Passeriformes from their common ancestry with some non-passerine group. Figure 2 is a diagram of the branching pattern of these groups.

The standard errors (S.E.) of the average delta $T_{50}H$ values (see Table 2) may also be translated into time by using the calibration of 1.0 delta $T_{50}H$ = 4.75 million years. For example, for the divergence between the ancestral lineages of *Acanthisitta* and the 41 oscines, the average delta $T_{50}H$ = 19.8 ±0.13 S.E., which is equivalent to 94 million ±585 000 years. The S.E. is thus less than 1% of the time since the divergence of the two lineages. If the average rates of divergence among the 41 species of Passeres were actually different it is unlikely that, after 20 to 60 million years of independent evolution, all 41 would have arrived at essentially identical delta values. The c. 1% error indicated by the S.E. of 0.13 is probably due to experimental error, not to differences in the average rate of nucleotide substitution. The most reasonable explanation for these data, and for the many similar examples we have observed, is that DNA evolves at the same average rate in all avian lineages.

The New Zealand Wrens may be the oldest living group of endemic New Zealand birds because there is DNA hybridization evidence that the ancestor of the New Zealand ratites did not diverge from the Australo-Papuan ratites until the Eocene, c. 40-50 mya (Sibley & Ahlquist 1981). However, more and better geological and/or fossil divergence dates are needed to obtain an accurate calibration of the DNA hybridization values.

The phylogeny of the major subgroups of the Passeriformes will not be complete until DNA-DNA comparisons have been made among all of the pertinent groups, including the Philepittidae, the DNA of which is not yet available. However, it is apparent that the New Zealand Wrens have no close living relatives and we propose that they be placed in their own Infraorder, Acanthisittides, and be listed among the suboscines, as in the following synoptic classification of some of the major subgroups of the Passeriformes.

- Order Passeriformes
  - Suborder Oligomyodi
    - Infraorder Acanthisittides
      - Family Acanthisittidae, New Zealand Wrens
    - Infraorder Tyrannides
      - Parvorder Pittae
        - Superfamily Pittoidea
          - Family Pittidae, Pittas
          - Family Eurylaimidae, Broadbills
        - (Family Incertae Sedis Philepittidae, Asities)
      - Parvorder Tyranni
        - Superfamily Furnarioidea
          - Family Formicariidae, Antbirds
          - Family Furnariidae
            - Subfamily Furnariinae, Ovenbirds
            - Subfamily Dendrocolaptinae, Woodhewers
        - Superfamily Tyrannoidea
          - Family Tyrannidae
            - Subfamily Tyranninae, Tyrant Flycatchers
            - Subfamily Cotinginae, Cotingas, Manakins
  - Suborder Passeres (or Polymyodi).

The categories Infraorder and Parvorder follow McKenna (1975) and are used to identify the major branching points in the phylogeny depicted in Figure 2.

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SHORT NOTE

YOUNG BLACK-BROWED MOLLYMAWK INLAND

On 26 May 1981, I was notified of a live albatross that had landed on a farm property at Makahu in Taranaki, approximately 30 km east of Stratford. The landowner had found the bird in a weakened state in a damp gully in pastureland. On collection we found it to be a Black-browed Mollymawk *(Diomedea melanophrys).* The feather tips, particularly those of the tail and some hind-neck contour feathers, which still retained vestiges of down, indicated that the bird had only recently fledged and flown. C. J. R. Robertson (pers. comm.) inferred that this was probably an early-departing chick of *D. m. impavida* from Campbell Island.

It was penned, supplied with a trough of seawater, and force fed with fresh fish (trevally) pieces, until after 2 days it showed signs of restlessness and greater resistance to being fed. It was released on to the paritutu headland at New Plymouth, from where it flew to sea.

D. P. GARRICK, *Wildlife Service, P.O. Box 96, New Plymouth*

PATTERNS OF VARIATION AND DISPERSAL IN THE BUFF-BANDED RAIL (Gallirallus philippensis) IN THE SOUTH-WEST PACIFIC, WITH DESCRIPTION OF A NEW SUBSPECIES

By RICHARD SCHODDE and R. de NAUROIS

ABSTRACT

Geographical variation in the Buff-banded Rail *(Gallirallus philippensis)* in the south-west Pacific is reassessed in the light of the origin of island stocks and nomadism. Nomadism appears to have diluted divergent evolution on small islands and (sub) continental mainlands throughout the region, and from it lines of colonisation from mainland sources have been adduced. There appear to be no justifiable subspecies on mainland Australia, and others on islands in the Bismarck Sea are open to question; one new subspecies, *G. p. tounelieri,* is described from cays in the Coral Sea.

INTRODUCTION

The Buff-banded Rail *(Gallirallus philippensis)** is one of the most polytypic and dispersive of rails. From what seem to be source populations in Australia and New Guinea, it has colonised islands throughout the south-west Pacific, even the smallest cays, diverging in isolation there to a greater or lesser extent. Mathews (1911), Mayr (1938, 1949), Junge (1953) and Ripley (1977) have summarised much of the variation throughout the region. Different island populations towards the southern, eastern and northern periphery show parallel trends towards darkening of the dorsum and loss of the rufous pectoral band. Flightlessness, another well-known characteristic of rails on islands, is not evident except in New Zealand and islands nearby. Rather, the wings of most forms are rather attenuated, with the second outermost primary usually longest, pointing to use in long flights. The penchant of the Buff-banded Rail for dispersal appears to have led to re-invasions of islands, and consequent gene-flow may have slowed the rates of evolutionary change and modified its direction in different islands or archipelagos.

The interplay of these factors is considered in the following review of regional variation. Material for the study came from Australian State and Commonwealth museums (AM, ANWC, NMV, QM, SAW, WAM), the National Museum of New Zealand (NMNZ), the Canterbury Museum, Christchurch (CMC), the American Museum

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* In New Zealand called the Banded Rail, **Rallus philippensis** — Ed.

of National History (AMNH) and the Musee national d'Histoire Naturelle, Paris (MHNP). It includes specimens gathered by de Naurois and CSIRO Division of Wildlife Research in the Coral Sea.

TABLE 1 — Measurements (in mm) of specimens of Buff-banded Rail from selected areas in the south-west Pacific (from material in Australian state and commonwealth museums, the National Museum of New Zealand, the Canterbury Museum, Christchurch, and the Musee national d'Histoire Naturelle, Paris). In samples of three or more specimens, only means ± one standard deviation are given; for breadth of breast band, range and mean (in parentheses) are given.

Locality	Sex	No.	Wing	Tarsus	Exposed culmen	Culmen/ wing ratio	Breadth of breast band
New Zealand	♂	3	137.3±0.6	41.6±1.9	34.9±5.2	.25±.04	0-15 (10)
	♀	3	130.7±2.5	40.9±4.4	33.2±2.1	.25±.02	5-18 (13)
Lord Howe Island	-	2	135,149	41,44	28.5,32.8	.21,.22	15
Norfolk Island	-	1	140	41	29.6	.21	13
South-western Australia	♂	8	142.9±7.3	40.3±3.0	30.8±2.1	.23±.02	0-20 (15)
north to 22°S	♀	7	138.8±11.1	40.5±2.7	31.3±3.2	.23±.02	10-20 (18)
North-western Australia	♂	4	143.5±2.4	41.8±2.2	21.8±2.9	.11±.01	13-30 (20)
(Kimberley Division to	♀	7	140.5±2.9	40.0±2.3	29.4±1.2	.11±.01	12-30 (19)
Gulf of Carpentaria)							
South-eastern Australia	♂	37	146.3±5.2	41.1±2.2	31.4±1.9	.21±.01	5-22 (16)
south of 26°S	♀	39	142.6±5.1	39.1±1.8	29.6±1.9	.21±.01	0-25 (16)
North-eastern Australia	♂	17	147.1±5.2	41.7±1.6	31.8±1.8	.22±.01	0-22 (14)
18-26°S	♀	12	139.8±5.7	39.0±2.6	30.0±1.5	.21±.01	5-25 (15)
Islands in Torres Strait	♂	2	147,150	41,43	31.4,33.0	.21,.22	20,25
	♀	2	129,137	34,42	23.9,27.6	.19,.20	5,25
Islands of northern Great	♂	5	133.2±8.0	38.8±1.6	31.2±1.2	.23±.01	10-25 (14)
Barrier Reef (Raine,	♀	6	130.2±4.8	37.8±1.0	28.6±0.4	.22±.01	6-20 (11)
Chilcott, Pelican)							
Islands of Coral Sea	♂	3	140.3±8.5	40.0±2.7	33.4±1.0	.24±.01	0-12 (6)
(Willis, Chesterfield,	♀	6	124.8±4.6	36.5±2.4	28.4±2.3	.23±.01	0-12 (5)
Surprise groups) and							
southern Great Barrier							
Reef (Bunker Group).							
Central montane	♂	2	145,148	43,46	32.0,32.6	.22,.22	8,15
Papua New Guinea	♀	2	137,145	40,43	27.9,28.9	.20,.20	5,11

ASSESSMENT

New Zealand

Divergence and invasion in the *philippensis* group of rails seem to have been most complex in New Zealand (cf Olson 1975 and *in* Ripley 1977; Ripley 1977: 70). There, the various forms of the Weka *(Gallirallus australis)*, as the sole survivors of some early radiation, represent the original stock. Their region of origin, like that of other possible members of the *Gallirallus* group of rails in the South-west Pacific, is obscure. Olson (1973), following Mayr (1949), showed them to be derivatives of the *philippensis* group that became large and dull in plumage, and lost the power of flight in parallel with the Takahe *(Porphyrio mantelli)**. The Buff-banded Rail itself, which we include here in *Gallirallus* after Olson (1973), apparently arrived later; and the evolutionary distance between it and the Weka is now too great to permit interbreeding and gene flow between them.

Buff-banded Rails on mainland New Zealand are morphologically closest to those in Australia, and, like so many other New Zealand birds (e.g. *Porphyrio p. melanotus* and *Zosterops lateralis)*, they probably came from there. Since their arrival, they have diverged subspecifically. Although they have the same dorsal and ventral pattern and tone as Australian populations, they differ in their longer and more slender bills (Table 1) and usually have narrower or incomplete rufous breast bands, duller chestnut collars and shorter longest secondaries. All of these characters vary, to the extent that occasional individuals barely differ from Australian birds in any way. It suggests that gene flow from Australia to New Zealand may be continuing.

The origins of now extinct satellite forms on Macquarie *(G. p. macquariensis)* and the Chatham Islands *(G. p. dieffenbachii* and *G. modestus)*** are more difficult to unravel because of the mixing of morphological characters in *macquariensis* and the very distinctiveness of *dieffenbachii* and *modestus;* we decline to guess. Traits combined in *macquariensis* were polymorphism, short bill and wing, dark dorsum, and broad rufous breast band, whereas *dieffenbachii* stood apart in its curved bill, extensive dorsal and ventral barring, short legs, and shortened remiges tending towards flightlessness. *G. modestus,* probably an earlier invader of the Chathams than *dieffenbachii,* acquired flightlessness and perhaps the colour pattern and small and slender-headed form of a true *Rallus* through neoteny (cf Ripley 1977: 96). For more general details, see Mathews (1911), Delacour in Mayr (1949), Oliver (1955) and Ripley (1977).

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* In New Zealand called **Notornis mantelli** — Ed.

** All three are included in the genus **Rallus** in New Zealand nomenclature —Ed.

Australia

Australian populations have been divided into two or three subspecies. Those in south-western Australia are said to be darker dorsally than those in the east (Mathews 1912), and smaller and more rufous on the hind neck (Ripley 1977); and those in northern Australia ranging to southern New Guinea are thought smaller than those in the south (Mayr 1938) and to have a narrower, deeper breast band of rufous (Mayr 1938, Junge 1953, Parker 1970). Our examination of much larger series from south-western and northern Australia than were available to previous revisers (Table 1) indicates firstly that there is no geographically consistent variation in Australian populations, and secondly that birds from these populations range north across Torres Strait to southern and western New Guinea (also Rand 1942; Junge 1953). All should be combined under a single subspecies *G. p. mellori* (Mathews) that includes as well *G. p. randi* (Mayr & Gilliard) from the Snow Mountains of Irian Jaya (cf Rand 1942; *pace* Mayr & Gilliard 1951).

Adults throughout Australia are alike in plumage except for the breadth and intensity of the rufous band on the breast. This band, which is usually complete, pale rufous and 10-20 mm wide (allowing for vagaries in the preparation of specimens), varies individually rather than geographically (Table 1). It averages just as wide in the four specimens we have seen from Torres Strait as in 89 from southern Australia, and is no darker (*pace* Parker 1970). Moreover, it is rarely obsolete except in immatures which may be otherwise identified by their duller chestnut facial stripes and collars, duller white dorsal spotting, brownish (not red) irides, and duller bills; their primaries, however, do not seem to be appreciably more pointed than in adults (cf Fullagar & Disney, in press, for *Tricholimnas sylvestris*). Thus, the bright rufous nuchal area on the type of *mellori* Mathews from south-western Australia (cf Greenway 1973, Ripley 1977; not seen by us) may reflect only age. The backs and shoulders of adults are not very variable, and they are paler and more olive in tone than in other subspecies, and spotted more finely with white. Specimens that Mayr (1938) and Junge (1953) record from south-western New Guinea and the Moluccas, and others that we have seen from Torres Strait, are little darker than most Australian specimens.

There are no consistent geographical trends in size either (Table 1; *pace* Mayr 1938; Parker 1970). Birds from north-eastern Australia and Torres Strait are just as large as those from south-eastern Australia, and those in the west, although averaging a trifle smaller, overlap eastern birds widely. On the other hand, there seems to be much local variability, only some of which can be attributed to differences in age and wear within samples. The more limited material measured by Mayr (1938) and Junge (1953) from southern New Guinea and islands in the Arafura Sea, although averaging smaller, is similarly variable and falls within the range for the relevant sex in Australian series. We stress that females average smaller than males everywhere.

That variation in plumage markings and size is individual rather than broadly geographical suggests continual, if haphazard interchange between and within local or regional populations. Parker *et al.* (1980) have drawn attention to seasonal movements in southern Australia which, according to our data, seem to be part of a wider pattern of more irregular nomadism, responding perhaps to the seasonal and unseasonal appearance of surface waters and to the growth and die-back of suitable fringing cover.

All specimens and records from far-northern Australia mentioned by Deigan (1964) and Parker (1970) and others in the ANWC collection are from July to October when the rails are most often seen in southern South Australia. There are also records, including breeding, from other parts of northern Australia over the wet season, between December and May (e.g. Barnard 1914, Crawford 1972; H. B. Gill, pers comm.; specimens in ANWC, NMV, WAM). The proportion of specimens in Australian museums taken there in those months is one in four. This, curiously, is the very same as the proportion from south-eastern Australia, which the rails are thought to leave then (Parker *et al.* 1980).

The rails may simply be more secretive in summer months, after their main breeding (e.g. North 1913; Dunlop 1970). Dunlop found them to be fairly sedentary in permanent habitat on the central coast of eastern Australia, and Gill (1970) and Bravery (1970) record them throughout the year in north-eastern Queensland. Some, nevertheless, may disperse north during the first half of the year, reaching southern New Guinea and the Moluccas (cf Junge 1953: 16), notwithstanding that nearly all specimens have been taken there between July and September (cf Mayr 1938, Rand 1942, Junge 1953). That the rail commutes frequently between northern Australia and southern New Guinea is suggested not only by the circumstantial similarity between Australian and south-western New Guinean birds (cf Rand 1942, Junge 1953) but also by at least one record in January from the lighthouse rock of Booby Island in Torres Strait where, among nomadic rallids, *Porzana pusilla, P. tabuensis* and *Poliolimnas cinereus* have also been picked up in transit between Australia and New Guinea (specimens in QM).

New Guinea

In northern and eastern New Guinea, the Australian form is replaced by darker and more richly coloured rails (Gloger's rule). Their crowns and hind necks are much deeper chestnut, their backs blackish and more heavily marked with white, and their rufous breast bands deeper in tone, yet often obsolete as well. Of the three subspecies described (Mayr 1938, Mayr & Gilliard 1951), only two seem to be valid: *lacustris* Mayr with white-spotted mantle and completely barred belly in the northern lowlands, and *reductus* Mayr with white-barred mantle and unbarred mid-belly in the east. A third from the central mountains, *G. p. wahgiensis* (Mayr & Gilliard), was based on four specimens that were darker than *reductus,* smaller in wing and bill, and had broader rufous breast bands. Nevertheless, another four specimens from the Wahgi Valley and Mt Giluwe in AM and ANWC *(terra typica* of *wahgiensis)* bridge the supposed differences between *wahgiensis* and *reductus* almost perfectly (see Table 1). Affinity between populations in lowland eastern New Guinea (e.g. *reductus*) and those adjacent in the central mountain ranges (e.g. *wahgiensis*) is common (Mayr & Gilliard 1954).

Coral Sea

Buff-banded Rails on the cays in the Coral Sea west to the Great Barrier Reef are also rather different from those of mainland Australia, as pointed out by Parker (1970). Collectively they average darker dorsally than Australian and New Zealand populations (including their chestnut nuchal collar), have narrower to obsolete rufous pectoral bands, and, though small in wing like New Zealand *assimilis,* have rather shorter bills approaching Australian *mellori* (Table 1). Parker (1970) referred them to *G. p. yorki* (Mathews), but the type of *yorki* from Cape York Peninsula, like other specimens from Torres Strait nearby, falls more within the range of Australian *mellori.* Although small with a wing of 134 mm (M. K. Le Croy, pers. comm.), it is a female with the pallid tone and well-developed pectoral band of Australian populations. Accordingly, we treat our series from the Coral Sea as a new subspecies, naming it after a colleague of de Naurois, *Gallirallus philippensis tounelieri,* n. subsp.

Holotype, in Musee National d'Histoire Naturelle, Paris: female adult; Ile Longe, Chesterfield Islands; coll. R. de Naurois, 21 Sept 1975; measurements (mm): wing 127, tail 58, tarsus 33.3, exposed culmen 29.5.

Description (from 8 males, 12 females): Crown dull olive to hair brown, usually heavily mottled with black; chestnut facial stripe and nuchal collar duller and darker than in *R. p. mellori;* back dark, heavily mottled black on olive, with white spots usually smaller and sparser than in *R. p. mellori;* chestnut bars on outer vanes of middle remiges usually narrower than intervening areas of dusky black and often rounded into spots; ventrally like *R. p. mellori* but with variably narrower and darker rufous band on the breast (0 - ± 25 mm wide, mean ± 9 mm); wings (mm), males 123-150 (mean 135.9), females 121-138 (mean 127.5); tarsus (mm), males 36-42 (mean 39.2), females 34-41 (mean 37.2); exposed culmen (mm), males 29.8-34.3 (mean 32.0), females 27.2-29.7 (mean 28.5).

Distribution: Coral islets of Coral Sea (Willis, Chesterfield and Surprise groups north to south-eastern New Guinean archipelagos) and Great Barrier Reef (Raine Island south to Bunker group). The specimen described by Mayr (1938) from the China Straits at the south-eastern tip of New Guinea as being intermediate between the New Guinean subspecies *G. p. lacustris* (Mayr) and *G. p. reductus* (Mayr) fits better with this form morphologically and geographically. A female, it is small with a wing of 139 mm and approaches *tounelieri* in dorsal tone and markings and dull narrow rufous breast band. Its differences of a blacker mantle and completely barred belly, on the other hand, suggest gene flow from Papuasian populations.

Although there is a remarkable overall similarity between the specimens from all Coral Sea islets, there is also local variation among them, mainly in size and development of the rufous breast band. Such intrinsic variability may not be due just to the founder effect but also to occasional, overseas interchange between the populations on adjacent islet groups. This may even be augmented by additional gene flow from Australian, New Caledonian and perhaps even New Zealand sources. Evidence for interchange among local populations comes from the general morphological similarity between the specimens on the different islets and the erratic appearance of rails on cays along the Great Barrier Reef (H. B. Gill, pers. comm.). Such movements may well have contributed significantly to the rapid build-up in the population on Heron Island during the late 1960s (Cooper 1948, Kikkawa 1970; cf Macgillivray 1928). It leads us to suggest (after Diamond 1974, Ripley 1977: 16-19) that the cays of the Coral Sea are colonised by a rather mobile island 'tramp' subspecies.

Evidence for gene flow comes from the greater frequency of Australian *mellori* characters in specimens from cays on the Great Barrier Reef close to Australia, and of New Caledonian *swindellsi* characters in those further east towards New Caledonia. Specimens from the Great Barrier Reef, for example, often have slightly paler dorsa and more distinct pectoral bands than those on the Chesterfield and Surprise islands near New Caledonia, and vice versa; those from the Surprise Islands, furthest from the Australian coast and closest to New Caledonia, are the darkest of all (aff. *swindellsi*). The flow, nevertheless, does not appear to have been strong enough to affect the overall morphological integrity of the populations on the cays. In birds on Heron Island, for example, the rufous pectoral band averages much narrower and is more frequently obsolete than in those on the Australian mainland only 70 km away. Of 22 individuals observed in December 1979, 18 had variably narrow and incomplete bands and 4 lacked them entirely (L. L. Short, pers. comm.). Gene flow in the opposite direction, from the Coral Sea outwards, cannot be traced in our material, almost certainly because it is drowned in the larger gene pools on mainland Australia, New Caledonia and other chains of large land islands.

Peripheral island groups in the South-west Pacific

The morphological characteristics of populations on islands to the east and north of the Coral Sea have been reviewed in detail by

Mathews (1911) and Mayr (1938, 1949). From material we have seen, *G. p. sethsmithi* (Mathews) of Vanuatu and Fiji is most like Australian populations in its general colour and markings while approaching Coral Sea birds in its reduced to obsolete pectoral band. It is, nevertheless, bounded geographically by much darker forms with more heavily black-barred ventral surfaces on New Caledonia (*swindellsi* Mathews) and in the southern Solomons (*christophori* Mayr). This patchwork pattern of variation suggests that these populations within and surrounding the Coral Sea were derived, at one time or another, directly or indirectly from Australia and not eastern New Guinea. Mayr (1938) also concluded that the birds in the Solomons arrived from the south, probably from Vanuatu.

Further southwards, we have seen one specimen from Norfolk Island (type locality of *norfolkensis* Mathews) and another two from Lord Howe Island in AM and ANWC. All three are indistinguishable in colour, markings and measurement from Australian *mellori* (Table 1). Judged from the accounts of Hindwood & Cunningham (1950) and McKean *et al.* (1976), Buff-breasted Rails are not permanent on these islands; those birds that have been found there are apparently episodic immigrants from Australia and, perhaps, New Zealand.

Eastwards are the outlying forms *G. p. goodsoni* (Mathews) and *G. p. ecaudatus* (J. F. Miller) in Samoa and Tonga respectively, apparently differing from each other mainly in size and in depth of dorsal tone (cf Ripley 1977, Kinsky & Yaldwyn 1981). There may be some inter-island movement among them, judged from the build-up in numbers in Niue Island from the late 1950s onwards (Wodzicki 1971) and the apparent variability of local populations: compare the conflicting characters described by Mathews (1911), Murphy (1924) and Ripley (1977) from different series of specimens. Birds on intervening Nuie are closest to *goodsoni* (Kinsky & Yaldwyn 1981). This form, despite the likelihood that it is derived from sources in southern Melanesia (e.g. Fiji, Vanuatu), approaches still darker forms in the eastern Bismarck Archipelago, particularly *G. p. meyeri,* in its bright chestnut crown, white-barred mantle and loss of the rufous pectoral band (cf *G. p. reductus* of eastern New Guinea). Perhaps the most likely explanation is not gene flow from the Bismarck Archipelago — which would be buffered by populations from the Solomons south to New Caledonia — but random fixation and selection within the small founding colonies originally reaching the islands.

Bismarck Archipelago

As Mayr (1949) has pointed out, the smaller islands of the Bismarck Archipelago appear to have been colonised from New Guinea. All forms from these islands have the rich, dark tones of New Guinean birds: deep chestnut napes, blackish dorsa with a tendency to white barring on the mantle, large white spots on shoulders and wings, and deep rufous pectoral bands. Differences between them are in fact so slight that the five or six subspecies distinguished among them by Mayr (l.c.) need further study and confirmation. In the limited material available to us, the tone of the crown and nape, the form of the white marks on the mantle, the presence of black barring in the rufous pectoral band, and size all vary individually within samples from each island group. Even the widths of black-and-white bars on the ventral surface and the rufous-and-black bars on the primaries seem unreliable because they tend to differ most between samples from neighbouring islands: compare *G. p. meyeri* of New Britain and Witu with *G. p. lesouefi* of New Hanover and the Hibernian Islands.

The slight inter-island variation that there is is of the chequer-board type, making it difficult to trace the routes of dispersal through the Bismarck Sea by morphoclines. Nevertheless, traits grouped and tabulated by Mayr (1949, Table 1) indicate that populations in the Admiralty, Ninigo, Anchorite and Hermit Islands in the western Bismarck Sea — *admiralitatis* Stresemann, *praedo* Mayr and *anachoretae* Mayr — are all inter-related. According to their combination of characters, they were probably derived from sources in northern New Guinea, but whether from *lacustris*- or *reductus*-like forms, or both, is not clear. Despite the geographical proximity of *lacustris* today, tendencies toward unbarred bellies and white-barred mantles in the island samples suggest at least some gene flow from *reductus* to the east.

Rails from New Britain, New Ireland and fringing islands in the eastern Bismarck Sea also seem to be inter-connected to one another and derived from adjacent parts of northern New Guinea independently of those to the west. They are particularly heavily barred with black and white across the lower ventral surface, and have vestigial rufous pectoral bands clearly barred with black, traits which seem to be correlated. Two forms are involved: *meyeri* Hartert from Witu and probably New Britain close to New Guinea, and *lesouefi* Mathews to the north on New Hanover, New Ireland (?) and the Hibernian Islands (Mayr 1949). Judged from the intermediacy of *meyeri* in barring on the wings and ventral surface, this group was derived from *reductus* in north-eastern New Guinea and terminates in small, dark and heavily barred *lesouefi.*

DISCUSSION

The present distribution of the Buff-breasted Rail in the south-west Pacific has been derived by dispersal from two sources: Australia and northern New Guinea. Australia is the primary centre. Rails from there still reach the Moluccas, southern New Guinea, and Norfolk and Lord Howe Islands; and, directly or indirectly, they have colonised New Zealand, Macquarie Island, the Chatham Islands, New Caledonia, cays in the Coral Sea, Vanuatu, the Southern Solomons, Fiji, Samoa and Tonga. Northern New Guinea is a minor centre, from which the birds have spread no further than the Bismarck Archipelago and islets in the Bismarck Sea. The precipitous central cordillera of New

Guinea, its great spine ranging from 3000 to 5500 m high, divides Australian and northern New Guinean populations and appears to be an important barrier to dispersal.

One general and unremarked pattern throughout the region is a tendency for distant populations to look more like one another than those on adjacent islands. An example is *G. p. sethsmithi* of Vanuatu and Fiji, which resembles Australian *mellori* more than *christophori* and *swindellsi* flanking it in the southern Solomons and New Caledonia. The latter two, moreover, approach each other morphologically more than they do intervening *sethsmithi.* In the Bismarck Sea, Mayr's (1949: 10-11) and our data show that several samples from adjacent islands share more traits with distant forms on mainland New Guinea than they do with one another. Thus *"praedo"* of the Admiralty Islands, although small, has the barred belly and narrow breast band of *lacustris* of mainland New Guinea, whereas *"anachoretae"* of the nearby Anchorite Islands has a plain belly like New Guinean *reductus,* is large in size like New Guinea *lacustris,* and has a much broader rufous breast band than any of these forms.

Some of these disparities and similarities undoubtedly result from random fixation and selection in the original founding populations. Nevertheless, the consistency of morphological links with mainland populations suggests sporadic gene flow from there as well, reaching each island independently. Some adjacent island groups in the Bismarck Sea could have been colonised directly from New Guinea mainland, rather than by interchange between each other. Even so, Coultas (in Mayr 1949) found Bismarck Sea rails to be much more abundant on tiny sand cays and islets used by colonially breeding seabirds than on main islands; and observations from these islets since (H. L. Bell, pers. comm.) indicate that the rails fluctuate dramatically in numbers from time to time. Populations there, it seems, may have the same nomadic ecology as those in the Coral Sea, and wander from island to island as seabirds are breeding, exploiting the pickings and perhaps breeding then. Here, as Salomonsen (1976) predicts, "insularization" may beget the colonisation of islands generally. In such circumstances, gene flow can be expected to be haphazard throughout the region, the characteristics of populations on particular islands being continually sifted, augmented and recombined according to the effects of irregular bottlenecks in numbers and frequent chance immigration. To recognise subspecies among them may prove to be rather misleading.

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SHORT NOTE

TERNS PERCHING ON WIRES

In a valuable chapter on Black-fronted Terns, *Clidonias albistriata (sic)*, Edgar Stead mentioned that occasionally they use most unexpected perches. " One day in June, I saw a Black-fronted Tern sitting on the post of a wire-fence around a ploughed paddock, while nearby another was actually sitting on the wire, balancing itself by spreading its wings every now and then." On another occasion at Lyttelton Harbour, he saw eight sitting on posts and four on the top wire of a fence which ran some distance out into the water.

During the winter of 1952 in the Bay of Plenty, Bernard Sladden paid special attention to the visiting Black-fronted Terns between May and August. On 19 July, he was watching as " 15 alighted on top of the battens of a fence "; but none actually on the wire. Latham (1981: 229-230) also noted this preference for fence battens as an inland roost in the Bay of Plenty.

For some months during the summer of 1954-55, a White-winged Black Tern *(Chlidonias leucopterus)* frequented upper Manukau Harbour, a favourite haunt being the shallows of Harania Creek, which have now largely disappeared under industrial fill. Quite often it rested on the ground near or among flocks of waders; but twice it was seen " balancing precariously on the topmost strand of a derelict coil of wire out on the mud."

On 4 April 1976, as reported in *British Birds,* W. G. Harvey and his wife counted about 40 White-winged Black Terns in various stages of transitional plumage, perched on telegraph wires about 10 metres over an area of extensive rice fields in West Java. This item of tern behaviour elicited further reports, which were later published in *British Birds.* From France, Spain and Hong Kong came notes on Whiskered Terns *(Chlidonias hybrida)* perching on wires above fishponds or rice-paddies; but Sweden added an interesting twist to the tale. A typical *Sterna,* which could not certainly be identified as either Common *(S. hirundo)* or Arctic *(S. paradisaea),* " looked very out of place perched alone above quite ordinary, dry agricultural country " (K. Verrall *in* Jones *et al.* 1979).

On 27 November 1980 Beth Brown, David Baker and I visited the west side of the Firth of Thames and, as a matter of routine, paused to scan the Wherekawa gravel pits. Almost at once a flitting White-winged Black Tern caught the eye, a pale bird, probably in first year plumage. From time to time it would cease hawking insects and rise to settle on an electric power wire which passed near its favourite pool at a height of about 10 metres. Against a background of green slopes and darker patches of bush, both wire and bird could be hard to see. In the light breeze the tern balanced with some difficulty, using head, neck and tail in its efforts to control a tendency to see-saw. Again on 14 December, between bouts of insect-hunting among numerous Welcome Swallows *(Hirundo tahitica neoxena)* it would withdraw to its lofty, if precarious, perch. What is assumed to be the same individual has now been present along the Wharekawa-Miranda coast for more than a year. It ranges widely but returns not infrequently to the sheltered and fruitful gravel pits. In the spring of 1981 Beth Brown found that it had been joined by a second White-winged Black Tern. Two were still conspicuously present on 3 February 1982.

Although terns of various species commonly perch on posts, wire squatting is unusual. Perhaps incidentally I may ask whether anyone has ever seen a Caspian *(Hydroprogne caspia)* or a Little Tern *(S. albifrons)* perching anywhere but on the ground?

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SEASONAL MOVEMENTS AND POPULATION OF THE SOUTHERN CRESTED GREBE IN CANTERBURY

By P. M. SAGAR and C. F. J. O'DONNELL

ABSTRACT

A summer and a winter survey of the distribution and numbers of the Southern Crested Grebe *(Podiceps cristatus australis)* were carried out in Canterbury during 1980-81. Grebes stayed on the alpine and subalpine lakes throughout the year. In summer grebes moved from lake to lake within a lake system, but during the winter they were concentrated on fewer lakes and some moved between lake systems. These observations are compared with those of the Southern Crested Grebe in Australia and the Great Crested Grebe *(P. cristatus cristatus)* in Europe. Breeding season counts of the Ashburton lakes and the Alexandrina group during 1978-1981 indicate that the Crested Grebe population in Canterbury is stable after a possible increase during the 1970s.

INTRODUCTION

In New Zealand the Southern Crested Grebe is found throughout the South Island but is known from the North Island only by subfossil remains and very few recent records (Falla *et al.* 1979). The largest grebe populations were thought to exist in South Westland (Falla *et al.* 1979) but in 1980 the New Zealand population was estimated to be 240-250 birds with Canterbury lakes supporting about 55% of this population (Sagar 1981). In Canterbury, grebes are restricted to alpine and subalpine lakes within and east of the main ranges (Kinsky 1970), with the largest concentrations being present on the Ashburton lakes (54-58 birds) and Lakes Alexandrina/McGregor (50 birds) (O'Donnell 1980, Sagar 1981).

Breeding season surveys (November-January) of the numbers and distribution of Crested Grebes in Canterbury have been reported by Sharp (1967), Westerskov (1971) and Sagar (1981). However, few observations of grebes have been made in winter and the grebes were thought to remain on high country lakes throughout the year (Falla *et al.* 1979). Therefore, we decided to complete a winter survey of grebes in Canterbury during 1981 and compare these observations with the numbers and distribution of grebes during November-December 1980 (Sagar 1981). Additional information about Crested Grebe populations on the Ashburton lakes and Lakes Alexandrina/McGregor during 1978-1980 is also presented.

NOTORNIS 29: 143-149 (1982)

METHODS

Canterbury lakes supporting populations of Crested Grebes are clustered into five groups: the Sumner group (Lakes Sumner, Mason, Katrine, Marion, Taylor, Sheppard/Mary); the Pearson group (Lakes Pearson, Sarah, Grasmere, Hawdon, Marymere and Letitia); the Coleridge group (Lakes Coleridge, Catherine, Henrietta, Selfe, Lilian, Evelyn, Ida, Georgina and Lyndon); the Ashburton lakes (Lakes Heron, Clearwater, Camp, Roundabout, Emma, Maori, Emily and Denny); and the Alexandrina group (Lakes Alexandrina and McGregor and the Glenmore Tarns).

The summer survey was completed during the period 29 November to 14 December 1980 and the winter survey from 11 July to 8 August 1981. Because Crested Grebes move from lake to lake, especially when not breeding, all lakes of a group were surveyed within one or two days to minimise duplication of numbers. Counts were made, using binoculars and telescopes, from vantage points overlooking a lake, by canoe or by walking lake edges.

When counting grebes on a lake or part of a lake, we made several surveys of an area within a short period to get more reliable numbers. Grebes were often close to the shore and easily observed. We did not count moving birds more than once, and during breeding season surveys, we allowed for birds which may have been out of sight on nests. Grebes seen patrolling raupo *(Typha orientalis)* beds or willow trees (*Salix* spp.) overhanging the water indicated the presence of an unseen incubating bird. Additional counts were obtained from Wildlife Service files and the 1980 national survey of Crested Grebes (Sagar 1981).

RESULTS

Canterbury

The total number of grebes recorded on summer and winter surveys were similar but their distribution had changed markedly between seasons (Table 1). In winter, grebe numbers on most lakes decreased, except on Lakes Clearwater and Alexandrina, where numbers had increased greatly (11 to 23 and 38 to 76 respectively). A decrease in grebe numbers on the Pearson and Coleridge groups and the Ashburton lakes was matched by an increase of similar numbers on Lake Alexandrina. Grebes were present on Lakes Sarah, Marymere, and Emily and on the Glenmore Tarns during summer but not in winter, and single birds were seen on Lakes Lyndon and Denny during the winter, where none was seen in summer. Lake Emily and the Glenmore Tarns were completely frozen over during the winter count, forcing grebes present during the summer to move elsewhere. Bad weather prevented a winter survey of Lake Coleridge, but we assume that some grebes were present. Three grebes were seen on the lake in May 1976 and 15 in August 1976 (S. Moore, pers. comm.). Thus grebes were estimated to be present on 17 out of 41 lakes during the summer survey and 15 during the winter survey.

TABLE 1 — Numbers of Crested Grebes on Canterbury lakes, summer 1980 and winter 1981

Lake	No. of Crested Grebes			No. of Crested Grebes	
	[1] Summer 1980	Winter 1981		[1] Summer 1980	Winter 1981
Tennyson	0	n.c.	Georgina	0	0
Guyon	0	n.c.	Lyndon	0	1
Sumner	0	0	Heron	29	13
Mason	0	0	Clearwater	11	23
Katrine	0	0	Camp	0	0
Marion	0	0	Roundabout	0	0
Taylor	0	0	Emma	10	4
Sheppard/Mary	2	2	Maori Lakes	2	1
Sarah	2	0	Emily	2	0*
Grasmere	4	3	Denny	0	1
Pearson	4	5	Alexandrina	38	76
Hawdon	0	0	McGregor	8	3
Marymere	1	0	Glenmore Tarns	4	0*
Letitia	4	4	Tekapo	0	0
Henrietta	0	0	Pukaki	0	0
Selfe	3	1	Ohau	0	0
Lilian	0	0	Raupo Lagoon	0	0*
Evelyn	0	0	Swan Lagoon	0	0*
Ida	0	0*	Benmore	0	n.c.
Catherine	6	2			
Coleridge	7	n.c.	TOTAL	137	139

[1] From Sagar (1981)

n.c. = no count

* lake surface frozen completely

Ashburton lakes

Grebes were recorded on the eight major lakes in the Ashburton lakes group (Table 2) and have been seen very occasionally on the minor lakes — Mystery, Spider, Seagull and Manuka Lakes and small unnamed tarns. Grebes' use of Lakes Camp and Roundabout is also very occasional and only during winter. Counts in three consecutive breeding seasons (1978-80) gave totals of 58, 57 and 54 adult grebes

TABLE 2 — Numbers of Crested Grebes on Ashburton lakes, November 1978 to July 1981

Lake	Number of Crested Grebes						
	Nov 1978[1]	6.10.79	Jan 1980	25.3.80	26.7.80	29.11.80	11.7.81
Heron	36	n.c.	37	6	20	29	13
Clearwater	5	12	8	11	1	11	23
Camp	0	3	0	0	0*	0	0
Roundabout	0	0	0	0	0*	0	0
Emma	10	8	8	14	0	10	4
Maori	1	2	2	2	0	2	1
Emily	4	2	2	2	0*	2	0*
Denny	2	0	0	0	0*	0	1
	58	27+	57	35	21	54	42

[1] S. Moore, Wildlife Service, pers. comm.

n.c. = no count

* lake surface frozen completely

respectively. Distribution of grebes within the Ashburton lakes was variable. During spring 1979 grebes were very mobile between most lakes and single birds appeared briefly on isolated tarns between breeding lakes. Grebes were sedentary while holding territories from November 1979 to the beginning of February 1980. By March 1980 the weather had become much colder and grebes moved away from the main breeding lake (Heron) with some abandoning nests. Several small loose flocks formed in March and July 1980 but only 21 grebes were counted in July, less than half the breeding population of the previous summer. In July all the lakes were frozen over completely except for very small areas on Lakes Clearwater, Emma and Maori and about half of Lake Heron. As no other Canterbury lakes were surveyed at this time the whereabouts of the balance of the population is not known. They possibly moved to larger ice-free lakes such as Alexandrina and Coleridge.

Alexandrina group

Breeding season surveys of the Alexandrina group were completed in November 1978 and November 1980 and 50 adults were counted on both occasions. In winter 1981, 79 grebes were counted on Lakes Alexandrina and McGregor (Table 1).

DISCUSSION

There are few Canterbury records of Crested Grebes away from the high-country lakes. Westerskov (1971) recorded specimens (now in the Canterbury Museum) from a small lake in the Rangitata Gorge (8 May 1917), Leeston (1922), Upper Riccarton (1929) and an immature male from Temuka (no date). One bird was seen on the Avon-Heathcote Estuary on 30 October 1947 (Guy 1948), two were seen on the western end of Lake Ellesmere in October 1966 and a juvenile was found drowned in a fishing net on Lake Ellesmere in June 1973 (G. A. Tunnicliffe, pers. comm.). Therefore, even though winter weather conditions are very harsh and some favoured lakes may freeze over, grebes apparently remain in the high country throughout the year.

This behaviour differs from that of the Southern Crested Grebe in Australia, where long-distance migration occurs in winter with birds moving from the highlands to coastal (often sea) waters (Frith 1969). In Europe, the Great Crested Grebe *(P. cristatus cristatus)* also undertakes a marked movement from inland to coastal areas. After breeding, short local movements occur and birds congregate in flocks to moult. Following moult, longer-distance dispersal occurs and large concentrations gradually build up in coastal and lowland waters (flocks of up to 20 000 in western Europe). Only odd pairs are residential on highland breeding lakes and some local movements occur to avoid harsh weather conditions (Witherby *et al* 1941, Simmons 1974, Cramp & Simmons 1977).

In Europe, grebes favour deltas, brackish estuaries, tidal channels and lagoons and relatively sheltered marine inshore waters (Cramp & Simmons 1977). Coastal Canterbury lacks some of these habitats. It has no deltas, very few small brackish estuaries, and, except for some harbours of Banks Peninsula, the inshore marine waters are exposed. The shallow coastal waters of Lake Ellesmere, Washdyke Lagoon and Lake Wainono appear to offer suitable winter feeding areas for Crested Grebes but, despite extensive recent surveys (Tunnicliffe 1973, Sagar 1976, Pierce 1980), no grebes have been reported.

In November-December 1980, the Ashburton lakes and the Alexandrina group supported about 76% of the Crested Grebe population in Canterbury. Breeding season counts between 1978 and 1980 show that the population of these two groups of lakes was stable. Surveys of the Ashburton lakes show variability in the distribution of Crested Grebes throughout the year. Post-breeding movements occur from lake to lake within the group and some grebes probably move to Lake Alexandrina (about 100 km). Therefore, all lakes within each group are important and lakes with a low number of breeding birds may support higher numbers of birds during the winter.

Three breeding season counts of Crested Grebes on Canterbury lakes have now been reported. During November 1966 to January 1967, a Wildlife Service team found 68-70 grebes on 13 out of 38 lakes and tarns surveyed. These included 33 on the Ashburton lakes and 17 on the Alexandrina group (Sharp 1967). However, this is a minimum estimate as Lakes Coleridge and Letitia were not surveyed and grebes were known to be present on these lakes (Sharp 1967). Westerskov (1971) estimated that 50 pairs were present as regular breeding birds on 23 lakes during the summer of 1969-70, including 12 pairs on the Ashburton lakes and 14 pairs on the Alexandrina group. Again, this is likely to be an underestimate because, for some lakes, Westerskov depended on information from people whose primary purpose in visiting these lakes was not to count grebes; also, Lake Emily was not included in the survey. The first co-ordinated national Crested Grebe survey was completed in November-December 1980, when an estimated 137 birds were present on 17 of the 41 lakes surveyed (Sagar 1981).

Accepting the limitations of previous surveys, a comparison of results indicates that the Crested Grebe population in Canterbury has increased slightly during the 1970s. This reverses the 35-40% population decline from a minimum of 80 pairs in the 1940s and 1950s detailed by Westerskov (1971), and our study shows that the present population is probably stable. However, because of the small numbers of grebes involved, the population is susceptible to changes caused by climatic factors or human interference. One or two successful breeding seasons would result in a marked population increase while conversely a number of adverse breeding seasons could cause a significant population decline. Because the birds are susceptible to population fluctuations, we hope that these results will stimulate regular surveys to monitor the Crested Grebe population in Canterbury.

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SHORT NOTES

COMMON SANDPIPERS IN FAR NORTH

On four occasions, we have seen two Common Sandpipers *(Tringa hypoleucos)* at Pirini Creek on Rangaunu Harbour.

On 12 January 1982, we saw a single bird perching on a small mangrove. It rose from its roost, calling *twee-twee-twee,* and flew with a short jerky flight, gliding to land in adjacent mangroves. On 13 January, two flew out of the mangroves and landed nearby on the exposed tidal flats beside Pirini Creek. We watched them feeding on crabs, stretching their necks forward to stalk, rapidly pecking several times, and running quickly in search of more prey. They ran with their bodies hunched and head outstretched.

On 15 and 19 January the two were feeding near Bar-tailed Godwits *(Limosa lapponica),* Knots *(Calidris canutus)* and Turnstones *(Arenaria interpres)* out near the water's edge on the exposed tidal flats. On all occasions, the sandpipers were feeding on dried-out *Zostera* flats during an incoming tide.

Over the past 6 months, we have seen these sandpipers, godwits, knots and Turnstones roosting among mangroves, along with many native wader, swamp and bush birds. Perhaps if ornithologists were to investigate these areas more often, some of the more uncommon migrant waders of this habitat such as the Common Sandpiper, Marsh Sandpiper *(T. stagnatilis)* and perhaps the Wood Sandpiper *(T. glareola)* could be found.

MARK BELLINGHAM *and* ALISON DAVIS, *C/o P.O., Kohukohu, Hokianga*

A TRANSIENT COLONY OF RED-BILLED GULLS

The transience of a colony of Red-billed Gulls *(Larus novaehollandiae)* was seen this summer on Rangaunu Harbour, Northland. On 24 October, 15 pairs had started nesting on Walker Island in the middle of the harbour, and most had laid eggs. By mid-November, however, all had shifted to a rock off Rangiputa, where 78 pairs were nesting, with eggs in 73 nests. All the nesting material had gone from Walker Island, but the gulls had shifted after a northerly storm in late October, when waves had swept across the nesting area.

On 20 November, gulls were seen flying from Rangiputa to Walker Island with nesting material. The whole colony had shifted back to Walker Island, and by 12 December, 153 pairs were nesting there. This shift had occurred soon after very high spring tides, and this time they nested higher in the marram above high water spring mark.

When we visited Walker Island on 8 January, we found no nesting Red-billed Gulls, and we did not find them nesting elsewhere around the harbour. In January, the Red-billed Gull population on the harbour had declined markedly, and they had apparently moved elsewhere or dispersed after three unsuccessful attempts at nesting. This final desertion of the harbour may have been prompted by curious sightseers over the Christmas holiday period.

MARK BELLINGHAM *and* ALISON DAVIS, *C/o P.O., Kohukohu, Hokianga*

SOOTY TERNS ON AUCKLAND'S WEST COAST

The southward movement of Cyclone Tracey down the east coast of Australia during the end of February and the beginning of March 1980 appears to have brought to New Zealand a small number of Sooty Terns *(Sterna fuscata)*.

While returning from South Head, Kaipara Harbour, on 5 March 1980, S. Chamberlain, J. & I. McCaw, S. M. Reed, N. Rothwell and I, travelling in two vehicles, were counting flocks of White-fronted Terns *(Sterna striata)* along Muriwai Beach, when I noticed in one flock an odd tern, notably darker than the White-fronted Terns.

On stopping our vehicle, we watched this bird feeding with the White-fronted Tern flock over the breaking waves and approaching the beach.

The following description was made:

Forehead white, crown, nape, back, upper wing and tail dark brown-black; bill black. A black line went from the bill through to the eye, where it joined the cap. The underparts were white, except the underwing, which appeared sooty grey. The tail was deeply forked.

This bird was larger than the White-fronted Terns.

On 9 March, a beach patrol on the same stretch of beach produced three beach-wrecked Sooty Terns and S. M. Reed has told me that one bird was seen roosting with White-fronted Terns.

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FOOD AND FEEDING BEHAVIOUR OF THE SOUTHERN CRESTED GREBE ON THE ASHBURTON LAKES

By COLIN F. J. O'DONNELL

ABSTRACT

The food and feeding behaviour of the Southern Crested Grebe *(Podiceps cristatus australis)* were studied on the Ashburton Lakes (South Island, New Zealand) in 1979 and 1980. Of 47 food items eaten on the surface by adults, 55.5% were fish, 31.9% were insects and 12.6% were plants. Chicks in their first week ate mainly fish under 55 mm long. Both adults and chicks ate feathers. One pellet contained feather, fish, insect, plant and egg remains. Dives lasted on average 20-30 seconds. Feeding success of adults was high while they were feeding chicks.

The New Zealand and European subspecies are compared. Differences suggest that much less food is available in New Zealand, which may affect productivity and population size.

INTRODUCTION

New Zealand literature gives little information on the food and feeding behaviour of the Southern Crested Grebe. Most standard texts make no mention of foods (Oliver 1955, Soper 1965, Williams 1973, Falla *et al.* 1979) and only brief mention of the grebes' diving habit. Reischek (1885) gave " fish and various insects," Moncrieff (1957) " chiefly fish " and Marshall *et al.* (1975) " mainly fish and crustacea " as grebe foods. In Europe the Great Crested Grebe *(P. cristatus cristatus)* eats fish, and to a lesser extent insects, crustacea, molluscs, seeds and small amounts of plant material (Cramp & Simmons 1977).

In this study I collected basic information on food and feeding behaviour while also studying breeding, behaviour, and habitat preferences of grebes on the Ashburton Lakes during 1979 and 1980.

Eleven named lakes are present in the Ashburton Lakes study area which lies at the foot of the Southern Alps, 130 km south-west of Christchurch (NZMS maps S73, S81). The lakes range in altitude from 624 to 685 m and in size from 5 to 729 ha. Crested Grebes bred on six lakes during this study (Lakes Heron, Clearwater, Emily, Emma, Denny and the Maori Lakes). The topography, lakes, climate, vegetation and fauna have been described in full by Adams (1978) and O'Donnell (1980).

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METHODS

Observations were made on most days from November 1979 to February 1980 using 8 x 30 binoculars, a x 20 spotting scope and a x 20-60 zoom telescope. I studied a population of 57 grebes, concentrating on the 37 grebes on Lake Heron. Grebes were not timid and were easy to observe. A quantitative study of foods was not possible because grebes swallow most items underwater. Observations were therefore confined to what grebes brought to the surface to eat, or when a feeding method other than diving was used. Size of fish eaten was estimated against bill length. Lake depths where grebes dived were measured from a canoe.

FOOD

Adults

During the many hundreds of dives I watched I saw only 47 food items eaten on the surface. Over half these items were fish (Table 1), mainly exotic trout and salmon. Although 44.5% of these food items were insects and plants they formed only a small part of the total volume of food eaten. Fish taken by adult grebes were estimated to average 96 mm in length (SD 59.9, range 30-190 mm, n = 18). Large fish took up to 5 minutes to manipulate and swallow. Smaller fish were eaten when chicks found them too large to swallow.

TABLE 1 — Food items of adult Crested Grebes on the Ashburton Lakes

FISH	n	%
Brown trout **(Salmo trutta)**	10	21.4
Rainbow trout **(S. gairdneri)**	3	6.4
Quinnat salmon **(Oncorhynchus tschawytscha)**	6	12.8
Bullies (Eleotridae)	6	12.8
Smelt (Retropinnidae)	1	2.1
TOTAL	26	55.5
INSECTS		
Unidentified species	10	21.4
Midge pupae	4	8.4
Waterboatmen	1	2.1
TOTAL	15	31.9
PLANTS		
Algae	4	8.4
Myriophyllum	2	4.2
TOTAL	6	12.6
TOTAL	47	100.0

A wide variety of invertebrate larvae was also readily available in the lakes and these were probably eaten by grebes. The most abundant were stoneflies (Plecoptera), midges (Chironomidae), mayflies (Leptophlebiidae), damselfly *(Xanthocnemis zealandica)*, dragonfly *(Procordulia grayii)*, caddisflies (Trichoptera), adult water boatmen (Corixidae), and terrestrial insects on the water-surface film.

Grebes cast pellets while feeding and loafing. A visual assessment of one dry pellet that measured 70 x 55 mm showed it to contain 40% feathers, 20% unidentified material, 15% fish bones, 10% vegetative remains and 5% each of insect cuticle, bird egg shell and fish scales by volume. Both adults and chicks were offered feathers to eat. Feather eating and pellet formation have been linked (Cramp & Simmons 1977). Feathers accumulate in the stomach (Chance 1970), where they probably catch indigestible food remains that may otherwise damage the intestine.

Chicks

Of 43 food items fed to chicks in their first week, 85.9% were fish about 10-55 mm long (mean 28.6 mm, SD 15.5, n = 37). Chicks refused fish over about 60 mm long. Midge pupae, waterweed and unidentified insects each made up 4.7% of chicks' food. Chicks were fed feathers from hatching onwards. A parent that had been away feeding often pecked a feather from its breast or flanks and took it to its mate, which dipped the feather into water and pulverised it with its bill before offering it to a chick. Chicks were reluctant to take fresh feathers.

A 3-month old juvenile was seen to catch two trout, each about 60 mm long.

FEEDING BEHAVIOUR

Adults

Grebes took most food underwater, submerging completely to do so. The dive was smooth, without a jump or splash. Usually grebes spent 20-30 seconds submerged, with females taking longer on average (mean 34.4 s, SD 14.8, range 5-85, n = 119) than males (mean 26.7 s, SD 13.8, range 5-65, n = 87). Diving times of parent grebes catching food for chicks were much shorter (mean 16.1 s, SD 13.4, range 7-56, n = 26). The diving times of parents feeding themselves while attending chicks were also shorter with females averaging 28 s (SD 9.7, range 7-57, n = 72) and males 20 s (SD 6.7, range 7-37, n = 152).

Adults spent most of the day feeding. They had long periods of intensive diving interspersed with short periods of resting and preening. The mean time spent on the surface between dives ranged from 7.7 to 17.3 seconds. The number of dives per feeding spell varied from 5-10 dives over a short period to 55 dives in 25 minutes.

Grebes fed in lake depths of 0.5-6.0 m. Females feeding themselves dived in water depths averaging 3.4 m, males dived in average depths of 2.4 m. Grebes usually fed in shallower water 5-13 m from the shore, and up to 100 m offshore on rare occasions. Females tended to feed closer inshore (mean 10.2 m) than males (13.1 m) when feeding themselves. When caring for chicks, grebes fed much closer to shore (mean for female 5.3 m, male 5.2 m) and sometimes under overhanging vegetation. Grebes surfaced 3-4 m from where they dived.

Grebes were very tolerant of rough water (waves up to 0.7 m high) and poor visibility (as little as 0.2 m) when feeding. Throughout the spring, summer and early autumn strong north-westerly winds blew almost constantly and lasted 5 to 17 days at a time. On occasions, while swimming and diving in the lakes, I could feel strong water turbulence up to 6 m offshore and to depths of 5 m. In these conditions spells of feeding were long (15-20 minutes, interspersed with preening spells of 5-10 minutes) but dives were shorter (c. 15 seconds). During intense storms, grebes fed little and sheltered under dense willows.

Surface feeding was seen only 17 times. On sunny, calm days grebes fed for up to 30 minutes from the surface in very shallow water with only their heads submerged, often bringing their heads to the surface for only a few seconds at a time. They were apparently feeding on midge pupae floating in the water column and on molluscs and bullies. Grebes also made quick stabs from the surface at passing fish (five spells of up to 10 stabs each were seen). Grebes were seen to pick insect prey from marginal vegetation twice and from the surface film seven times.

Feeding young

While chicks were still on the nest, food was often caught under marginal vegetation close to the nest. When chicks had left the nest, the adult diving rate increased markedly. The chicks of one brood left the nest site for good when the final egg of the clutch hatched and spent their first two days off the nest on the back of one or other parent. After a change-over of carrying duty, the parent just relieved fed the chicks and then fed itself. Only rarely did an adult which had been feeding for some time return with food for young. After two days, chicks swam begging towards a parent bringing food and competition among the brood increased. Food was moistened with water before being given to a chick. Each chick received one fish per feed and sometimes there was a long interval between feeding each member of the brood. The average interval between the chicks' feeds was 31.6 minutes (SD 17.1, range 5-65, n = 20). Feeding success was high when catching fish for chicks. One pair providing food for two 1-week old chicks caught 14 fish in 23 dives (61% success).

One independent 3-month-old juvenile watched during a feeding spell made over 30 dives in quick succession. Dives were short (mean 18.3 s, SD 4.0, range 12-25, n = 32), perhaps because the bird was inexperienced and its catch-rate low.

DISCUSSION

The feeding ecology of the Southern Crested Grebe is different in several respects from that of the Great Crested Grebe in Europe.

1. The foods are similar (cf. Witherby *et al.* 1941, Simmons 1974, Cramp & Simmons 1977) but the available foods are much more varied in Europe. New Zealand has a small freshwater fish fauna (Waugh 1973, Falla 1975, McDowall & Whitaker 1975), and probably only four indigenous and three introduced fish species were in the Ashburton Lakes (Boud *et al.* 1959) whereas over 20 fish species are eaten in Europe.
2. Feeding was usually in depths between 0.5 and 6.0 m (once 15 m) in the Ashburton Lakes. In Europe the grebes usually feed in depths of 2-4 m or less (Cramp & Simmons 1977).
3. Crested Grebes in Europe have a wider ecological niche than in New Zealand, where they feed in cool to cold, fresh, moving waters. In Britain the grebes also commonly feed in artificial, standing, brackish and sea waters (Cramp & Simmons 1977).
4. The mean dive of adults feeding themselves lasted 30.5 (max. 85) seconds in the study area compared to means of 26.0, 24.0 and 19.5 (max. 56) seconds cited by Cramp & Simmons (1977). This may reflect the relative abundance of fish prey. In New Zealand, feeding was often difficult because of poor weather and was completely abandoned during many storms.
5. The rate at which young are fed in Europe may be much greater than in New Zealand. In Europe chicks were fed on average 12 times per hour (max. 95) compared to twice per hour (limited sample) on the Ashburton Lakes.

These differences suggest that supply of suitable food is very limited in New Zealand. In Europe, food is much more diverse, aquatic niches are more diverse, and grebes spend relatively less time feeding. Dives last much longer in New Zealand and much of the day is spent feeding. Rate of feeding young is much greater in Europe. The young of one New Zealand brood studied were left alone during adult feeding after two days off the nest. Simmons (1974) states that, unless food is scarce, young are constantly attended until 30 days old.

These facts may be pertinent to discussions on population decline (Westerskov 1971), very low breeding success (O'Donnell 1980), and the small number of Crested Grebe in New Zealand (Sagar 1981). Food availability is a major determinant of breeding success (Simmons 1974). The introduction of three species of salmonid predator to the Ashburton Lakes may have created important competitors for Crested Grebes. The impact of these introductions on native fish and invertebrates is not known, but there is some circumstantial evidence to suggest that native fishes have declined because of predation and competition by the salmonids (Waugh 1973).

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SHORT NOTES

WHITEHEAD BREEDING, AND PARASITISM BY LONG-TAILED CUCKOOS

During a visit to Little Barrier Island from 28 January to 1 February 1982, I recorded all flocks of Whitehead *(Mohoua albicilla)* seen during walks along the four main tracks leading away from the ranger's house (Thumb, Valley, Main Summit, and Shag Tracks) and down a track called Number 3, which leads from the Thumb summit to the western coast. To try not to record the same birds twice, I did not record flocks if I backtracked during the day or if I re-used a track along which I had recorded flocks on previous days.

I noted 35 Whitehead flocks, ranging from 2 to an estimated 40 birds. I have regarded two birds as a flock because they could have included young birds. Of these 35 flocks, 22 (63%) did not contain dependent Whitehead fledglings, which can easily be recognised by their almost continuous twitter; 12 (35%) included fledglings (sometimes larger flocks seemed to include two separate groups of fledglings); and one (3%) small group of three birds was seen feeding two Long-tailed Cuckoo *(Eudynamys taitensis)* fledglings. The cuckoos were both well advanced in development.

The only data that I can find for comparison of Whitehead breeding success are eight nests observed by Wilkinson (1927) in one season, only one of which was successful. My observations were recorded late in the season, and most were made from tracks that tend to follow ridges. Therefore, any estimates of breeding success or of parasitism rate could be biased in several ways. However, two points should be made.

First, I saw all three Whiteheads feed one of the cuckoos. Rather than follow the adults constantly, as did young Whiteheads, the cuckoos tended to remain perched in one place, allowing easier monitoring of all birds. At one point during my 20 minutes of observation, all three Whiteheads fed one cuckoo one after the other. The Whiteheads appeared to be two males and a female, with one of the males being slightly duller than the other and possibly a younger bird. Guthrie-Smith (1925) reported more than two adult Whiteheads attending nests and, apparently speaking of fledglings, said that " there were innumerable cases of families which we believe also were fed by four old birds." This topic needs further investigation.

Second, two cuckoos were being fed together, and yet only one egg or chick has ever been reported in nests parasitised by Long-tailed Cuckoos (Stead 1936, Oliver 1955). Three explanations are possible:

1. A nest had been parasitised at about the same time by two cuckoos, and neither chick managed to eject the other;
2. One cuckoo layed twice in the one nest; and
3. Two groups of birds, each with a cuckoo fledgling, had come together in one flock, and one group had ended up with both fledglings.

Even if two cuckoos share the same nest, either because they were siblings or because neither managed to eject the other, the large size of cuckoo nestlings and the small size of Whitehead nests make the first two explanations seem unlikely. However, there are records of young being adopted by adults other than their parents in birds (e.g. in fantails — M. Powlesland, in prep.) and mammals (e.g. ground squirrels, Holmes & Sherman, in press; various primates, Wilson 1975, Hrdy 1980). My observation of Whitehead flocks apparently with two groups of fledglings suggests that adoption could occur in Whiteheads. The likelihood that two cuckoos should end up in the same flock seems improbably low, but until more is known, this seems to be the best explanation.

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ADDITIONS TO THE BIRDLIFE OF NIUE

Recently my friend Don Morrison of Alexandra spent nearly 2 years (March 1979 to December 1980) on Niue. During that time he made regular observations of the birdlife, using Wodzicki's (1971) paper as reference. I had also given him some notes and sketches for other likely visitants, especially waders. Unfortunately Kinsky & Yaldwyn's (1981) comprehensive booklet was not then available. I have compiled the following summary from Don's written and oral notes.

One heron and two waders (listed below) are new records, and the presence of a Reef Heron (listed by Kinsky & Yaldwyn as " unconfirmed ") was established. One of the waders was not positively identified, so that we could now say the Niue bird-list is 28 species, with three more unconfirmed; this last group consists of a duck, a calidrine wader and the Red-tailed Tropicbird.

These additional notes should be read in conjunction with Wodzicki's extensive paper and the Kinsky & Yaldwyn booklet. Place names are shown on Wodzicki's map. Status for individual species agrees with Kinsky & Yaldwyn, except where otherwise commented upon.

GREATER FRIGATE BIRD *Fregata minor*

25/9/79: Two adults soaring over Tapeu hill in the evening. 23/2/80: One adult soared out of sight.

BANDED RAIL *Rallus philippensis goodsoni*

Wodzicki mentioned a mid-winter breeding season in 1969. Kinsky & Yaldwyn suggest that breeding appears to extend throughout the year. DM recorded chicks from mid-March through to late September in 1980.

BLUE-CROWNED LORY *Vini australis*

On 18/8/79 a flock of 6-12 were feeding on nectar on a red trumpet-flowered tree, giving the characteristic high-pitched screech. They were not seen again, and the locals believe them to be in decline. One school pupil maintained that they were previously caught to use some of the feathers for fishing lures.

LONG-TAILED NZ CUCKOO *Eudynamys taitensis*

29/7/79: One seen in a roadside tree, the only positive sighting in nearly 2 years.

BARN OWL *Tyto alba lulu*

More common than Wodzicki indicated; quite often seen in early mornings and evenings; also DM frequently saw these birds after dark when he was travelling around the island road by push-bike.

As Wodzicki suggested, the locals are very superstitious about the owl — it is often " associated with stories about death." A wing taken to the High School by a New Zealand biology teacher was not welcomed by the students.

WHITE-RUMPED SWIFTLET *Collocalia spodiopygia*

28/8/79: Nests in caves at Avaiki (near Makefu) contained young. 14/11/79: In the same caves, nests contained both eggs and young. They appear to breed throughout the year.

In caves at Ulupaka (near Lakepa) nesting was in total darkness, and adults appeared to use some sort of (partly audible) " sonar " for orientation, detection of walls, etc. This did not seem to be effective on the human body, since they frequently bumped into the visitor.

REEF HERON *Egretta sacra*

Unconfirmed reports up to 1971 are mentioned in Kinsky & Yaldwyn. DM said that he did not obtain a vernacular name as the bird was said to be previously unknown; *motuku* listed by Kinsky & Yaldwyn is the most likely one, agreeing with similar words in other Polynesian languages. The name *kiu tahi* also listed by Kinsky & Yaldwyn is more correctly reserved for the Wandering Tattler, which is well known locally. A more liberal interpretation of *kiu tahi* than Kinsky & Yaldwyn's ' shore-bird ' (p. 25) would be ' shore-plover,' *kiu* being the local name for the common and well-known Golden Plover, and *tahi* referring to the more coastal habitats of the tattler compared with the plover.

7/4/79: One grey-phase bird beside a road 1 km inland; it flew off lazily into a coconut plantation where cattle grazed. 14/7/79: One on a coastal headland at Utako (Alofi) at high tide; it flew off low to the south. 6/10/79: One near the Japanese wreck on the east coast north of Hakupu; later, it landed on the wreck. 20/10/79: One at the same place.

All sightings were believed to have been of the same bird. There was a hurricane on 11/12/79. No sightings were made in the whole of 1980.

WHITE-FACED HERON *Ardea novaehollandiae*

25/4/80: One adult first seen on a tidal cliff-edge, at a point where a lot of young sea-snakes were in the tidal pools. 26/4/80: Feeding on locusts on the hotel lawn (Alofi Bay). 18/5/80: Standing on a coastal rock at Utako (Alofi). 30/5/80: Feeding on the reef at low tide. (This bird was not seen again.) This is a new species for Niue.

PACIFIC GOLDEN PLOVER *Pluvialis fulva*

The greatest daily tally was 116 on the airport apron on 4/11/79. On 8/3/80, the change into breeding plumage was noted. From 12/10/80, numbers began to increase on the airport runway as the southern migration developed.

BRISTLE-THIGHED CURLEW *Numenius tahitiensis*

The vernacular name is *kiu-vouvou;* Wodzicki's *motuku,* which appears to have been copied by Kinsky & Yaldwyn without comment, was not known; it is more correctly reserved for the Reef Heron.

Small numbers, mostly singletons, were recorded from early October to mid-March, the largest group being of four on the airport runway on 14/10/79.

WANDERING TATTLER *Tringa incana*

Contrary to Wodzicki's assessment, the Wandering Tattler was considered common, especially on the low-tide reef, cliff ledges, grassy airport verges and the golf course; e.g. on 4/11/79, 21 were recorded on the airport alone. Some were present all the year round.

No positive identification was made of the Siberian Tattler *(T. brevipes).*

TURNSTONE *Arenaria interpres*

Wodzicki did not list the Turnstone; DM recorded somewhat larger numbers than Kinsky & Yaldwyn implied, but it could hardly be described as common.

On 8/9/79 the first Turnstone was noticed with a flock of seven Golden Plover on the low-tide reef. Numbers increased but remained small, the biggest groups recorded being each of ten birds on 25/11/79 and 15/12/79.

Kinsky & Yaldwyn indicated that over-wintering by this species was an unsolved question, but DM reported small numbers still present for June, July and August of 1980.

SANDERLING *Crocethia alba*

4/12/79 and 5/12/79: One was seen on each day at lunch time, feeding on the reef near the wharf. On 19/10/80, one was recorded on the runway. This is a new wader record for Niue.

SANDPIPER sp. (? *Calidris* sp.)

On 4/11/79, four small sandpiper-like birds appeared on the airport verge. (Field notes submitted to me suggest the Sharp-tailed Sandpiper, *C. acuminata.*) One, two, or three individuals were recorded on grassy areas (airport or golf course) until mid-March, and again in October and November 1980. They sometimes associated with Turnstones, but on at least two occasions Golden Plovers chased them off. This is consistent with interspecific aggressive behaviour between these two species, which I have seen in the Gilbert Islands (Child 1960).

This is a probable new wader record for Niue.

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WODZICKI, K. 1971. The birds of Niue Island, South Pacific: an annotated checklist. Notornis 18 (4): 291-304.

PETER CHILD, *10 Royal Terrace, Alexandra*

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REVIEWS

Handbuch der Vogel Mitteleuropas (Textbook of Birds of Central Europe). Herausgegeben von Urs N. Glutz von Blotzheim — Urs N. Glutz von Blotzheim, Editor. Vol. 9. Pigeons to Woodpeckers. Akademische Verlagsgesellschaft Wiesbaden, 1980. 1148 pp.

This monumental volume (1148 pages) describes pigeons, cuckoos, owls, night swallows, swifts, kingfishers, bee-eaters, the hoopoe family and woodpeckers.

The treatment of every family is impressive. For instance, the description of *Columba livia* or domestic pigeon begins with an account of its field appearance, preceded by a key to species of pigeons found in Central Europe and a page of references. Then follow accounts of moult, calls (with some diagrams), a description of the pigeon's nesting area, populations, reproduction and its results, behaviour (with line diagrams) and food. Every species gets the same treatment to the effect that the book contains a wealth of information, supported by the latest literature. Excellent black and white drawings illustrate differences between related species, show various bird species in flight, or show characteristic behaviour patterns. An index of scientific names and a brief index of German and English names of birds conclude this volume. The latter is unfortunately incomplete as no English names are given for a number of species.

The textbook lists two bird species which are on the New Zealand bird list: the domestic pigeon *(Columba livia)* and the Little Owl *(Athene noctua)*. Both these species are introduced species. The perusal of the description and ecology of these two species in

Central Europe shows how much we have still to learn about their ecology in New Zealand conditions.

KAZIMIERZ WODZICKI

Oiseaux de Nouvelle Caledonie et des Loyautes (New Caledonian birds) by F. Hannecart & Y. Letocart. 1980. Les Editions Cardinalis. 150 pp.; map and 180 species described.

This, the first volume of an intended two-volume work, deals with what the authors call the more common birds of the area. Volume 2 will concentrate on the birds of the Loyalty Islands and the rarer species of the main island and surrounding seas.

It is not a great reference work but a picture book with a very brief text, given in both French and English. The birds' names, where possible, are in the local vernacular as well as in Latin, French and English. The book is divided into four sections by habitat: savannah, forest, swamps and ponds, seashore and sea.

The photographs, all in colour and all taken by the authors, are generally excellent. Many species, some of them photographed for the first time, have nest with eggs, young and adults illustrated. There are some very fine studies of petrels and terns and also more difficult subjects like small finches and honeyeaters, particularly the lovely Scarlet Honeyeater. The dramatic moment when a young cuckoo ejects its foster parents' chick from the nest is very emotively captured.

The text is disappointing in its brevity. I am sure that in their 8 years' field experience the authors gathered more knowledge about the resident birds of New Caledonia than is imparted in this book. Migratory waders do not appear to be the authors' strongpoint; the Wandering Tattler *(Tringa incana)* has been misidentified as the Grey-tailed Tattler *(T. brevipes)*, although this error has been corrected by the addition of a small insert. In the text we are told that the Turnstone ". . . . was found nesting on coral islands in our lagoon in 1978 and 1979." If this did indeed occur, then it is of some ornithological note!

The captioning of photographs could be improved. Some pictures are too briefly described and others are not described at all. Of the two photographs of the Turnstone, the first, captioned " nuptial plumage," shows an adult in non-breeding dress, and the second, not described, shows a first-winter subadult. There is also an annoying fault in the setting out; many full-page photographs placed along the page have their captions running across it.

The map, though adequate itself, lacks a scale.

All in all, though, I commend the authors on adding a fine pictorial record of the birds of New Caledonia to the literature and I look forward to volume 2. As New Caledonia is a neighbour of ours this book should excite some interest among New Zealand ornithologists and bird watchers, and I recommend it to them on the strength of its beautiful photographs.

The book may be ordered direct from M. Francis Hannecart, B.P. 229, Noumea, New Caledonia, at the New Zealand equivalent of $US32 per copy, including mailing.

P. C. M. LATHAM

OBITUARY

SYLVIA MARY REED, 1915-1981

Born within sound of Bow Bells, Sylvia, as she was known to a host of friends, received her early education at Crouch End High School. She then went to Cheltenham Ladies College; and, after matriculation, to Reading University, where she studied for a Diploma in Dairying. Her academic studies finished, she became a land-girl, working on farms in Surrey and Devonshire.

Through that admirable publication, *N.Z. Weekly News,* Sylvia made pen-friends, among whom was her future husband, Milford Reed, When he returned to his native Kent in 1939, they were married. Sylvia remained in London throughout World War 2, delivering people daily bread and dodging the blitz.

Mick returned to New Zealand with repatriated forces, and in December 1945 Sylvia followed with their daughter, Phyllida. The arrival of twins kept Sylvia tied to the home, first at Birkenhead, then at Meadowbank. Time permitting, she began to go on Royal Forest & Bird excursions, and so she graduated to the Ornithological Society. The birds of the coast were her especial delight.

In everything she undertook her energy was manifest. ' Get on with the job ' could well have been her motto. Appointed Regional Representative for Auckland in 1969, she succeeded Ross McKenzie in 1972 as Associate Ornithologist at the Auckland Museum. Theoretically she was there two days a week; but ornithology had now become the core of her existence. She was elected to the Council of OSNZ in 1973.

Sylvia was an eminently practical person. If she thought a corporate activity worthwhile, she set about organising it and enlisting volunteers. Hence monthly beach-patrols and annual surveys of Muriwai lakes and major tern colonies. She loved to be out in the field. She came to know Muriwai beach and its hinterland like the back of her hand. One needed a steady nerve to sit beside her in her Toyota as she charged at sandhills among the Woodhill pines.

Although her later years were clouded with pain, her spirit was indomitable. In search of birds she had recently visited Samoa, the Chatham Islands and Alaska, and only last September she astonished her friends by setting off to Greece. One very happy memory which she brought back was of big Mediterranean Shearwaters lazily following in the wake of an inter-island steamer.

Her return from Greece coincided with an unusual wreck of Blue and Kerguelen Petrels. Calling in young helpers, she pitched into the fray, salvaging specimens and examining gut contents. Right to the end she was a worker, even if the work was messy.

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Her initiative showed itself in many ways. From Ross McKenzie she inherited the patronage of the local New Zealand Dotterels and extended the banding programme. She was a foundation member, a practical adviser and a generous benefactor of the Miranda Naturalists Trust. She set *Tara* on its feet and was the driving force behind it. *Tara* is the Auckland region's quarterly mixture of serious ornithology and light-hearted bird-watching. Her room at the Museum always seemed to be thronged with visitors.

Naturalists from far afield, both old and young, have reason to remember Sylvia with affection and admiration. Grateful for years of unsparing service, the Ornithological Society offers its sympathy to her husband, and to her children and grandchildren scattered across the globe.

— R. B. S.

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LETTER

24 March 1982

The Editor,

Sir,

I have just received the December 1981 issue of Notornis, which contained the obituary of our friend, Ross McKenzie.

Mrs Foster and I had the privilege of spending three days with Ross and Hetty, back in February 1971.

We arrived at Auckland on a Saturday morning, and went to our hotel, figuring we would call Ross (whom we had never met, but whose name we had got from the B.O.U.), and hadn't much more than checked in, when the telephone rang, and here was Ross, saying, " Come on, throw your bags down, and get out here." We had a most delightful three days, which was a rare privilege, because both Ross and Hetty were so kind, so hospitable, and so very friendly, that, even though we have not had the privilege of seeing them since, we treasure their friendship. The picnics that we had, which Hetty fixed up, built around her homemade bread, were really something. They not only took us by automobile to various points, but also we had one day out on a boat to see the shearwaters, etc.

I just thought, maybe, this tribute from one of your overseas members might be of interest.

I can close by saying that the list of birds that he showed us, in his area, was terrific, and, furthermore, he and Hetty told us where to go in South Island, which, also, proved most successful.

JOHN H. FOSTER, *1616 Walnut Street, Philadelphia*