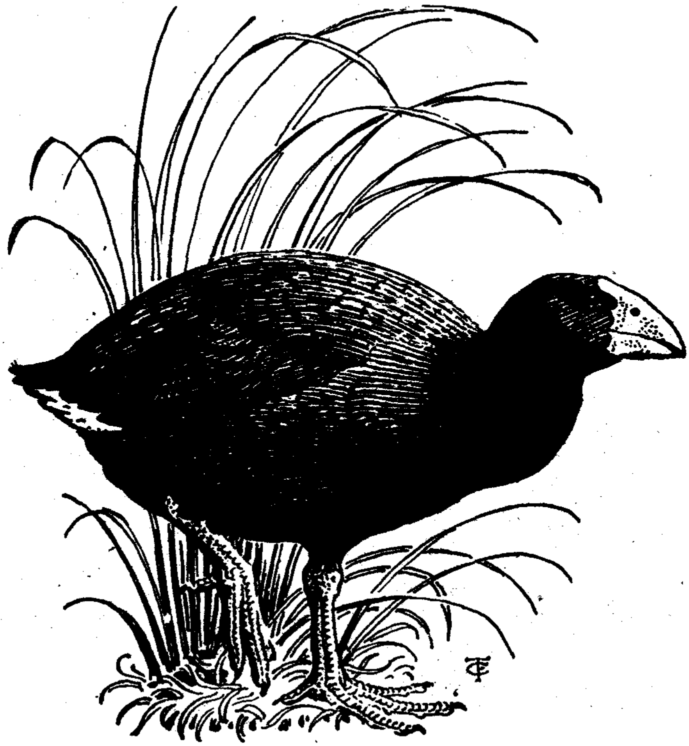
# NOTORNIS

Journal of the Ornithological Society
of New Zealand



Volume 33 Part 4 December 1986

## OFFICERS 1986-87

President – B. BROWN, 20 Redmount Place, Red Hill, Papakura
Vice-President – D. E. CROCKETT, 21 McMillan Ave., Kamo, Whangarei
Editor – B. D. HEATHER, 10 Jocelyn Crescent, Silverstream
Treasurer – D. F. BOOTH, P.O. Box 35337, Browns Bay, Auckland 10
Secretary – R. S. SLACK, c/o P.O., Pauatahanui, Wellington

*Council Members:*

BEN D. BELL, Zoology Dept., Victoria University, Private Bag, Wellington
BRIAN D. BELL, 9 Ferry Road, Seatoun, Wellington
P. D. GAZE, Ecology Division, DSIR, Private Bag, Nelson
B. J. GILL, Auckland Institute & Museum, Private Bag, Auckland
J. HAWKINS, 772 Atawhai Drive, Nelson
H. A. ROBERTSON, Ecology Division, DSIR, Lower Hutt
P. M. SAGAR, 38A Yardley Street, Christchurch 4

*Conveners and Organisers:*

Rare Birds Committee: Secretary, J. F. M. FENNELL, P.O. Box 12, Darfield, Canterbury
Beach Patrol: R. G. POWLESLAND, Wildlife Service, Dept. of Internal Affairs, Private Bag, Wellington
Librarian: A. J. GOODWIN, R.D. 1, Clevedon
Nest Records: H. A. ROBERTSON, Ecology Division, DSIR, Private Bag, Lower Hutt
Banding Liaison Officer: L. GURR, 84 Marne Street, Palmerston North
Reviews Editor: D. G. MEDWAY, 25A Norman Street, New Plymouth

*Classified Summarised Notes –*

North Island: L. HOWELL, 38 Okahu Rd., Kaitaia
South Island: P. D. GAZE, Ecology Division, DSIR, Private Bag, Nelson
S.W. Pacific Island Records: J. L. MOORE, 32 Brook St., Lower Hutt

Editor of *OSNZ news*: P. SAGAR, 38A Yardley St., Christchurch 4

## SUBSCRIPTIONS AND MEMBERSHIP

*Annual Subscription (including GST):*

Ordinary Member $27.50; Husband & Wife members $41.25; Junior Member (under 20) $20.62; Life Member $550; Family member (one *Notornis* per household), being part of a member's family and household, $13.75; Overseas Member $25; Institution $55. Overseas institutions and members $5.00 extra (postage).

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

*Applications for membership, changes of address, resignations and advice on non-delivery of Notornis and OSNZ news should be sent to:–*

Membership Secretary,
The Ornithological Society of N.Z. Inc.,
P.O. Box 35337,
Browns Bay, Auckland 10.

Exchanges and library subscriptions should be sent to the Treasurer.

Editorial matters ONLY should be sent to the Editor.

[Registered with the GPO Gisborne as a publication]

ISSN 0029-4470

# CONTENTS

Short Notes

Letter

---

Printed by TE RAU PRESS LTD, Peel Street, Gisborne

## REGIONAL REPRESENTATIVES

FAR NORTH: L. Howell, 38 Okahu Rd., Kaitaia, Ph. 1424
NORTHLAND: D. E. Crockett, 21 McMillan Ave., Kamo, Whangarei.
Ph. 50954.
AUCKLAND: M. J. Taylor, 28 Awarua Crescent, Orakei, Auckland 5.
Ph. 549234.
SOUTH AUCKLAND: Beth Brown, 20 Redmount Place, Red Hill,
Papakura, Ph. 2988157.
WAIKATO: F. Nieuwland, 38 Berkley Ave., Hamilton. Ph. 62045
BAY OF PLENTY: P. C. M. Latham, c/o Papamoa Beach P.O., via
Te Puke. Ph. 420406.
VOLCANIC PLATEAU: J. G. Innes, Loop Road, Okareka, Rotorua.
Ph. 28107.
GISBORNE/WAIROA: J. C. Henley, 6/456 Aberdeen Rd., Gisborne.
Ph. 81581.
TARANAKI: D. G. Medway, 25A Norman Street, New Plymouth.
MANAWATU: } L. J. Davies, 71 Jickell Street, Palmerston North.
WANGANUI: } Ph. 70159
HAWKES BAY: K. V. Todd, 2/416 E. Heretaunga Street, Hastings.
Ph. 82172.
WAIRARAPA: C. Scadden, 15 Madden Place, Masterton. Ph. 86423.
WELLINGTON: R. N. Thomas, 6 Satara Crescent, Khandallah,
Wellington 4. Ph. 791165.
NELSON: J. Hawkins, 772 Atawhai Drive, Nelson. Ph. 520151.
MARLBOROUGH: Beverley North, P.O. Box 341, Blenheim. Ph. 88585
CANTERBURY: E. Graham, Woodchester, 76 Banks Ave.,
Christchurch 6.
WEST COAST: C. S. Lauder, 9 Winnie Street, Greymouth. Ph. 6349.
OTAGO: P. Schweigman, 121 Maryhill Terrace, Maryhill, Dunedin.
Ph. 52790
SOUTHLAND: W. J. Cooper, 218 Chelmsford Street, Invercargill.
Ph. 75281.

## LITERATURE AVAILABLE

*From all bookshops:*

| | |
|---|---|
| Collins guide to the birds of New Zealand by R. A. Falla, R. B. Sibson and E. G. Turbott | $24.95 |

*From M. Bishop, Maungakura Road, R.D.3, Hellensville:*

| | |
|---|---|
| Back numbers of 'Notornis': Parts of Vol. 1-25, $3.00 per part: Vols. 26-29, $5.00 per part; Vols. 30-34, $6.00 per part; all plus 10% for postage and packaging (in NZ). | |
| Reports and bulletins (1939-1942) | $2.00 |
| OSNZ Library catalogue (1976 ed) 17 pp. | $0.55 |
| Banding reports, Nos. 8-14, 55¢ each | |
| Kermadec Expedition, 1964, by A. T. Edgar. | $0.50 |
| Amendments & Additions to 1970 Checklist. | $2.00 |

# NOTORNIS

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

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

**Volume 33** **Part 4** **December 1986**

# AN EARLY ACCOUNT OF SOME BIRDS FROM MAUKE, COOK ISLANDS, AND THE ORIGIN OF THE "MYSTERIOUS STARLING" *Aplonis mavornata* BULLER

By STORRS L. OLSON

## ABSTRACT

Overlooked manuscript notes made by Andrew Bloxam during the voyage of HMS *Blonde* detail his observations of birds on the island of Mauke, southern Cook group, on 9 August 1825, nearly 150 years before birds were again collected on the island. These notes establish that the unique type of the "Mysterious Starling" *Aplonis mavornata* Buller, a valid species previously of unknown origin and now extinct, was one of the three specimens collected on Mauke by Bloxam. The other two, which have not yet been located, if they still exist, were the kingfisher *Halcyon tuta mauke* and the fruit dove *Ptilinopus rarotongensis* cf. *goodwini*, the latter otherwise unknown on Mauke and probably now extinct there.

## INTRODUCTION

Ornithologically, the Cook Islands, in south-central Polynesia, are among the most poorly known archipelagos of the Pacific. The first native land birds known certainly to have been taken in these islands were in a small collection made by Andrew Garrett on Rarotonga, probably in 1869, because the specimens were received by Godeffroy in 1870 (data from specimen labels) and described by Hartlaub & Finsch in 1871. Wiglesworth (1891a: 574) stated that Garrett "spent six months collecting in the Cook Islands of Rarotonga, Atiu, and Aitutaki," but there is no indication that he obtained birds on either of the last two, of which Atiu has an endemic subspecies of kingfisher, *Halcyon tuta atiu* (Holyoak 1974). Because Garrett was mainly a collector of marine life (Thomas 1979), he may have devoted little attention to ornithology. There is some evidence to suggest that birds besides those reported here may have been obtained in the Cook Islands prior to Garrett, but I have not yet had the opportunity to investigate this further.

Other collections were made on Rarotonga in March 1901 (specimens taken by Lt-Colonel Gudgeon and donated by the Earl of Ranfurly to the British Museum, Natural History), 1903 (specimens collected by Alvin Seale, B. P. Bishop Museum, Honolulu), and 1904 (Wilson 1907). The Whitney South Sea Expedition (1920-1932), of the American Museum of Natural History, was denied permission to collect in the Cook Islands (E. Mayr, *in litt.*) and obtained only some seabirds from the northern Cook group (Holyoak 1980). Not until Holyoak's brief sojourn in 1973, more than a century after Garrett, were any additional species of land birds obtained in the Cook Islands (Holyoak 1974).

I report here an overlooked account of the collection and observation of birds by Andrew Bloxam on the island of Mauke, southern Cooks, during the voyage of HMS *Blonde* in 1825. These manuscript materials not only record in 1825 two species of birds that have vanished from Mauke, but also establish the provenance of the so-called "Mysterious Starling" *Aplonis mavornata* Buller, 1887, a species described from a single specimen of unknown origin in the British Museum (Natural History). Although this has long been recognised as a valid species assumed to be from some island in the Pacific, nothing else has certainly been known about it.

HMS *Blonde*, commanded by George Anson, Lord Byron, had the dismal commission of returning to their native land the bodies of the king and queen of the Hawaii, who had died of measles in England. At age 23, Andrew Bloxam, a fresh graduate from Oxford with an enthusiasm for natural history but with little instruction in the subject, was sent along as the expedition's naturalist, together with his brother Rowland, the ship's chaplain. The *Blonde* left England on 28 September 1824 and returned on 15 March 1826. It arrived in the Hawaiian Islands on 3 May 1825 by way of Madeira, Brazil, Chile, Peru, and the Galapagos. Leaving the Hawaiian Islands on 18 July, the ship made its way south, discovering and naming the island of Malden in the Line group, pausing very briefly at Mauke, and then returned home via South America and St Helena (summarised from Macrae 1922 and Bloxam 1925).

A general account of the voyage (Byron 1827) was compiled by Mrs Maria Graham, mainly from the diary of Rowland Bloxam, to which she added some natural history and other notes from Andrew Bloxam's papers. Neither of the Bloxams contributed to the production of the published volume, Rowland having been posted to Bermuda soon after his return. Mrs Graham's redactorial efforts were not well received, the general account later being called "nearly worthless" (see Macrae 1922:1), with the appendix on Hawaiian birds attributed to Andrew Bloxam being a "disgrace" that was "utterly unworthy of its reputed author" (Newton 1892:466). In 1925, the portions of Andrew Bloxam's diary pertaining to Hawaii and the Pacific were published by the B. P. Bishop Museum, the original manuscript having been obtained from Bloxam's grandson and edited by Stella M. Jones (Bloxam 1925). Both these publications contain an account of landing on Mauke and two sentences about the avifauna.

According to Bloxam's diary (1925), his party landed on Mauke, which they spelled "Mauti", on 9 August 1825, probably in the early afternoon, because Bloxam stated that they returned to the ship "about four p. m." and because, in a letter to William Swainson (Rothschild 1900:vi), he mentioned that he was on the island for only two hours. He took his gun with him "in case of meeting any curious birds" and with his party set out on a road "forming an opening through the wood", coming first to a clearing where canoes were being built and then proceeding

> . . . through the woods, in which we found some trees of an immense magnitude – twenty-six or twenty-seven feet in circumference of the age I should suppose of several centuries. We next entered into a small opening where the screw pine (Pandanus) grew very abundantly and crossing this the path again struck into the wood. We had hitherto seen no indication of huts or dwellings and had already proceeded nearly a mile. I saw several beautiful birds flying about and having loaded my gun, shot one.

Thereafter they came to a park-like opening in the middle of the island, containing the main settlement. The *Blonde* had been preceded on Mauke only by missionaries, who had come from Tahiti in 1823 (Byron 1827, Bloxam 1925, Coppell 1973) and whose influence was already much in evidence. Bloxam (1925) estimated the human population of Mauke at no more than two or three hundred.

> The interior of the island is open and free from trees and the whole in a state of cultivation. They were in possession of goats, pigs, fowls, etc. I saw only one dog and that apparently of the European species .... We saw quantities of rats with long tails, different in appearance from the common South Sea rat and resembling in color and almost in size the Norway rat. We saw them running about the wood in great quantities. I saw no lizards, but several small and beautiful butterflies. The birds found here are a brown wild duck, a species of thrush or starling, very dark brown, a beautiful kingfisher, two species of doves, the smaller kind green with the top of the head of a dark lilac color approaching to pink, a snipe, a white and blue heron and hawk. The only sea birds seen were a few tern and petrel.

The brief published mention of the birds of Mauke that appears in Byron (1827: 213) bears ample testimony to Mrs Graham's editorial deficiencies:

> We saw a green dove, but could not get it: another of the same genus, extremely beautiful, which we named Columba Byronensis. We also saw a fine duck, a species of scolopar [*sic*]; a blue and white heron; a hawk; a king-fisher peculiar, and called by us Alcedo Mautiensis; a starling, and some tarn [*sic*] and petrels.

Had the editor included any of Bloxam's detailed descriptions (see below), the overlooked and unaccounted for names *Columba byronensis* Bloxam (in Byron 1827) and *Alcedo mautiensis* Bloxam (in Byron 1827) would preoccupy *Ptilinopus rarotongensis* Hartlaub & Finsch (1871) and *Halcyon* *tuta mauke* Holyoak (1974) respectively. As they appear, however, these names are absolute *nomina nuda* and have no effect on subsequent nomenclature.

## BLOXAM'S MANUSCRIPT NOTES

An overlooked and ornithologically much more revealing source that I have examined on microfilm is Bloxam's detailed natural history notes, along with considerable correspondence about them, mainly between Alfred Newton and Andrew Bloxam's son, A. Roby Bloxam. These materials are now filed under number M8S BLO in the British Museum (Natural History). They were examined in detail in the last century by no less an ornithologist than Alfred Newton of Magdalene College, Cambridge, and later passed through the hands of Walter Lord Rothschild and Ernst Hartert without anyone recognising the value of Bloxam's observations on Mauke (or, for that matter, of his Hawaiian notes).

There are two sets of Bloxam's notes, one rough and the other a neater transcription, which is reproduced below, followed by a discussion of the few discrepancies between the two versions. As the original largely lacks punctuation, I have supplied enough to aid comprehension.

Island of Mauti in the South Seas
situated SW of Otaheite

N. 1. Columba. L[ength] 8¾ Inch. Bill ⅝ inch. Legs red, covered with feathers nearly to the toes. Bill short, brownish. Tongue entire, sharp pointed.

Color. Forehead & top of the head a beautiful deep lilac approaching to pink. Hind head & neck all round & upper part of breast a powdered grey. Upper part of wings, tail, & back, green of various & beautiful shades & tints. The last ¾ inch of the tail a dusky pale white bar, slightly tinged with green. Wing and tail beneath pale ash. Lower part of belly and vent yellow. Upper part of belly yellowish, with a slight tinge of pink or dark lilac in the middle. Red berries were found in its maw.

Columba Byronensis.

N.2. Sturnus. L 7½ inch. Color a light brownish black all over, the feathers edged round with a lighter shade of brown. Bill strong, 1 inch long. Lower m[andible] straight, upper m[andible] compressed, rather curved & slightly notched at the tip. Nostrils at the base oval. Tongue at the extremity bifid. Tail short, 12 equal f[eathe]rs, rounded at the tips. Legs strong, outer toe not connected with the middle. Iris yellow.

Sturnus Mautiensis.

N.3. Alcedo. L. 8¾ inch. Bill 1¾ inch long, straight, pointed, nearly ¾ inch broad at the base. Upper m[andible] black, base of the lower flesh color. Nostrils oval at the base. Tongue broad, short, entire, rounded at the extremity, situated far back, ¼ inch long. Feet short, strong, outer toe connected with the middle as far as the third joint. Middle claw not serrated. Legs black. Tail feathers 12, equal, rounded at the ends.

> Color. Top of the head blue surrounded with a ring of white above the eyes. Under the latter a small blue ring runs from the bill round to the back of the head, from thence on to the back is white. The upper parts of the back, wings, and tail are blue. The inner half of each quill feather brown, primary quills almost wholly so. From lower mandible to tail underneath white, as also the under wing coverts. The quill and tail f[eathe]rs underneath brown.
>
> Alcedo Mautiensis
>
> Besides the preceding
>
> I observed another & larger species of the dove, a brown duck similar in color & size to the common English wild duck, a species of the *Scolopax*, a white & blue heron, also a few small but beautiful insects of the papilio class, small lizards, and rats, the latter rather larger than the common S Sea rat. Few dogs, many pigs, cats, & a few goats comprised the remainder of the animals peculiar to this small island.

The rougher set of notes begins as follows:

> Sea birds. White and blue heron. Hawk. A small white tern. A black tern or noddy. Frigate pelican. Widgeon or duck. A species of Tringa or Scolopax. Large green pidgeon.

This is followed by the more detailed descriptions of the *Sturnus*, *Alcedo*, and *Columba*, in that order, and a more extensive description of the duck, together with a sketch of the head. These are essentially the same as in the transcribed version, except that in the account of the "Sturnus" there is a measurement for "B[readth = wing span] 12½ inches" and the comment that it was "killed hopping about tree," which is all that we shall ever know about the behaviour of this extinct species.

A draft list of 121 specimens, mostly from South America, that Bloxam collected and presented to the Admiralty on his return includes the three birds collected on Mauke – "the number answers to the label marked on each":

| **No.** | **Island of Mauti** |
|---|---|
| 30. | Columba Byronensis |
| 31. | Alcedo Mautiensis |
| 32. | Sturnus Mautiensis |

Clearly, these were the only specimens obtained on Mauke and they reached England bearing tags numbered as above.

## SPECIES ACCOUNTS

We may now try to identify the birds that Bloxam saw or collected with those known today on Mauke, as listed in Holyoak (1980) and Taylor (1984).

### PROCELLARIIDAE?

A "petrel" is thus mentioned only in the diary, and so the record is equivocal. Although various petrels may be seen at sea around the Cook Islands, none were known to breed there, which is certainly an artifact of human disturbance. In caves on Mangaia, Steadman (1985) discovered abundant remains of a small species of *Pterodroma* as well as bones and a living fledgling of the *Puffinus lherminieri/assimilis* group, thus confirming petrels as breeding in the Cook Islands. Also, some form of petrel is now known to breed in small numbers on Atiu (G. McCormack, *in litt.*).

FRIGATEBIRD *Fregata* sp.

The "frigate pelican" could refer to either *F. minor* or *F. ariel*, both of which now breed in the Cook Islands only in the more remote and sparsely inhabited islands of the group, although they may wander throughout the archipelago. Although there seems to be no specific mention of frigatebirds on Mauke in the modern literature, G. McCormack (*in litt.*) informs me that a small permanent roost is there.

REEF HERON *Egretta sacra*

The "blue and white heron" can refer only to this dichromatic species, which is on all the islands of the Cook group.

GREY DUCK *Anas superciliosa*

Bloxam's description and illustration are clearly of this widespread species, which is still on Mauke.

WANDERING TATTLER *Heteroscelus incanus*

The species of "Tringa or Scolopax" is surely this, the most abundant migrant shorebird in the Cook Islands.

NODDY *Anous* sp.

Although "a black tern or noddy" could refer to *Anous stolidus* or *A. tenuirostris*, as both occur in the Cooks, the former is reported to nest on Mauke today, whereas the latter is unknown to the residents there (G. McCormack, *in litt.*).

WHITE TERN *Gygis candida*

This "small white tern" breeds at Mauke and throughout the Cook group.

ACCIPITRIDAE?

The single word "hawk" in Bloxam's rough notes and diary was curiously omitted from his transcribed notes, which, in the absence of any further description, casts great doubt on this observation. Hawks are not known in the South Pacific east of Fiji, but they may have been more widely distributed before human settlement because bones of an *Accipiter* have been found in Holocene deposits in the Hawaiian Islands (Olson & James 1982).

PACIFIC PIGEON *Ducula pacifica*

Bloxam's rather equivocal reference to a second columbid in his diary and transcribed notes is resolved in the rough notes by his mention of a "large green pidgeon", which almost certainly refers to *D. pacifica*, a species still on the island.

COOK ISLANDS FRUIT DOVE *Ptilinopus rarotongensis* cf. *goodwini*

Bloxam's wonderfully detailed and accurate description of his "Columba Byronensis" leaves no doubt that he collected *P. rarotongensis* on Mauke, where it has not otherwise been recorded and must be assumed extinct. The species was originally described from Rarotonga, to which the nominate race is restricted, and was unknown elsewhere until Holyoak discovered a population on the island of Atiu, which he named *P. r. goodwini* (Holyoak 1974). This subspecies was distinguished from the nominate form by having the magenta patch on the belly reduced to a "few orange feather tips". (The purple crown is also darker, a character not mentioned by Holyoak.) Bloxam's description of the Mauke bird as having the belly "with a slight tinge of pink or dark lilac in the middle" accords better with *P. r. goodwini* than with the nominate race, as would be expected on geographical grounds.

### CHATTERING KINGFISHER *Halcyon tuta mauke*

Bloxam's detailed description of "Alcedo Mautiensis" establishes that he collected this subspecies, which is endemic to Mauke, nearly 150 years before Holyoak (1974) collected and formally named it.

### "MYSTERIOUS STARLING" *Aplonis mavornata*

This species is based on a single specimen of unknown origin that was long overlooked in the collection of mounted birds in the British Museum (Figure 1). Despite this unique specimen's uncertain source and nomenclature, it is accepted in the modern literature as representing a species distinct from any other form of *Aplonis* .

The name is attributed to Buller (1887: 25), who mentioned it as follows in an account of *Aplonis caledonicus (= Aplonis striata).*

> The British Museum contains a good number of specimens, showing little variation, and all from New Caledonia. A specimen marked *Aplonis mavornata*, but without any reference, differs from *A. caledonicus* in having the plumage dingy brown, without any gloss, the feathers of the underparts narrowly margined with grey. This may prove to be the young of *A. caledonicus*, but no locality is given.

It is quite clear that Buller never intended to describe this specimen as a new species. Furthermore, as indicated by Sharpe (1890), the label on the stand actually said *"inornata,"* and so the spelling in Buller must have been unintentional, as the specimen was *not* marked *"Aplonis mavornata"*. For this reason, Sharpe (1890), followed by Wiglesworth (1891b), listed the species as *Aplonis inornata*, although that name is preoccupied in *Aplonis*, as now constituted, by *Calornis inornata* Salvadori, 1880. Greenway (1958), Amadon (1962), and others have retained the erroneous original spelling, citing Buller as the author. Although names cannot be based only on a label (Article 12c, International Code of Zoological Nomenclature, 3rd ed., 1985), which is almost the case here, Buller nevertheless did supply a description. Although the name is obviously misspelt, Buller's publication gives no internal evidence of this, as would be required to emend it. Thus, according to the present rules of nomenclature, I suppose the name *Aplonis mavornata* can stand, although the cirumstances of its introduction make me most reluctant to accept it.

Sharpe (1890, 1906) and Wiglesworth (1891b) tried to equate the specimen of *Aplonis mavornata* with the drawing by Georg Forster (folio 146

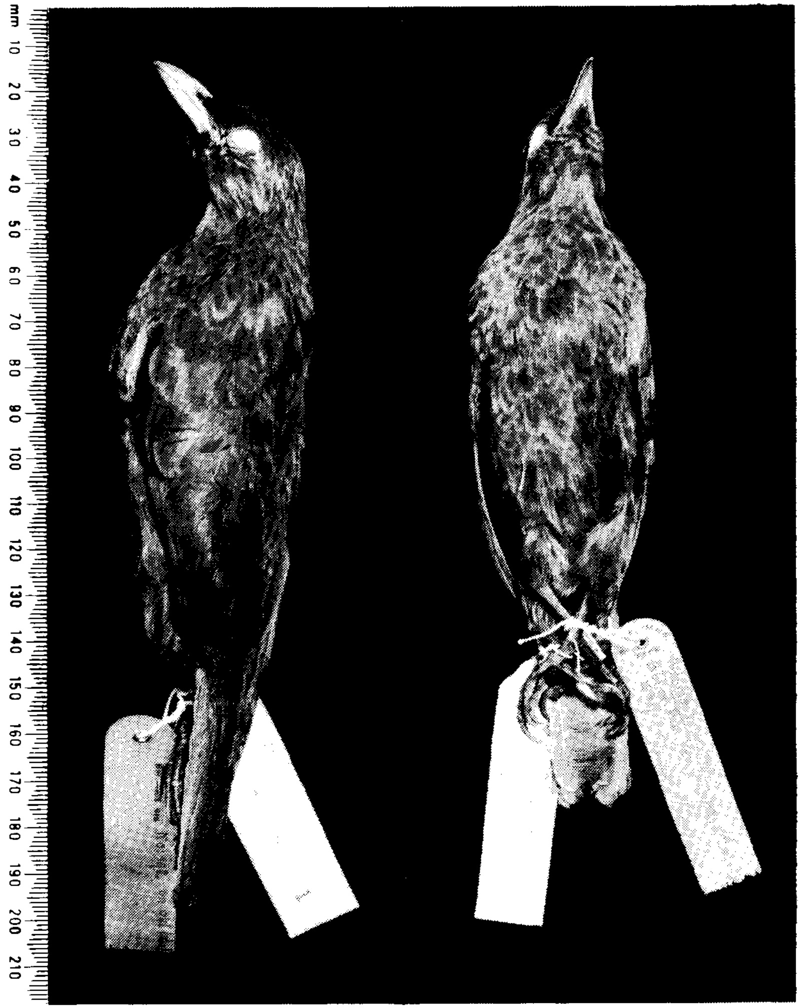


FIGURE 1 — Left lateral and ventral views of the unique holotype of the "Mysterious Starling" *Aplonis mavornata* Buller. Photographs by the British Museum (Natural History). Scale is in mm; the figure on the right is reduced 10% over that on the left.

in BM [NH], see Lysaght 1959) of a bird from Raiatea (Ulietea) in the Society Islands obtained on Cook's second voyage and called in manuscript by Forster *Turdus badius*. This became the type of *Turdus ulietensis* Gmelin. Kinnear (*in* Stresemann 1949: 248, footnote) pointed out the discrepancies between the specimen of *A. mavornata* and Forster's drawing and therefore considered Sharpe's claim to be unsupported. Note that a colour illustration of *"Merula" ulietensis* in Seebohm (1881: plate 16), stated to have been copied from Forster's illustration, is but a poor copy "since the whole aspect of the bird is changed" (Lysaght 1959: 306). The coloration in this plate also does not conform well with the original Forster drawing, which is said to depict a "reddish-brown bird with distinctly dark, almost black, wings and tail" (Kinnear, *op. cit.*). This description likewise cannot apply to *Aplonis mavornata*, nor do Forster's measurements of *"Turdus badius"* agree with that specimen, as shown by Wiglesworth. Despite the fact that there was no good reason to suppose that *Turdus ulietensis* and *Aplonis mavornata* were the same, the latter has nevertheless been directly or indirectly associated with the Society Islands by various authors up to the present.

As pointed out by Kinnear *(op. cit.)*, Sharpe (1880, 1906) had twice claimed that the type of *Aplonis mavornata* was the sole surviving specimen from Cook's voyages to remain in the British Museum after the collection of Joseph Banks was transferred there. The other specimens "were inadequately prepared, were always mounted, and, from a lack of appreciation of their priceless value, were allowed to decay, through want of proper curatorial knowledge" (Sharpe 1906: 79).

I have examined the unique type of *Aplonis mavornata* (British Museum, old vellum catalogue vol. 12, no. 192a). In spite of its age and having been mounted and then dismounted, it is in excellent condition and does not seem particularly faded (Figure 1). This is contrary to DuPont's (1976) speculation and to what might be inferred from Sharpe (1906: 79), who described the specimen of *"Aplonis ulietensis"*, as he termed it, as having "persisted in a kind of mummified state to the present day, after having been mounted and exposed to the dust and light of the old British Museum for nearly a century." He greatly exaggerated the time it may have been thus exposed, however, because he believed wrongly that the specimen came from Cook's voyages. Its condition belies that belief, however, because the only surviving Banksian specimen would not be likely to be in such fine shape, given Sharpe's comments about the fate of the rest of the specimens. On the other hand, many of Bloxam's specimens are still in good to excellent condition. I was able to locate in the British Museum (Natural History) all but one of the 25 specimens he brought back from the Hawaiian Islands. Unfortunately, in a survey of the appropriate parts of the skin collection, I could not find Bloxam's specimen of *Ptilinopus*, nor that of *Halcyon*, from Mauke.

The specimen of *Aplonis mavornata* corresponds exactly with Bloxam's description of his "Sturnus Mautiensis," which was "light brownish black all over, the feathers edged round with a light shade of brown." The adjective "light" applies if seen as a modifier of "black," the overall appearance of the bird being quite dark. This colour is relieved only by the narrow lighter-brown margins of the feathers, as mentioned by Bloxam, the plumage having little or no gloss or iridescence, unlike most species of *Aplonis*. As presently made up, with the head bent upwards somewhat, the skin measures nearly 7¼ inches in length and when fresh would therefore have been very near the 7½ inches given by Bloxam. His measurement of the bill in the Mauke starling was 1 inch. This must have been taken from the rictus, as his measurement of 1¾ inches for the bill of the Mauke kingfisher is exactly that from the rictus to the tip in the one paratype of *Halcyon tuta mauke* in the British Museum (Natural History). The same measurement in the type of *Aplonis mavornata* is just short of 1 inch (0.94), the discrepancy being easily accounted for by shrinkage. For comparison in future studies, the following measurements of the type of *Aplonis mavornata* may prove useful: wing 105 mm, tail 64.0, culmen from anterior margin of nostril 12.4, length of mandibular symphysis 11.7, tarsus 27.4.

Bloxam's description and the type of *Aplonis mavornata* are alike in all details; the specimen is in good condition and in the British Museum (Natural History) where Bloxam's material was deposited; only one specimen of the species is known; and no one collected birds on Mauke for almost 150 years after Bloxam, ample time for the species to become extinct. Thus, it is almost inconceivable that the type of *Aplonis mavornata* is anything other than the starling collected by Bloxam. Therefore, rather than having no data whatever, one can now say with some confidence that the specimen was shot hopping about in a tree before 4.00 p.m. on the afternoon of 9 August 1825 by Andrew Bloxam on the island of Mauke in the southern Cook group, which is about as precise as one could hope to be after 160 years.

The presence of *Aplonis mavornata* on Mauke is of further interest in that a very different species, *Aplonis cinerascens*, occurs on Rarotonga. The latter could not possibly be the bird described by Bloxam because *A. cinerascens* is larger (length 8½ inches) and is decidedly grey, with light grey margins to the feathers and a whitish belly and undertail coverts. It will be interesting to see what paleontology reveals of the former distribution of *Aplonis* in the Cook Islands. Were there different species on each island, for example, or could two such different species as *A. cinerascens* and *A. mavornata* have coexisted sympatrically on some islands?

## CONCLUSIONS

The evidence for man-caused extinctions of organisms on islands in the Pacific continues to accumulate at a fast rate. Much of this evidence, which has come mainly from analyses of bones from paleontological and archeological sites, shows dramatically just how severely depleted the avifaunas of Polynesia really are – for example, in the Hawaiian Islands (Olson & James 1982), Henderson Island (Steadman & Olson 1985), and New Zealand (Cassels 1984). In the Cook Islands, Steadman (1985) has documented from fossils found in caves on Mangaia the disappearance of a petrel *(Pterodroma)*, a storm petrel *(Nesofregetta)*, two species of flightless rails *(Porzana, Gallirallus)*, three columbids *(Gallicolumba, Ducula, Ptilinopus)*, and a parrot *(Vini)*, probably since the arrival of Polynesians.

Particularly in areas as poorly explored as the Cook Islands, it may be impossible to determine the exact timing of such extinctions, their exact causes, or whether the extinctions are attributable to the influence of Polynesians, Europeans, or both. The precious data supplied by Bloxam and the voyage of the *Blonde* indicate with certainty that at least two species of birds, *Ptilinopus rarotongensis* and *Aplonis mavornata*, have become extinct on Mauke since 1825. To these may possibly be added a petrel and a hawk.

The cause of the extinction of these birds remains uncertain, but Bloxam's own observation of "quantities" of rats, which he perceived to be similar to Norway rats *(Rattus norvegicus)*, is of considerable interest. Atkinson (1985) has suggested that the Norway rat became the common shipboard rat between 1710 and 1830 and thus reached most Pacific islands from Europe before *Rattus rattus* did. Bloxam's visit to Mauke, coming only two years after the first European contact with that island, shows the evident rapidity with which populations of these rats may increase, provided Bloxam was correct that the rats he saw were not *R. exulans.*

We can safely assume that other, as yet unknown, species of birds inhabited Mauke before the coming of man, many of which would have disappeared well before the arrival of the *Blonde*. Flightless rails, doves of the genus *Gallicolumba*, and parrots are three likely possibilities. Paleontological investigations on Mauke would doubtless aid in revealing the kind and number of these species.

## ACKNOWLEDGEMENTS

This study was possible only because the staff of the British Museum (Natural History), particularly Anne Vale, I. C. J. Galbraith, and Derek Read, generously provided microfilm copy of Bloxam's notes and access to critical specimens. In addition, David W. Snow kindly supplied information and made arrangements for the photographs. For comments on the manuscript I thank Ernst Mayr (Harvard University), Gerald McCormack (Education Department, Rarotonga), and David W. Steadman (New York State Museum).

## LITERATURE CITED

AMADON, D. 1962. Family Sturnidae. Pages 75-121 *in* E. Mayr and J. C. Greenway, Jr. editors. Check-list of Birds of the World. Vol. 15. Cambridge, Massachusetts: Museum of Comparative Zoology.

ATKINSON, I. A. E. 1985. The spread of commensal species of *Rattus* to oceanic islands and their effects on island avifaunas. ICBP Technical Publication 3: 35-81.

BLOXAM, A. 1925. Diary of Andrew Bloxam, naturalist of the "Blonde" on her trip from England to the Hawaiian Islands, 1824-25. [Stella M. Jones, ed.]. Bernice P. Bishop Mus. Spec. Publ. 10: 1-96.

BULLER, W. L. 1887. The Birds of New Zealand. 2nd ed. 2 vols. London: The author

BYRON, Lord. 1827. Voyage of H.M.S. Blonde to the Sandwich Islands in the Years 1824-1825. [Compiled by M. Graham]. London: John Murray. [Although the date of publication is given as 1826, an unverified note in the C. W. Richmond card file in the library of the Division of Birds, Smithsonian Institution, indicates the actual date to be 20 February 1827].

CASSELS, R. 1984. Faunal extinction and prehistoric man in New Zealand and the Pacific islands. Pages 741-767 *in* P. S. Martin and R. G. Klein, editors. Quaternary Extinctions: A Prehistoric Revolution. Tucson: University of Arizona Press.

COPPELL, W. G. 1973. About the Cook Islands. Their nomenclature and a systematic statement of early European contacts. J. Soc. Oceanistes 29 (38): 23-56

DUPONT, J. E. 1976. South Pacific Birds. Greenville, Delaware: Delaware Mus. Nat. Hist. Monograph Ser. 3.

GREENWAY, J. C., Jr. 1958. Extinct and Vanishing Birds of the World. New York: American Committee for International Wild Life Protection Special Publication 13.

HARTLAUB, G.; FINSCH, O. 1871. On a collection of birds from Savai and Rarotonga Islands in the Pacific. Proc. Zool. Soc. London 1871: 21-32.

HOLYOAK, D. T. 1974. Undescribed land birds from the Cook Islands, Pacific Ocean. Bull. Brit. Orn. Club 94: 145-150.
HOLYOAK, D. T. 1980. Guide to Cook Islands birds. [Cook Islands Library and Museum Society].
LYSAGHT, A. 1959. Some Eighteenth Century bird paintings in the library of Sir Joseph Banks (1743-1820). Bull. Brit. Mus. (Nat. Hist.) Historical Ser. 1: 253-386.
MACRAE, J. 1922. With Lord Byron at the Sandwich Islands in 1825; being extracts from the MS diary of James Macrae, Scottish botanist. [William F. Wilson, ed.]. Honolulu: [No publisher given].
NEWTON, A. 1892. Ornithology of the Sandwich Islands. Nature 45: 465-469.
OLSON, S. L.; JAMES, H. F. 1982. Prodromus of the fossil avifauna of the Hawaiian Islands. Smithsonian Contr. Zool. 365: 1-59.
ROTHSCHILD, W. 1900. The avifauna of Laysan and the neighboring islands: with a complete history to date of the birds of the Hawaiian possessions. Part 3. London: R. H. Porter.
SEEBOHM, H. 1881. Catalogue of the Birds in the British Museum. Vol. 5. London: British Museum.
SHARPE, R. B. 1890. Catalogue of the Birds in the British Museum. Vol. 13. London: British Museum.
SHARPE, R. B. 1906. Birds. Pages 79-515 *in* The history of the collections contained in the Natural History Departments of the British Museum. London: British Museum (Natural History).
STEADMAN, D. W. 1985. *Fossil birds from Mangaia, southern* Cook Islands. Bull. Brit. Orn. Club 105: 58-66.
STEADMAN, D. W.; OLSON, S. L. 1985. Bird remains from an archaeological site on Henderson Islands, South Pacific: man-caused extinction on an "uninhabited" island. Proc. Nat. Acad. Sci. USA 82: 6191-6195.
STRESEMANN, E. 1949. Birds collected in the North Pacific area during Capt. James Cook's last voyage (1778 and 1779). Ibis 91: 244-255.
TAYLOR, F. J. 1984. Birds on Aitutaki, Atiu and Mauke, southern Cook Islands. Notornis 31: 267-270.
THOMAS, W. S. 1979. A biography of Andrew Garrett, early naturalist of Polynesia: Part 1. Nautilus 93: 15-28.
WIGLESWORTH, L. W. 1981a. On the Polynesian members of the genus *Ptilopus*. Ibis (Ser. 6. 3: 566-584.
WIGLESWORTH, L. W. 1891b. Aves Polynesiae. A catalogue of the birds of the Polynesian subregion (not including the Sandwich Islands). Abhandlungen und Berichte des Königlichen Zoologischen und Anthropologisch-Ethnographischen Museums zu Dresden No. 6: 92 pp.
WILSON, S. B. 1907. Notes on the birds of Tahiti and the Society group. Ibis ser. 9, 1: 373-379.

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

# SHORT NOTE

## Unusual waterfowl behaviour

On 6 July 1986 I visited the Matata Lagoons, arriving about 10.30 a.m. The weather was cold and wet with a south-westerly wind blowing. On scanning the lagoon opposite the Matata Hotel I saw two dense, round groups of birds, about 70 m apart, well out in the open water. Each group, about 15 m in diameter, was composed of c.100 ducks of two species – New Zealand Shoveler *(Anas rhynchotis)* c.65% and New Zealand Scaup *(Aythya novaeseelandiae)* c.35%. In general, the shoveler formed the dense centre of each group, swimming in circles and surface feeding, while the scaup formed the perimeter, diving about, and under, the group. The sexes of both species appeared to be equally well represented. There were numerous other members of both species scattered around the lagoon but none of them seemed to take any interest in the two dense groups, which seemed to be involved in a feeding frenzy.

When I left Matata at 11 a.m. both groups were still in much the same position and still actively feeding. I returned briefly at about 2 p.m. to find the groups still present and active, though their positions had altered a little.

P. C. M. LATHAM, *c/o Papamoa Beach P.O., via Te Puke, Bay of Plenty*

# KERMADEC ISLANDS EXPEDITION REPORTS: EUROPEAN PASSERINES IN THE KERMADEC GROUP

By DON MERTON and C. R. VEITCH

## ABSTRACT

The history and status of European passerines on the Kermadec Islands are reviewed and supplemented by observations from the Ornithological Society of New Zealand's expedition to the group from 13 November 1966 to 27 January 1967 and by more recent unpublished data.

Of nine species of European passerine recorded from the group, four are established, all apparently self-introduced from the New Zealand mainland some 720-980 km distant.

Counts on Raoul Island in January 1967 showed that the more abundant passerines were, in order of relative abundance, Starling, Song Thrush, Tui, Blackbird and Yellowhammer.

Measurements of Song Thrush, Blackbird and Starling are recorded.

## INTRODUCTION

From 13 November 1966 to 27 January 1967 seven members of the Ornithological Society of New Zealand (OSNZ), a botanist and an entomologist were based on Raoul (Sunday) Island (2938 ha) in the Kermadec group to study birdlife and do biological surveys. The venture marked the 25th anniversary of the Society.

Each of the Herald Islets was visited, and a party was on North Meyer from 19 November to 20 January (Merton 1968). We did not land on the more southern islands of the group, but data from visits to these islands by NZ Wildlife Service (NZWS) parties in August 1966 and November 1970, and other records, have been included.

Merton (1970) gave a general account of the birdlife of the Kermadec Islands. This paper examines in more detail the history and status of European passerines recorded from islands in the Kermadec group.

The Guineafowl *(Numida meleagris)*, introduced to Raoul Island by Thomas Bell in 1906 and last reported in 1909 (Oliver 1955), and domestic poultry are the only birds known to have been introduced to the Kermadec Islands. Nevertheless, nine species of European passerine, four of which are now established in the group, have been recorded (Table 1). The New Zealand Tui *(Prosthemadera novaeseelandiae)*, the only common indigenous passerine, is on Raoul Island only.

Table 1 lists the islands of the Kermadec group and the known status of the European passerines on them.

NOTORNIS 33: 209-218 (1986)

TABLE 1 — Distribution of European passerines on islands of the Kermadec group

| | Skylark | Song Thrush | Blackbird | Yellowhammer | Chaffinch | Greenfinch | Goldfinch | Redpoll | Starling |
|---|---|---|---|---|---|---|---|---|---|
| Raoul | S | Xb | Xb | X | - | V | V | S | Xb |
| N Meyer | - | - | Xb | - | - | - | - | - | Xb |
| S Meyer | - | - | - | - | - | - | - | - | - |
| Napier | - | - | - | - | - | - | - | - | Xb |
| Nugent | - | - | - | - | - | - | - | - | - |
| Dayrell | - | - | - | - | - | - | - | - | Xb |
| N Chanter | - | - | - | - | - | - | - | - | X |
| S Chanter | - | - | - | - | - | - | - | - | X |
| Macauley | - | V | X | - | V | - | V | - | X |
| Haszard | - | - | - | - | - | - | - | - | - |
| Curtis | - | V | V | - | - | - | - | - | X |
| Cheeseman | - | - | - | - | - | - | - | - | - |
| L'Esperance | - | U | - | - | - | - | - | - | - |

KEY: X = Present, b = Breeding confirmed,
V = Vagrant, S = Status unknown,
U = Unconfirmed report

## SPECIES RECORDED

### SKYLARK *Alauda arvensis*

This was first recorded in 1944, when Sorensen (1964) noted three on Raoul, one of which he collected. The 1964 OSNZ party recorded one (Edgar *et al.* 1965). T. Blake of the 1966/67 meteorological team reported two on the farm in early January 1967, but members of the 1966/67 OSNZ party did not record it. One was seen on the farm on 16 and 19 April 1973 (J. C. Smuts-Kennedy, pers. comm.).

### SONG THRUSH *Turdus philomelos*

In 1908 Iredale (1910) found the Song Thrush firmly established on Raoul, and Oliver (*in* Sorensen 1964), of the same party, found it nesting in September. On Curtis Island, Guthrie-Smith (1936) recorded it during a brief visit in April 1929, but it was not found there or on Cheeseman Island (7.4 ha) in November 1970 (B. D. Bell, pers. comm.). A few were on Macauley Island in August 1966 (J. F. O'Brien, pers. comm.), but it was not recorded there between 20 November and 1 December 1970 (B. D. Bell, pers. comm.). In July 1969 W. R. Sykes (pers. comm.) saw what he thought to be a Song Thrush on L'Esperance Rock. It has not been recorded on the Herald Islets.

Sorensen (1964) stated that it was "moderately plentiful" on Raoul in 1944, where the 1964 OSNZ party (Edgar *et al.* 1965) recorded it as "very plentiful". Counts of passerines on Raoul in January 1967 (Table 6) showed the thrush to be widespread, second in order of relative abundance, but perhaps less common in lower altitude coastal associations.

Two nests at the northern end of Denham Bay flat on 23 November 1966 contained four eggs and three eggs and a newly hatched chick. Recently fledged young were common at lower altitudes during the early part of our stay and two were recorded on the Denham Bay track on 10 and 14 December 1966. During the NZ Wildlife Service expedition of March-July 1973 one cat-eaten corpse was found.

Full song was heard throughout the day during November and early December 1966, after which it gradually declined. During January song was heard mainly in the early morning and the evening, with occasional full song and subsong during the day. At Smith Bluff full song began at 0410 hours on 13 January 1967, but it had become spasmodic by 0600 hours. J. Ireland (pers. comm.) noted that full song was general by early May 1973.

BLACKBIRD *T. merula*

Iredale (1910) found the Blackbird firmly established on Raoul in 1908. It was recorded on Curtis in 1929 (Guthrie-Smith 1936), but it was not seen there, or on Cheeseman Island, in November 1970 (B. D. Bell, pers. comm.). It was first reported from Meyer in 1944 (Sorensen 1964). On Macauley, a female was recorded in August 1966 (J. F. O'Brien, pers. comm.) and in November 1970 (B. D. Bell, pers. comm.).

In 1944 Sorensen (1964) considered it to be more commonly met with on Raoul than the Song Thrush and in 1964 it was "very common" there (Edgar *et al.* 1965). An early note in the camp log of the 1966/67 OSNZ expedition stated that Blackbirds were seen more often than Song Thrushes on Raoul, and mist-netting results of 39 adult Blackbirds to 12 adult Thrushes tend to confirm this observation. However, in contrast, data on relative abundance from counts in January 1967 (Table 6) show that, although Blackbirds were plentiful and widespread, they were less common on Raoul than Song Thrushes. The anomaly can perhaps be explained by the fact that Song Thrushes were more vocal than Blackbirds at that time and results may therefore be biased in favour of the Song Thrush. Furthermore, Song Thrushes seemed less common than Blackbirds at lower altitudes, where most previous observations have been made and the mist-nets were set.

A nest with four eggs was found on 5 December 1966, 0.5 m above the ground in a stunted ngaio *(Myoporum obscurum)* at Boat Cove, Raoul Island, and recently vacated nests were common at that time. Fledglings were plentiful in November and early December.

We found a few Blackbirds on both North and South Meyer but not on the other Herald Islets. Two used nests of the current breeding season were found on North Meyer. On 18 December 1966 a male on North Meyer was seen foraging in damp soil that Wedge-tailed Shearwaters *(Puffinus pacificus)* had scraped from burrows the previous night.

Song seemed the same as that of Blackbirds on mainland New Zealand, but the alarm call differed slightly. During November and early December full song was heard on Raoul and Meyer in the early morning, the evening and often throughout the day. Song then declined, and in January, Blackbirds were almost silent except for spasmodic full song and subsong in the early morning and evening.

YELLOWHAMMER *Emberiza citrinella*

E. B. Davidson (pers. comm.), who spent five months on Raoul in 1937, did not record this species. However, in 1944 Sorensen (1964) found it "moderately plentiful". The 1964 OSNZ expedition considered it well established and "fairly common in open areas". In 1966-67 we found it to be fifth in order of abundance among passerines (Table 6). It was in moderate numbers in more open areas and also occurred in small flocks near the meteorological station's fowl run and pig sty. It was singing well. Occasionally it frequented forest far from clearings. In June 1973, J. Ireland (pers. comm.) counted 60 on the farm and, also in 1973, J. C. Smuts-Kennedy (pers. comm.) saw it occasionally at Boat Cove and along the terraces towards Hutchinson Bluff.

It has not been reported from other islands in the Kermadec Group.

CHAFFINCH *Fringilla coelebs*

The only Kermadec record is one female seen on Macauley Island in November 1970 (B. D. Bell, pers. comm.).

GREENFINCH *Carduelis chloris*

This was first recorded by the 1964 OSNZ party, who saw a few near the meteorological station on Raoul in November (Edgar *et al.* 1965). J. Ireland (pers. comm.) found part of an old wing near the hostel on 11 March 1973. He also saw a live bird in the hostel garden on 21 and 27 May, three on the farm on 1 June, and one that visited the hostel garden throughout June and was seen again on 7 July 1973.

GOLDFINCH *C. carduelis*

The first record is that of Smith (1887) who, presumably upon information from the Bell family, stated that it was seen on Raoul two years before his visit in 1887, although neither Cheeseman of the same party nor Oliver and Iredale of the 1908 expedition mentioned Goldfiches in their accounts of birdlife. However, according to Oliver (*in* Sorensen 1964), R. S. Bell shot one on Raoul on 17 May 1909, and Sorensen recorded that three were seen there in 1940. Smuts-Kennedy (pers. comm.) reported that one occasionally visited the hostel garden during the first half of June 1973.

The Wildlife Service party on Macauley in August 1966 (J. F. O'Brien, pers. comm.) reported one seen with a flock of Silvereyes *(Zosterops lateralis).*

REDPOLL *Acanthis flammea*

Birds identified on Raoul in 1885 as "Linnets" (Smith 1887) were probably Redpolls.

According to Roy Bell's diaries of 1909 and 1910, small finches were common on Raoul in 1909 and some undoubted Redpolls were seen, one being shot by King Bell in May 1910; yet Oliver and Iredale did not record the species during 10 months on Raoul in 1908.

On 29 May 1944 Sorensen saw, in the crater on Raoul, a flock of small finches which seemed to be Redpolls only. Flight calls were heard near the meteorological station by the 1964 OSNZ party, and on 30 November 1966 DVM heard flight calls over D'Arcy Point ridge. The 1973 party reported scattered sightings of groups of up to five birds on Raoul Island (J. Ireland, pers. comm.).

The Redpoll has been reported only from Raoul Island.

STARLING *Sturnus vulgaris*

This was first recorded on Raoul by Iredale (1910), who in 1908 found it "firmly established", and on Curtis by Guthrie-Smith (1936), who in 1929 saw a flock of 10-12. In August 1966 the NZWS party on Macauley reported flocks of up to eight, and in November 1970 it was recorded on L'Esperance Rock, at which time small numbers were again noted on Curtis and Macauley. In 1944 Sorensen (1964) found it common on both Raoul and Meyer and breeding on Raoul. The 1964 OSNZ party found it common on Raoul and recorded it from both Meyer Islands and the Napier Islets.

Our counts of passerines on Raoul in January 1967 showed the Starling to be the most numerous species. In 1966-67 we found it widespread and most abundant in the parts of the crater disturbed by the 1964 volcanic activity, especially Blue Lake's islands and the coastal zone – particularly the north-eastern shore – where it fed on the prolific invertebrate life, mainly midges (*Chironomus* sp.) and their larvae. In wooded areas flocks fed in the canopy and in the crowns of nikau (*Rhopalostylis cheesemanii*), presumably on insects and nikau berries. The pastoral farm (about 18 ha) was also a favourite haunt. J. C. Smuts-Kennedy (pers. comm.) counted 400 on the farm on 7 April 1973.

In the Herald group, the 1966/67 OSNZ party noted breeding on North and South Meyer, Napier and Dayrell Islets and recorded Starlings on both North and South Chanter Islets.

Occupied nesting holes in trees and cliffs were common in many parts of Raoul in November 1966. Most young had flown by the end of November and no occupied nest was found after the end of December. Fledglings were frequently seen early in our stay. The 34 Starlings mist-netted on Raoul between 27 November 1966 and 8 January 1967 had an adult:juvenile ratio of 1:2.4.

Flocks frequenting the crater and farm increased from a maximum of about 50 birds on 3 December 1966 to a maximum of about 1500 on 5 January 1967. The number of the birds flying to roosts on the Meyer Islands similarly increased and was still increasing when we left in late January. These evening flights were remarkably regular, all birds arriving within about 15 minutes. In mid-January, flights of 3-50 birds would begin to arrive on the western slopes of North Meyer at about 1830 hours and had all arrived by about 1845 hours. There were two lines of flight; most coming from the south-west, the direction of the crater and South Meyer Island, and the rest from the west, the direction of Low Flat and the Farm. The birds roosted on the leeward sides of the summit ridges of both islets. At 0600 hours on 26 December 1966 small flocks were seen to arrive at Low Flat from the direction of Meyer.

In December 1966 12 dead fledglings, which had apparently fallen from nesting holes, were found beneath Rayner Point cliffs on Raoul Island and a further 14 dead Starlings, mainly juveniles, were found on North Meyer. A composite sample of breast tissue from 21 birds from the crater, garden and farm on Raoul Island contained 0.2 parts per million DDE and 0.014 ppm DDD, but no DDT. These are sublethal quantities (report from

Wallaceville Animal Research Station). We therefore concluded that, with large numbers of young birds roosting on Meyer, deaths of this order from natural causes could be expected.

## MEASUREMENTS

At irregular intervals between 18 December 1966 and 9 January 1967 mist nets were operated at seven sites on North Meyer Island and at the Crater, the meteorological station and Low Flat, Raoul Island. All birds caught, as well as any fresh dead specimens found, were measured by the methods described by Baldwin *et al.* (1913). Song Thrush measurements are summarised in Table 2; Blackbird in Table 3, and Starling in Table 4. A comparison with Blackbirds and Starlings measured by us and others on mainland New Zealand indicates some possible minor size differences.

TABLE 2 — Summary of measurements (mm) of Song Thrushes

| | Number | Mean | SD | Range |
|---|---|---|---|---|
| Exposed culmen | 11 | 18.6 | 0.8 | 17.0- 20.0 |
| Bill width | 11 | 9.2 | 1.4 | 7.0- 11.5 |
| Bill depth | 12 | 6.5 | 0.5 | 6.0- 7.0 |
| Wing | 12 | 111.3 | 3.4 | 104.0-119.0 |
| Tarsus | 12 | 32.2 | 1.4 | 30.2- 35.0 |
| Mid toe & claw | 12 | 26.2 | 1.8 | 23.0- 29.0 |
| Tail | 11 | 81.0 | 5.0 | 72.0- 89.0 |

## RELATIVE ABUNDANCE

During three planned walks in January 1967 over similar distances, we counted birds to assess their relative abundance.

We made one-minute pauses every 4 minutes on the transects to record all birds seen or heard within c.100 metres. We also recorded all birds within c.100 metres of the transect lines between stations and added them to those noted at the subsequent station. We were careful not to record the same bird twice. Table 5 gives the physical conditions encountered on these transects and Table 6 the numbers and relative abundance of species.

We considered that, because the song of some species was subdued in January, our results are biased in favour of the more vocal species, Song Thrush and Yellowhammer. Starlings were heard more often than seen as they fed noisily in the canopy or in nikau crowns.

Song Thrushes were less common in the dry coastal associations; Tuis preferred the lower altitude forests; Yellowhammers recorded were all on the open seaward slopes; Blackbirds and small flocks of Starlings were widespread throughout

TABLE 3 — Summary of measurements (mm) of Blackbirds

| MALES | Number | Mean | SD | Range |
|---|---|---|---|---|
| Exposed culmen | 12 | 22.1 | 1.1 | 20.5- 24.0 |
| Bill width | 12 | 9.9 | 0.8 | 8.0- 11.0 |
| Bill depth | 12 | 8.2 | 0.6 | 7.0- 9.0 |
| Wing | 11 | 125.2 | 3.1 | 120.0-130.0 |
| Tarsus | 12 | 33.7 | 1.5 | 30.0- 35.5 |
| Mid toe & claw | 12 | 28.4 | 1.6 | 25.5- 31.0 |
| Tail | 11 | 107.2 | 3.1 | 101.0-113.0 |

| FEMALES | Number | Mean | SD | Range |
|---|---|---|---|---|
| Exposed culmen | 27 | 21.7 | 1.1 | 19.2- 23.5 |
| Bill width | 27 | 10.4 | 1.1 | 8.9- 13.0 |
| Bill depth | 27 | 7.6 | 0.6 | 6.5- 8.5 |
| Wing | 27 | 121.2 | 3.1 | 116.5-129.0 |
| Tarsus | 27 | 33.7 | 1.1 | 31.4- 35.0 |
| Mid toe & claw | 27 | 28.1 | 1.6 | 24.0- 30.0 |
| Tail | 27 | 101.9 | 4.2 | 91.0-109.0 |

TABLE 4 — Summary of measurements (mm) of adult Starlings

|  | Number | Mean | SD | Range |
|---|---|---|---|---|
| Exposed culmen | 10 | 24.8 | 1.5 | 22.0- 26.5 |
| Bill width | 10 | 8.7 | 1.0 | 7.5- 9.5 |
| Bill depth | 9 | 8.6 | 0.6 | 8.0- 11.0 |
| Wing | 10 | 120.9 | 6.3 | 110.5-127.0 |
| Tarsus | 10 | 28.7 | 1.9 | 24.5- 31.0 |
| Mid toe & claw | 10 | 26.3 | 1.8 | 24.0- 30.0 |
| Tail | 6 | 61.5 | 4.5 | 57.5- 69.0 |

TABLE 5 — Physical conditions on transects

| Transect | 1 | 2 | 3 |
|---|---|---|---|
| Date | 12/1/67 | 14/1/67 | 14/1/67 |
| Time | 0805-1110 | 0700-1010 | 1435-1720 |
| Locality and topography | Mt Prospect to Smith Bluff via Mt Mahoe and intervening ridge tops | Smith Bluff to D'Arcy Pt via Mt Mahoe and intervening ridge tops | Boat Cove to Low Flat via formed road; NE aspect |
| Altitude | 300-480 m | 240-450 m | 70-240 m |
| Habitat | Pohutukawa, nikau, *Ascarina* rainforest | Pohutukawa, nikau, *Ascarina* rainforest | Pohutukawa, nikau, *Myrsine* coastal forest and grass road verge |
| Weather | Fine and cool with light northerly wind | Fine and warm with light northerly wind | Overcast, mild with light northerly wind |

TABLE 6 — Relative abundance of passerines

| | Starling | Song Thrush | Tui | Blackbird | Yellowhammer | Total |
|---|---|---|---|---|---|---|
| TRANSECT 1 (38 stations) | | | | | | |
| No of birds | 25 | 23 | 10 | 10 | 4 | 72 |
| Positive stations | 14 | 18 | 10 | 9 | 4 | |
| TRANSECT 2 (39 stations) | | | | | | |
| No of birds | 56 | 19 | 9 | 14 | 4 | 102 |
| Positive stations | 18 | 17 | 8 | 13 | 4 | |
| TRANSECT 3 (27 stations) | | | | | | |
| No of birds | 28 | 8 | 23 | 11 | 1 | 71 |
| Positive stations | 9 | 8 | 17 | 9 | 1 | |
| TOTAL BIRDS | 109 | 50 | 42 | 35 | 9 | 245 |
| Relative abundance (%) | 45 | 20 | 17 | 14 | 4 | 100 |

## DISCUSSION

Three of the four European species now so plentiful on Raoul were well established there in 1908 (Iredale 1910), the year in which Hull (1909) visited Norfolk Island (1380 km west of Raoul) and lord Howe Island (2200 km west of the southernmost islands of the Kermadec group) and did not record any exotic species. The first did not reach Norfolk and Lord Howe Islands until about 1913 (Hindwood 1940), thus ruling out those islands as sources for the Kermadec birds. At that time European passerines had not colonised the Tongan Islands, 850 km north of Raoul (Mayr 1945), or Fiji, 1300 km north-north-west of Raoul (Watling 1982). Some may have come from Australia, 3000 km west of the Kermadecs, but the distance seems too great. Furthermore, the Yellowhammer, Chaffinch and Redpoll could have originated only in New Zealand because they are not in Australia, Tasmania, Norfolk, or Lord Howe. They have all been widespread and common in New Zealand since soon after their introduction in the 1860s (Thomson 1922) and probably found their way to the Kermadecs, helped by prevailing south-westerly winds (Williams 1953). In this regard it is of interest to note Jenkins' (1967) report of a Song Thrush which came aboard a ship 579 km south-west of Raoul, from where it had apparently flown, aided by a 24 knot north-easterly wind.

Although Cape Brett, 983 km south-west of Raoul, is Raouls Island's nearest New Zealand landfall, L'Esperance Rock (5 ha), the southernmost of the Kermadec group, is only 720 km NNE of Cape Runaway, and birds reaching L'Esperance Rock could readily disperse to other islands in the group: Curtis Island (42 ha) is 97 km NNE of L'Sperance, Macauley Island (236 ha) is 35 km NNE of Curtis, and Raoul (2938 ha) 120 km NNE of Macauley.

Smith (1887) recorded the first European passerines at the Kermadecs, when he visited Raoul at the time of its annexation in 1887. Apparently on information supplied by the resident Bell family, he stated: "Strange to say some Linnets and Goldfinches found their way here two years ago, but have not been seen since." The "Linnets" were probably Redpolls because Linnets *(Acanthis cannabina)* did not become established in New Zealand or Australia and have not been recorded from the Kermadecs by any other observer. redpolls, which are abundant in New Zealand, and have colonised most outlying islands of New Zealand, are often called "brown linnets" and Greenfinches are often called "green linnets". Redpolls were apparently common on Raoul earlier this century (Sorensen 1964), whereas Greenfinches have only recently been recorded (Edgar *et al.* 1965). Strangely, Cheeseman (1887, 1888, 1890), Oliver (1911, 1912) and Iredale (1910,1912) did not comment on Smith's statement, although they did discuss other species reported by settlers. Cheeseman recorded no European passerines in 1887, but Iredale (1910) found three species well established in 1908. Apparently only one further species, the Yellowhammer, has successfully colonised the islands since.

Like Iredale (1910), we found the European passerines unusually "wild", especially Song Thrushes and Blackbirds, but we could not confirm Iredale's surmise that this may have resulted from bullying by New Zealand

Kingfishers *(Halcyon sancta vagans)* and Tuis. We have seen similar behaviour by Blackbirds in remote parts of New Zealand.

Measurements from Raoul Island Blackbirds and Starlings suggest that they may differ slightly in size from those of mainland New Zealand. However, further work is needed to confirm this.

Transect counts and general observations indicate that Starlings comprise at least 50% of the passerine population while Song Thrushes, Tuis and Blackbirds are in about equal abundance. The relative abundance of Tuis and Blackbirds in forested areas of Raoul Island, which at that time were heavily modified by goat browsing, are similar to those of modified forests of the North Island, New Zealand (Diamond & Veitch 1981). However, Song Thrushes seem to be much more abundant in Raoul Island forests.

## ACKNOWLEDGEMENTS

We are grateful to fellow members of the OSNZ Kermadec Islands Expedition for assistance in the field and to B. D. Bell, E. B. Davison, J. Ireland, J. F. O'Brien, J. C. Smuts-Kennedy and W. R. Sykes for information from more recent expeditions. We are also grateful to T. A. Caithness and M. J. Williams for assistance in summarising bird measurements, and to the late R. A. Falla & G. R. Williams and to P. C. Bull & B. D. Heather for criticism of earlier drafts of this paper.

## LITERATURE CITED

BALDWIN, S. P.; OBERHOLSER, H. C.; WORLEY, L. G. 1913. Measurements of Birds. Sc. Publ. Cleveland Mus. Nat. Hist. 2: 1-165.
BELL, R. 1909 and 1910. Unpublished diary. Turnbull Library, Wellington.
CHEESEMAN, T. F. 1887. On the flora of the Kermadec Islands; with notes on the fauna. Trans. NZ Inst. 20: 151-181.
CHEESEMAN, T. F. 1888. On some birds of the Kermadec group. Trans. NZ Inst. 21: 121-124.
CHEESEMAN, T. F. 1890. On the birds of the Kermadec Islands. Trans. NZ Inst. 23: 216-226.
DIAMOND, J. M.; VEITCH, C. R. 1981. Extinctions and introductions in the New Zealand avifauna: cause and effect? Science 211: 499-501.
EDGAR, A. T.; KINSKY, F. C.; WILLIAMS, G. R. 1965. The Kermadecs expedition, November 1964. Notornis 12: 3-43.
GUTHRIE-SMITH, H. 1936. Sorrows and Joys of a New Zealand Naturalist. Dunedin: Coulls, Somerville, Wilkie.
HINDWOOD, K. A. 1940. The birds of Lord Howe Island. Emu 40: 1-86.
HULL, A. B. 1909. The birds of Lord Howe and Norfolk Islands. Proc. Linnean Soc. NSW 34: 636-693.
IREDALE, T. 1910. Birdlife on the Kermadec Islands. Emu 10: 2-16.
IREDALE, T. 1912. Concerning the Kermadec Islands avifauna. Trans. NZ Inst. 45: 78-92.
JENKINS, J. A. F. 1967. Unusual records of birds at sea. Notornis 14: 153.
MAYR, E. 1945. Birds of the Southwest Pacific. New York: McMillan.
MERTON, D. V. 1968. Narrative of the Kermadec Islands expedition. Notornis 15: 3-22.
MERTON, D. V. 1970. Kermadec Islands expedition reports: a general account of birdlife. Notornis 17: 147-199.
OLIVER, W. R. B. 1911. The geographic relationships of the birds of Lord Howe, Norfolk and the Kermadec Islands. Trans. NZ Inst. 44: 214-221.
OLIVER, W. R. B. 1912. Further notes on the birds of the Kermadec Islands. Trans. NZ Inst. 45: 92-93.
OLIVER, W. R. B. 1955. New Zealand Birds. 2nd ed. Wellington: Reed.
SMITH, S. P. 1887. The Kermadec Islands, their Capabilities and Extent. Wellington: Govt. Printer.
SORENSEN, J. H. 1964. Birds of the Kermadec Islands. Notornis 11: 69-81.
THOMSON, G. M. 1922. The Naturalization of Animals and Plants in New Zealand. Cambridge University Press.
WATLING, D. 1982. Birds of Fiji, Tonga, and Samoa. Wellington: Millwood.
WILLIAMS, G. R. 1953. The dispersal from New Zealand and Australia of some introduced European passerines. Ibis 95: 676-692.

DON MERTON, *Wildlife Service, Dept of Internal Affairs, Private Bag, Wellington;* C. R. VEITCH, *Wildlife Service, P.O. Box 13, Papakura*

# BREEDING DISPLAYS AND CALLS OF THE BANDED DOTTEREL
## *(Charadrius bicinctus)*

By MARY BOMFORD

## ABSTRACT

Described are the Banded Dotterel's threat display and call, used by either sex to defend the territory; wing-clicking flight display, used by the male to advertise territorial ownership; scrape display used by the male to entice the female to inspect the nest scrape; coition and associated display; changeover display given at the nest by either sex during incubation; displays used by parents to call chicks for brooding; and distraction displays and alarm calls given when predators approach the nest or chicks.

## INTRODUCTION

The Banded Dotterel is a small plover which breeds only in New Zealand. The main breeding habitats are dry, open, stable areas of shingle, sand or stones, on riverbeds, lakeshores, seashores, fields or mountain tops and slopes. Phillips (1980) has given the most detailed descriptions of the display behaviour of this species. In addition, Stead (1932) and Soper (1972) gave brief descriptions of the distraction displays performed when people approach nests or chicks, and Cunningham (1973) described some calls. The present study provides greater details and photographs of the types of breeding display and the situations in which they are given.

The main study site was the Cass River delta on the west shore of Lake Tekapo, Canterbury, which is a typical high country breeding ground (Bomford, in press). All observations were made between July 1977 and January 1978 (Bomford 1978).

## THREAT DISPLAY AND CALL

Aggression was nearly always limited to stereotyped threats, and body contact was rare. Both non-breeding birds and territorial breeding birds gave threat displays and accompanying threat calls, but these were far more frequent in the breeding season.

On the Cass River delta in late July, just before birds left the social feeding flocks to establish breeding territories, aggressive encounters between flock birds increased sharply. Birds began to occupy territories in early August (Bomford, in press). Males were more aggressive than females and did more to defend territories against intruders, but females often flew to support their males in prolonged disputes.

NOTORNIS 33: 219-232 (1986)

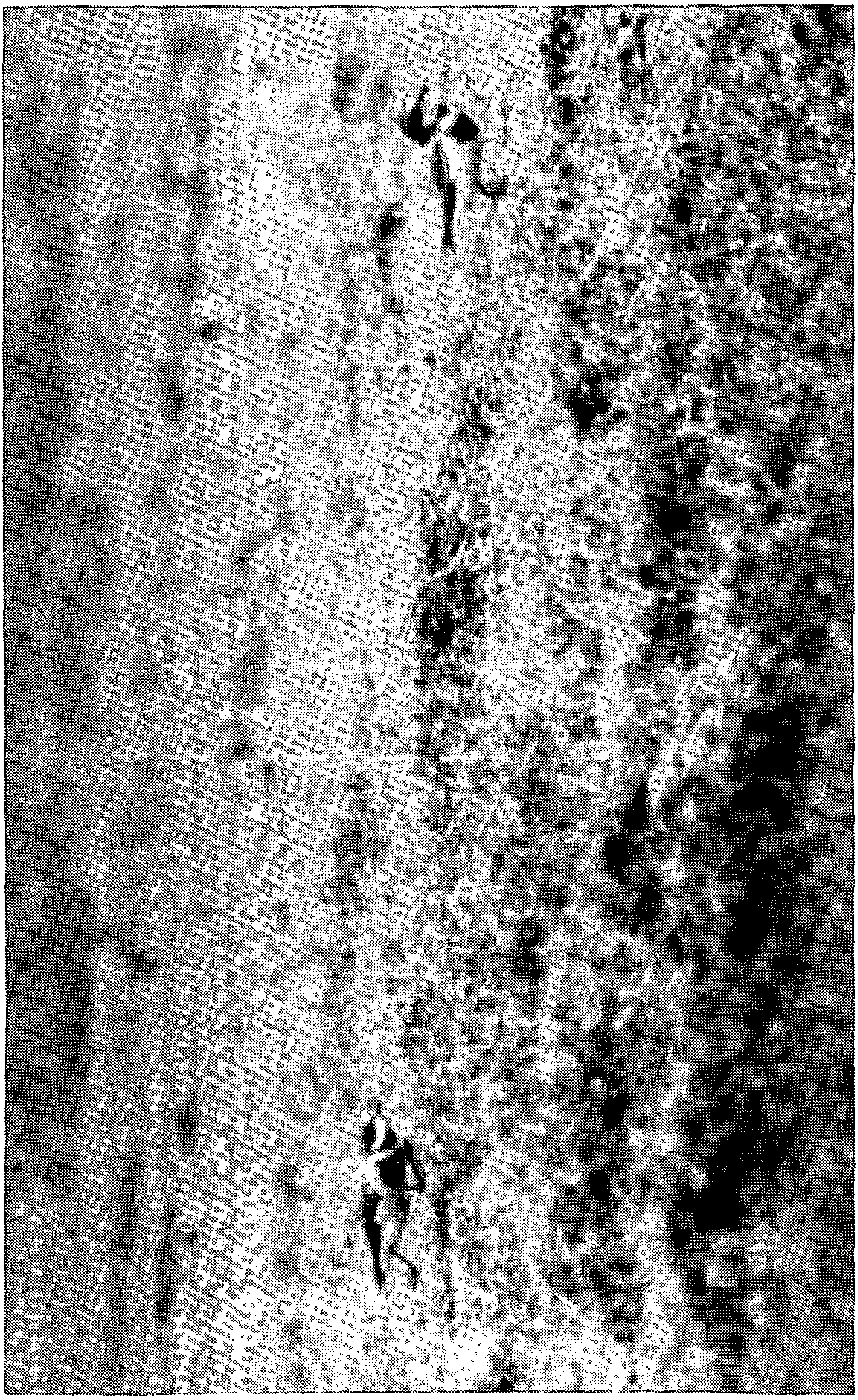


FIGURE 1 — Male Banded Dotterel running in the horizontal threat posture, chasing an intruder from his territory

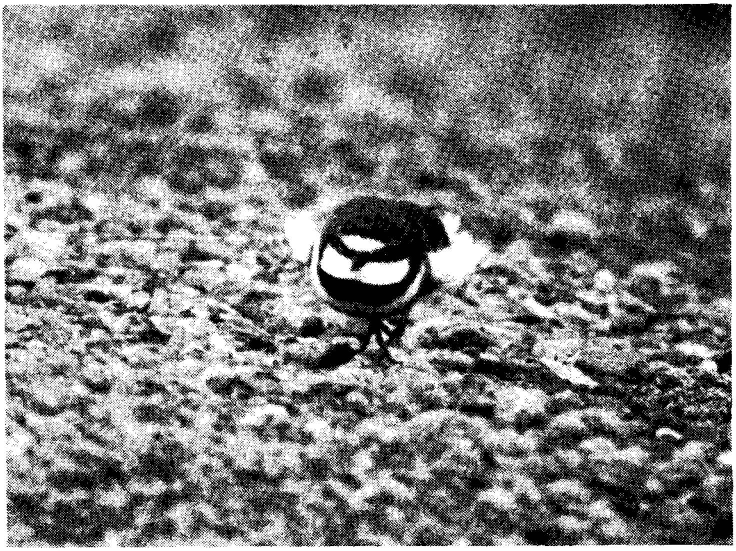


FIGURE 2 — In the horizontal threat posture, the black chest band is clearly displayed and the raised white flank feathers give the bird added width

The following description of a typical display is based on observations of more than 300 displays. The bird runs rapidly towards an intruding bird, holding its body in a horizontal posture (Figure 1). The throat is puffed out, clearly displaying the upper black chest band, but largely hiding the lower chestnut band. In this horizontal running posture the dark bands across the forehead, face and chest, alternating with white, produce a striking pattern (Figure 2). The white feathers along the flanks are raised over the closed wings, making the bird appear abnormally wide.

After running in this horizontal posture for 2-10 m, the bird halts abruptly, facing the intruder, and immediately jerks itself into an upright posture with the head held back, the chest lifted and pushed forwards, and the white flank feathers still fluffed out (Figure 3a). In this posture the broad chestnut chest band is prominently displayed surrounded by white but the upper black band is largely obscured by the lifted chest (Figure 3b). This sudden flashing of the chestnut band is very striking to an observer at ground level.

The displaying bird usually repeats this horizontal run with a following pause in the upright posture several times, coming closer to the intruding bird with each successive run. The display is always accompanied by a threat call, which is given at any time in the display sequence. Cunningham (1973) aptly described this threat call as *che-ree-a-ree*, and it has a fast, rolling rhythm with the accent on the second syllable.

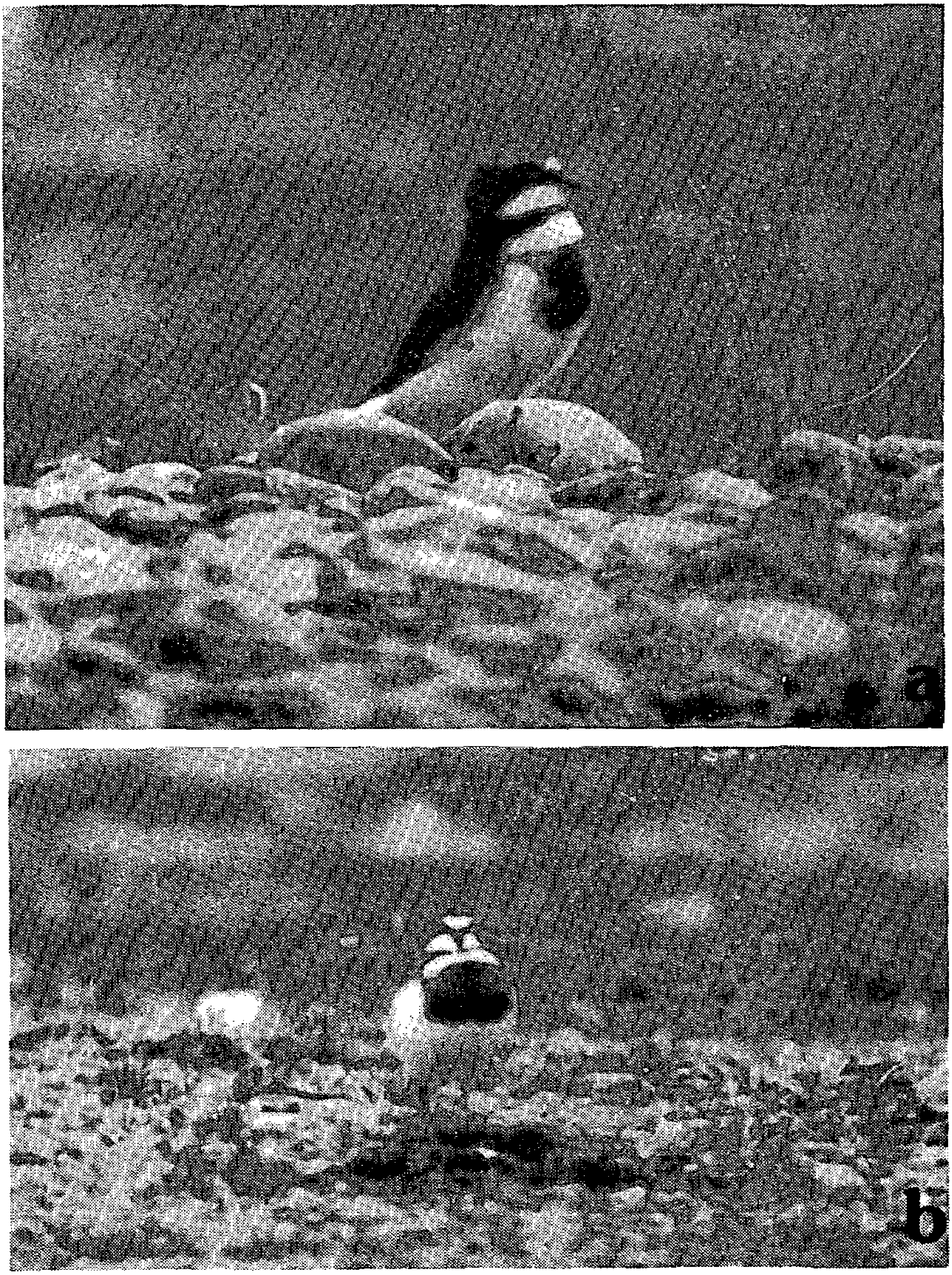


FIGURE 3 — Male Banded Dotterel standing in the upright threat posture.
a. The chest is lifted and thrust forwards.
b. *The chestnut chest band is clearly displayed* but the upper black band is largely hidden by the raised chest.

If the intruder runs away, the owner follows in the horizontal posture and gives repeated threat calls. If the intruder flies away, the owner usually takes flight after it, again giving threat calls, and if the bird lands within the territory, threat displays are resumed. But if the intruder flies further, the owner always turns back from the chase, suggesting an awareness of a territory boundary.

If the threatened bird does not retreat, the displaying bird repeats the horizontal run and upright posture display until it comes within a metre of the intruder, and then both birds face each other in upright display postures. Then one bird makes a run in the horizontal posture towards the other, but turns when it gets close and abruptly retreats. The disputing birds often alternate in making such threats, or instead, they both run together in horizontal postures in roughly parallel directions. If neither bird retreats, such disputes with parallel running may continue for up to 30 minutes, and the disputing birds are often joined by their mates. Parallel running may help define mutual territory boundaries.

Higher-intensity aggression is sometimes seen after two birds have faced each other in upright threat postures. One bird jumps up and comes down as though to land on the other bird's back, but the attacked bird dodges or flutters away. Occasionally such attacks are very one-sided, the same bird repeatedly jumping up at the other, but more often the disputing birds jump up alternately. Sometimes both birds jump up simultaneously, chest to chest, only to land again and face each other in upright threat postures. Such altercations usually end when one bird retreats and is chased away with threat calls. Alternatively, the intensity of aggression declines and the jumps are replaced by parallel running.

Fights were observed only three times. They lasted for up to a minute. Two fighting birds moved so rapidly that they looked like a whirling ball of feathers. The birds sprang at each other and used beating wings and striking feet and bills in the attack. Feathers were plucked out in two fights. One fight was between two males, the second was a male fighting a female whose chicks were hatching, and the third was a female fighting another female who had a recently hatched chick 50 m away.

Banded Dotterels also directed threat displays at and chased away other species that intruded on their territories, including Skylarks *(Alauda arvensis)*, Pied Oystercatchers *(Haematopus ostralegus finschi)*, and Wrybills *(Anarhynchus frontalis)*.

## TERRITORIAL FLIGHT DISPLAY

Males gave flight displays frequently during the first 2-4 days of territory occupation. The earliest flight display observed on the Cass River delta was on 9 August, and 80% of all flight displays were recorded in the following two weeks. Occasional flight displays were seen until November.

All 56 flight displays observed were given by males, 44 straight after an intruder was chased from the territory. Usually, however, no flight display followed the chasing of an intruder.

Flight displays are stereotyped. On turning back from the chase, or on take-off, the male starts a unique wing-clicking flight in which each wingbeat emits a loud click, audible for over 100 m. The wing-clicking male flies in curves, circles and figures of eight over the territory and frequently changes direction. The maximum height reached averaged 7 m, ranging from 2 m to 15 m. Visual estimates of the area displayed over ranged from 180 $m^2$ to 3320 $m^2$, and averaged 1530 $m^2$ for the 56 displays observed. The area defended on the ground appeared to be larger, especially compared with the small areas covered in the briefer flight displays. Wing-clicking lasted from 5 to 120 seconds, averaging 40 seconds. Flight displays were recorded from early dawn until dusk but were not heard at night.

No call is specific to the Banded Dotterel's flight display, although such calls have been described for several other *Charadrius* plovers (Simmons 1953 and 1956, Drury 1961, Glutz von Blotzheim 1975). The most common call associated with the Banded Dotterel's flight display is the *che-ree-a-ree* threat call, which was given just before or during 79% of the displays recorded, sometimes even when no intruder was present. Another call occasionally given is a *kwereep* courtship call, but this call was heard in only 7% of flight displays. At the end of a flight display the male glides to the ground, assumes an upright threat posture for a few seconds, and runs in a horizontal posture for several metres, even if no intruder is present. If an intruding bird is present, it is vigorously chased with threat displays and calls. After a flight display the male often stands on a rise with a good view and looks around his territory.

## NEST SCRAPE DISPLAY

Nest scrape displays are given from the first day a pair occupy a territory. The following description is based on 30 observed scrape displays. A male makes a scrape in sand or shingle by shuffling with his breast and kicking backwards. Shallow scrapes are often made that are never used as nests. The male stands, crouches or sits in a hunched posture in the scrape with his back feathers raised and calls his mate with the *kwereep* courtship call. This call has a soft, crooning quality and it slides up the scale in the second syllable. The call is repeated every few seconds until a female approaches. The male then stops calling and starts bowing (Figure 4). The head is lifted high and then bowed forwards and downwards in a series of rapid jerks. This jerking bow is repeated up to 20 times, the movements becoming faster and more exaggerated as the female comes closer. During this bowing display, the male pushes his chest lower and lower into the scrape, until his body is tilted forward steeply.

The female approaches the bowing male slowly, with many stops and starts. She often circles the scrape, and the male may swivel around to keep facing her. When she eventually runs up to the scrape, she holds her body in a horizontal posture. The male quickly backs out of the scrape, keeping his body hunched, and rapidly fans and closes his tail once. On two occasions a female touched the male's flank with her bill at this stage of the scrape display. On another three occasions the female stood beside the male and both bowed their heads together for a few seconds. Usually the female hunches her body slightly and steps directly into the scrape, while the male stands facing her at right angles (Figure 5). Sometimes the female just stands in the scrape for a second or two before running off, but usually she crouches down and shuffles around in the scrape for up to 10 seconds, while the male stands close by, facing her.

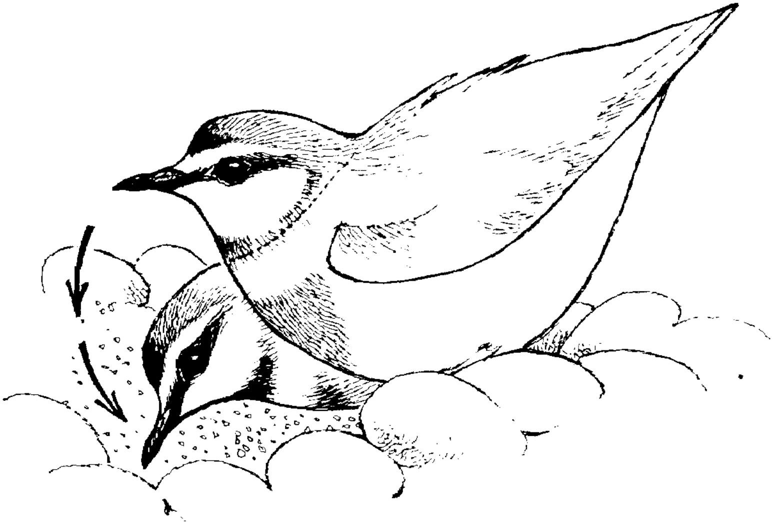


FIGURE 4 — The nest scrape display given by the male to attract the female. The male hunches his body in the scrape and then repeatedly lifts his head and bows it forwards and down in a series of rapid jerks

When the female runs from the scrape, the male usually returns to settle in it for a few seconds. He then runs off in a horizontal posture, being particularly vigorous at chasing intruders at this time. Alternatively the male walks from the scrape slowly, picking up small stones and pieces of plant and throwing them over his shoulder towards the scrape as he goes. (Birds of both sexes often did this throwing independently of scrape ceremonies until the time of late incubation, and the small objects so collected formed a nest lining up to 3 cm deep.)

## COITION AND THE PRECEDING DISPLAY

Coition was observed seven times and the preliminary display without coition four times. Coition is preceded by a scrape display. When the female leaves the scrape she pauses 1-5 m away and the male approaches her from behind, holding his body upright. As he comes close, his steps become shorter and he lifts his feet higher. Eventually he stands right behind her for 5-15 seconds, high-stepping on the spot and swaying slightly from side to side in time with his stepping, but all the time retaining his upright posture. On three occasions when coition was not achieved, the female walked away from the male while he was high-stepping. Each time the male high-stepped forwards again until he was just behind her, but when she continued moving away he desisted and ran off in a horizontal posture. When a female is receptive to the male's approach, she stands in front of him with her tail conspicuously raised and then slowly crouches down. The male then jumps on her back, flutters his wings to balance himself, and then folds them. Once a male jumped on to the back of a female which had not crouched, but he slipped down again within 5 seconds. When the male is mounted, he crouches down with his belly against her back and then bends his tail downwards and repeatedly moves it from side to side. In the seven coitions observed the male stayed mounted for 20-122 seconds, averaging 79 seconds.

At the end of mounting the pair tip over backwards, the male apparently pulling the female over on top of him. For 2-5 seconds the pair remain together with the male leaning backwards on his rump, supporting himself in this position with rapidly flapping wings. The female is tipped backwards on top of the male and is apparently supported in this position by his legs. When the pair finally flutter to their feet, the male immediately assumes an upright posture for a second or two, facing the female, and then both birds often preen or settle their feathers before walking or flying away.

FIGURE 5 — The arrival of the female at the end of the nest scrape display. The male (left) has just backed out of the scrape and the female is about to enter it

## CHANGEOVER DISPLAY

Eight incubating nests were observed from hides, each nest being observed from dawn to dusk. The total time spent observing these nests was 109 hours.

Both sexes incubate the eggs and the number of changeovers observed at any one nest during a day ranged from 2 to 16, averaging 6. The usual sequence of events at a changeover is for the incubating bird to see its mate approaching and simply leave the nest and fly or run away. Sometimes, when the incubating bird has left the nest on the approach of a predator or an intruder, the mate returns to incubate the eggs. In only 12 of the 46 (26%) changeovers observed was a changeover display given. This display is indistinguishable from the head-bowing nest scrape display given during courtship, except that changeover displays are given by either sex, whereas nest scrape displays are given only by males. In three of the changeover displays the incubating bird initially called its mate with the *kwereep* courtship call. Twice it was the female that called. More often the incubating bird simply sees its mate nearby and gives a head-bowing display until the mate comes (Figure 6).

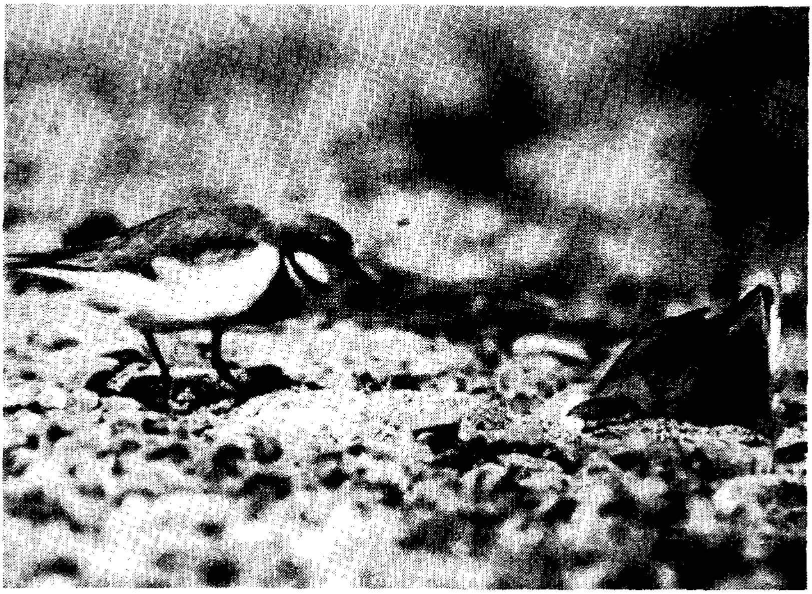


FIGURE 6 — The changeover display given during incubation. The female in the scrape (right) is head-bowing to the approaching male

## CHICK-CALLING DISPLAY

Parents use two methods to call young chicks for brooding. A parent within a few metres of a chick often crouches, fluffs its feathers and gives repeated soft *chirp* calls. Usually the chick then comes to the parent, but sometimes it either ignores the invitation or approaches the parent and then turns away.

The other method parents use to call chicks is head-bowing, which is sometimes preceded by a few *kwereep* calls. Soft *chirp* calls are also sometimes given during this head-bowing display. Chicks always come to parents when called in this way. When a chick arrives the parent rises and fluffs out its feathers so that the chick can crawl under for brooding.

## ALARM CALL AND ESCAPE BEHAVIOUR

Sitting birds stay alert during the day, and the nest is nearly always sited to give a good view of the surrounding land (Bomford, in press). Even though incubating birds sometimes turn their heads on their shoulders and close their eyes, they keep opening them, presumably to check for predators. A sitting bird is camouflaged by its drab back plumage, which blends with the surrounding shingle, and by the dark chest bands, which resemble the shadows of stones and so visually disrupt the bird's image.

Banded Dotterels do not rely solely on camouflage for defence against predators. When a potential predator is seen, they give alarm calls and leave the nest. The alarm call is usually a loud high-pitched *pit*, but it varies in pitch and tone, ranging down to a lower *chip*. Sometimes an alarmed bird alternates these two calls. Stead (1932) was the first to describe the *pit* call, but Falla *et al.* (1966) have recorded both variations. Alarm calls are repeated every second or two and their sound carries well. Thus, although most Banded Dotterel nests on the Cass River delta were spaced 100 m or more apart, the alarm calls of a disturbed bird caused birds in neighbouring territories to become alert.

Cunningham (1973) observed that, when a predator is close to a nest and the parents are alarmed, the *pit* call becomes louder and more drawn out, sounding like *peet*, and further, he distinguished between the sound of *peet* calls given by males and females. *Peet* calls were heard in the present study when a person was close to young chicks, but a difference between male and female calls was not discerned.

Whenever a bird of prey flew near a nest, the parent birds flew up and circled around, repeatedly giving alarm calls and often flying near the predator. Banded Dotterels were not seen to swoop towards or dive-bomb birds of prey. This was in contrast to other wader species on the delta – Pied Stilts *(Himantopus h. leucocephalus)*, Black Stilts *(H. novaezelandiae)* and Wrybills – which were often seen making aggressive dives towards Harriers *(Circus approximans)*. Stead (1932) also recorded that Banded Dotterels do not swoop at predators.

On the approach of a person, a Banded Dotterel usually left the nest in a crouch-run when the person was still 50-100 m away. Simmons (1955) defined the term 'crouch run' as "a low run by the wader away from the intruder, with its legs bent, neck contracted, and body horizontal". This aptly describes the Banded Dotterel's crouch-run. When crouch-running away, the Banded Dotterel keeps its drably coloured back or sides towards the approaching person so that its conspicuous chest bands cannot be seen. The bird crouch-runs 50-100 m from the nest, often going behind small plants or other objects to conceal its retreat. If the person continues to approach the nest, the bird flies back or runs back in stops and starts. Sometimes the mate or Banded Dotterels from neighbouring territories also approach, and an intruder may be surrounded by as many as 12 birds bobbing and flying around giving alarm calls, while the defence of territory boundaries is temporarily neglected.

## DISTRACTION DISPLAYS

How closely a parent bird will approach a person depends on the individual bird and the stage of incubation. During laying and early incubation, birds often remain 20-40 m away, giving alarm calls and bobbing. Bobbing is an upward jerking and relaxing of the head and chest. If the person walks towards the bird it runs off, giving alarm calls but staying only 5-10 m in front of the approaching person and repeatedly looking around to see if it is being followed. If the person stops the bird stops, and if the person runs the bird also runs to maintain the 5-10 m distance. This is contrast to escape behaviour in the non-breeding season, when Banded Dotterels usually run away when an approaching person is about 25 m away and, when followed, fly up and land 50-100 m away.

As incubation advances, the parent birds more frequently come close to intruders, and distraction displays are frequent in late incubation. Once the eggs have hatched nearly all birds give a distraction display if a person approaches the nest or chicks, and when a chick gives a *scree* alarm call one or both parents always respond with a distraction display. Simmons (1955) defined distraction displays: "Distraction-display comprises those forms of conspicuous behaviour (dependent on the major reproductive drive) which have been specially evolved by natural selection to deflect potential predators from eggs or young, by presenting to these predators stimuli releasing and directing their hunting behaviour". Distraction displays given by Banded Dotterel involve injury feigning.

In low-intensity displays, usually given before the eggs hatch, the bird leaves the nest in a crouch-run when an approaching person is still about 100 m away, and then returns to run across in front of the intruder at right angles to their line of approach to the nest. When close to the person, the bird leans its body to one side and lowers its wings and tail slightly. In this posture it runs to a distance of 10-30 m from the intruder and crouches down, often partly concealed by a large stone or small shrub. Sometimes the bird false broods, shuffling around and fluffing out its feathers as though settling down on eggs. False brooding is common during the first week of incubation and is always done in silence.

Once hatching starts, displays become more conspicuous and are always given on the side of the intruder away from the chicks or eggs. When a Banded Dotterel chick is released from the hand, one parent often gives a conspicuous distraction display to the side away from the retreating chick, while the other parent flies above the chick giving alarm calls.

Conspicuous distraction displays are fairly stereotyped. In the sideways-leaning posture described above, the bird runs from the intruder, sometimes giving a rapid sequence of *pit* calls. The bird then crouches down and spreads its wings, often in a place where it is partly concealed from view. Soper (1972) has a photograph of a bird in this 'spreadeagled posture'. In this position the bird often repeatedly gives long drawn-out *weer* calls. This call is always loud, but it varies considerably in pitch and tone between birds. When giving this call, a displaying bird often flaps it wings for 5-30 seconds, sometimes hitting them noisily against the ground. Usually the bird stays in one place while displaying, but some birds shuffle towards the intruder.

In the highest-intensity displays the bird comes close to the intruder, often to within 1 m, and gives *weer* calls that are louder and more strident than those given in lower-intensity displays. The bird circles the intruder, repeatedly raising the wing furthest from the intruder and fanning and lowering its tail. The wing on the near side is often partly unfolded but not raised. Soper (1972) has a photograph of a Banded Dotterel displaying in this posture.

A Banded Dotterel giving a distraction display often attracts other Banded Dotterels, especially if it flutters on the ground giving *weer* calls. When another Banded Dotterel runs up, the displaying bird immediately ceases displaying, gets up and moves away.

Banded Dotterels were not seen to give any distraction displays to cattle or sheep, even when they came close to an incubating bird. Nethersole-Thompson (1973) described Dotterels *(C. morinellus)* "exploding in the face of large but non-aggressive mammals to deflect them from walking on the nest". Banded Dotterels just quietly leave the nest if stock come within a few metres, and they soon return.

## DISCUSSION

Despite its geographical isolation the Banded Dotterel is, in its behaviour, a typical *Charadrius* plover. Threat displays similar to that of the Banded Dotterel have been described by Simmons (1953) for three European *Charadrius* plovers: the Little Ringed Plover *(C. dubius)*, the Kentish Plover *(C. alexandrinus)* and the Ringed Plover *(C. hiaticula)*. Simmons described displays ranging in intensity from stereotyped threat displays to fights, and the horizontal threat posture assumed by the Little Ringed Plover is similar to the Banded Dotterel's horizontal posture. Similar horizontal postures have also been observed in aggressive Black-fronted Dotterels *(C. melanops)* (Maclean 1977), Wrybills *(Anarhynchus frontalis)*(Bomford 1978), Red-breasted Dotterels *(C. obscurus)* (Phillips 1980), Dotterels *(C. morinellus)*, Golden Plovers *(Pluvialis apricaria)* (Cramp *et al.* 1983), and in Spur-winged Plovers *(Vanellus miles novaehollandiae)* (van Tets, pers. comm.). An upright threat posture has been described for the Greater Sand Plover *(C. leschenaultii)* (Simmons 1953, Penny, 1971) which is similar to that described for the Banded Dotterel in the present study.

Phillips (1980) described two horizontal display postures for Banded Dotterels, either of which may correspond partly to the horizontal posture seen in threat displays in the present study: (1) 'Horizontal, bulged breast', which he observed only in males whereas I observed my horizontal posture in both sexes; (2) 'Horizontal spread', which he described as similar to my horizontal posture, with the white flank feathers raised. However, he found that "the neck was withdrawn so the black collar was hidden", and his drawing of this posture shows a clear contrast to my horizontal posture in which the black collar was always conspicuously displayed (Figure 3b).

Flight displays are described in the European literature for other *Charadrius* plovers (Glutz von Blotzheim 1975) where a male advertising role for these displays is suggested when territories are isolated. The heights reached by male Banded Dotterels giving flight displays make them visible for a long way. That the *kwereep* call is given in 7% of flight displays suggests that these displays may serve to strengthen pair bonding because this is the call usually used by a male to entice a female to approach. Possibly flight displays serve both to notify other males of territory occupation and to attract females.

The wing-clicking during the flight display of the Banded Dotterel has not been described for any other *Charadrius* plover and may be unique.

Phillips (1980) described 'Choke' and 'Bow' displays, which perhaps both correspond to the head-jerking bows described in the present study for scrape displays, changeover displays and chick-calling displays. Phillips also gave a similar description of coition in Banded Dotterels to that given in the present study and, further, he found that Wrybills and Red-breasted Dotterels have similar coition behaviour. In addition, coition behaviour similar to that of the Banded Dotterel has been described or illustrated for the Ringed Plover and the Little Ringed Plover (Glutz von Blotzheim 1975), the Kentish Plover (Rittinghaus 1961), the Red-capped Dotterel *(C. ruficapillus)* (Davis & Reid 1964, Hobbs 1972), and Kittlitz's Plover *(C. pecuarius)* (Slight 1966, Took 1967). Male Banded Dotterels, Kentish Plovers, Ringed Plovers, Little Ringed Plovers, Kittlitz's Plovers and Red-capped Dotterels all mark time in an upright posture behind the female, and all remain mounted for a long time and conclude coition by tipping over backwards. Given the similarity of the coition displays of Red-capped and Banded Dotterels, the record of hybridising between the two species in Canterbury (Oliver 1955) is not surprising.

Distraction displays observed in this study are also similar to those of many other *Charadrius* plovers. The late P. Child and B. D. Heather (pers. comm.) have observed false brooding in the Black-fronted Dotterel *(C. melanops)* similar to that described for the Banded Dotterel. The conspicuous distraction displays given on the side of an intruder away from the eggs or chicks have also been recorded for Ringed Plovers and Little Ringed Plovers (Ledlie & Pedlar 1938, Drury 1961).

## ACKNOWLEDGEMENTS

I especially wish to thank R. J. Pierce for his help and encouragement during this study, and B. D. Heather, G. H. Moore and G. F. van Tets for their constructive criticism of the manuscript. I also thank K. E. Westerskov for supervising the study. J. J. Bauer kindly translated German literature for me, Graeme Chapman printed the photographs and Frank Knight drew Figure 4. For help with accommodation in my two study sites I thank Mr and Mrs J. G. Murray and Mr and Mrs A. E. Rollinson. This work was part of a study for a Master of Science degree at the University of Otago, with funding from a University Grants Committee scholarship.

### LITERATURE CITED

BOMFORD, M. 1978. Behaviour of the Banded Dotterel, *Charadrius bicinctus*. MSc thesis. University of Otago, Dunedin.

BOMFORD, M. In press. Breeding of the Banded Dotterel *(Charadrius bicinctus)*. Notornis.

CRAMP, S.; SIMMONS, K. E. L. 1983. Handbook of Birds of Europe, the Middle East and North Africa. Vol. 3. Oxford: Oxford University Press.

CUNNINGHAM, J. M. 1973. The Banded Dotterel *Charadrius bicinctus* Pohowera or Tuturiwhatu? – call notes and behaviour. Notornis 20: 21-27.
DAVIS, W. A.; REID, A. J. 1964. Mating display of Red-capped Dotterel. Emu 63: 332.
DRURY, W. H. 1961. The breeding biology of shorebirds on Bylot Island, N.W.T. Canada. Auk 78: 176-219.
FALLA, R. A.; SIBSON, R. B.; TURBOTT, E. G. 1966. A Field Guide to the Birds of New Zealand. Auckland: Collins.
GLUTZ VON BLOTZHEIM, U. N. *et al.* 1975. (Ed.) Handbuch der Vogel Mitteleuropas. Vol. 6 Akademische Verlagsgesellschaft Weisbaden.
HOBBS, J. N. 1972. Breeding of Red-capped Dotterel at Fletchers Lake, Dareton, N.S.W. Emu 72: 121-125.
LEDLIE, R. C. B.; PEDLAR, E. G. 1938. Nesting of the Little Ringed Plover in Hertfordshire. Br. Birds 32: 90-102.
MACLEAN, A. L. 1977. A field study of the Australian Dotterel. Emu 76: 207-215.
NETHERSOLE-THOMPSON, D. 1973. The Dotterel. London: Collins.
OLIVER, W. R.B. 1955. New Zealand Birds. Wellington: A. H. & A. W. Reed.
PENNY, M. J. 1971. Migrant waders at Aldabra, September 1967-March 1968. Phil. Tran. Roy. Soc. Lond. B. 260: 549-561.
PHILLIPS, R. E. 1980. Behaviour and systematics of New Zealand plovers. Emu 80: 177-197.
RITTINGHAUS, H. 1961. Der Seeregenpfeifer, *C. alexandrinus*. Wittenberg Lutherstadt: A. Ziemsen Verlag.
SIMMONS, K. E. L. 1953. Some aspects of the aggressive behaviour of three closely related plovers *(Charadrius)*. Ibis 95: 115-127.
SIMMONS, K. E. L. 1955. The nature of the predator-reactions of waders towards humans, with special reference to the role of the aggressive-, escape-, and brooding-drives. Behaviour 8: 130-173.
SIMMONS, K. E.L. 1956. Territory in the Little Ringed Plover *(Charadrius dubius)*. Ibis 98: 390-397.
SLIGHT, D. A. 1966. Mating behaviour of Kittlitz's Sandplover. Ostrich 37: 227.
SOPER, M. F. 1972. New Zealand Birds. Christchurch: Whitcombe & Tombs.
STEAD, E. F. 1932. The Life Histories of New Zealand Birds. London: Search Publishing Co.
TOOK, J. M.E. 1967. Mating behaviour of Kittlitz's Sandplover. Ostrich 38: 199.

MARY BOMFORD, *43 Waller Crescent, Campbell, A.C.T. 2601, Australia*

★

# SHORT NOTE

## A Glosy Ibis in the Chatham Islands

On 31 December 1984, we were in a party from the 1984-1985 Taiko Expedition visiting several sites at the north-eastern end of Chatham Island. At the side of a small lagoon near the causeway of the Taia-Hapupu Road (176°21'E, 43°47'S), we saw a Glossy Ibis *(Plegadis falcinellus)* wading at the water's edge. From about 50 m away, as we studied it through binoculars for 30 min. and photographed it, we could see well its purplish-bronze plumage and long, downcurved bill. This seems to be the first record of the species at the Chathams.

RALPH POWLESLAND, *64 Roseneath Terrace, Wellington 3;* DAVID CROCKETT, *21 McMillan Avenue, Kamo, Whangarei*

# SEASONAL AND DIURNAL TIME BUDGETS AND FEEDING INTENSITY OF THE WHITE-FACED HERON IN PASTURE

By PETER L. LO and R. A. FORDHAM

## ABSTRACT

Time-activity budgets and feeding rates were compiled for White-faced Herons *(Ardea novaehollandiae)* on pasture near Pukepuke Lagoon, Manawatu, from March 1980 to February 1981. Indices of the hourly strike, catch and step rates were calculated. The direction of the bill during strikes was recorded to indicate the kind of prey being hunted.

Time spent foraging increased from summer through to spring. Feeding rates were highest in spring, less in summer and winter, and lowest in autumn. Herons fed most actively early and late in the day. Adults were more efficient at foraging than juveniles. Herons spent longer foraging and fed at a faster rate when energy demands were high owing to cool temperatures, breeding or moult, and when more food was available.

Areas of pasture in which herons fed, and some that they avoided, were sampled with a sweep net and soil quadrat to determine the seasonal availability of potential prey. Earthworms were most abundant in winter and scarcest in summer, whereas larger insects were common in summer and autumn. Herons fed on whatever prey was most available, taking earthworms in winter and less often in autumn and spring, but concentrating more on insects in summer and autumn.

## INTRODUCTION

The White-faced Heron *(Ardea novaehollandiae)* is widely distributed over the south-west Pacific (Hancock & Elliot 1978). After reaching New Zealand from Australia before the mid-1800s (Carroll 1970), it remained sparse until the 1940s, increased rapidly to a peak in the 1960s, and then stabilised. It is now widespread in coastal and inland habitats to 330 m a.s.l. and is the most common heron in New Zealand. It is unusually versatile, exploiting estuarine, freshwater, and pastoral habitats, hunting slowly and methodically for a wide variety of prey.

Carroll (1967) analysed the stomach contents of 89 White-faced Herons collected around New Zealand, and the behaviour, feeding methods and diet of the herons in coastal districts have been studied by Spurr (1967a, b), Louisson (1972) and Moore (1984) in New Zealand, and by Lowe (1983) in Australia. Recher & Recher (1980) briefly discussed its ecological niche in Australia in a broader discussion of resource partitioning by herons. For herons in general, Kushlan (1978) reviewed the literature on feeding behaviour, foraging methods and food habits, but noted a need for time-budget studies.

NOTORNIS 33: 233-245 (1986)

This paper reports on work aimed primarily at better understanding the seasonal and diurnal time-activity budget of White-faced Herons on pasture, where they have not previously been studied. A secondary aim is to provide indices of the intensity and success of feeding, and to relate these to the levels of some potential prey in coastal Manawatu pasture.

## STUDY AREA

The study was made between March 1980 and February 1981 on farmland near Pukepuke Lagoon (40° 20'S, 175° 16'E), 30 km west of Palmerston North and 3 km from the coast. The original sand plains are now under ryegrass/clover *(Lolium/Trifolium)* pasture, which includes scattered artificial ponds for stock, with interconnecting drains, and stands of pine trees (*Pinus* spp.).

The region lacks sharp seasonal contrasts in climate. During the study, mean air temperature varied from 19.0 °C in January to 6.7 °C in July, but rainfall differed markedly from the average seasonal pattern (NZ Meteorological Service, Ohakea). March and September to November 1980 were unusually wet, and from June to November 1980 many fields had extensive areas of surface water. Other months were drier than normal. The prevailing west-northwesterly winds can be strong at times, especially in spring.

## METHODS

Observations were made for two or three days each week on the largest group of herons located on pasture near Pukepuke Lagoon, at five sites within a 2.5 km radius. Observations at roosts and nest sites were not included.

Time-budget data were collected from scan samples (Altmann 1974) at 5-minute intervals, when the activity of each heron was recorded. Implicit assumptions were that a 5-minute interval did not match any natural periodic behaviour in the herons, and that each individual was observed for the same brief time (Fordham 1978).

The activities of the herons were ascribed to six broad categories:

Foraging : Searching for, striking at, and swallowing prey.
Looking : Resting and looking about (but not in an agonistic context) while standing or walking.
Body care : Maintenance and comfort actions such as preening, scratching, washing and stretching.
Flying : All flying except aggressive pursuits.
Agonism : All intraspecific threat and appeasement displays.
Miscellaneous : Infrequent behaviour such as drinking and courtship.

The low-frequency categories of flying, agonism and miscellaneous were grouped as 'other activities'.

We measured feeding rates by observing individual herons for 1-minute periods during which we counted the number of strikes made at prey (strike rate); the number of successful strikes (catch rate) when the bird swallowed immediately after striking; and the number of steps taken (step rate). These data were taken only from herons already foraging but were discarded if a bird stopped for more than 5 seconds. The feeding rate of any one heron was recorded only once in any 5-minute interval.

Feeding and stepping rates were combined with the time-budget data to calculate two indices of feeding *intensity* and an index of the area searched. We calculated strike, catch, and step indices by multiplying each rate by the proportion of time (in minutes) spent foraging for a particular diurnal period or season to get the total number of strikes, catches, and steps made per hour on average by a foraging heron.

The direction of the bill during strikes was scored to indicate the kind of prey being hunted. Horizontal strikes (with the bill directed 0°-30° below the horizontal) indicated attacks on more mobile prey, such as flies, on or above the ground, and vertical strikes (with the bill directed 30°-90° below the horizontal) suggested attacks on slow-moving prey, such as earthworms, on or in the ground.

Daylight was taken as being from half an hour before sunrise to half an hour after sunset and was divided into six equal parts for each month and season: autumn (March-May), winter (June-August), spring (September-November), and summer (December-February).

The potential prey in heron feeding areas was assessed weekly by sweep net and turf-soil samples. Sweep net samples, which we took while walking, consisted of 100 sweeps brushing the pasture. From these samples we counted and identified the insects according to CSIRO (1970). Turf-soil samples comprised five $0.05\ m^2 \times 7.5$ cm quadrats, which amply covered the depth penetrated by the bill. Following Edwards and Lofty (1977), we handsorted the samples, identified the animals, and obtained their dry weights by heating at 80 °C to a constant weight. Earthworms were identified from Martin (1977). From July 1980 to February 1981 (except December), we took an additional monthly sample close to the current feeding area to compare areas in which herons fed with those they consistently avoided, which tended to be slightly higher and therefore drier.

Seasonal and diurnal changes in time given to an activity and rates of feeding were analysed by analysis of variance, with tests by orthogonal coefficients (Meddis 1975) for linear and quadratic trends to the diurnal data. Data on prey sampling, and on feeding rates between pairs of seasons, and adults and juveniles were compared by Mann-Whitney U-tests. For these tests significance was set at the 0.01 level.

## RESULTS

### Seasonal and diurnal time budgets

During 668 hours of observation we made 38 011 bird recordings. Overall, herons spent 68.7% of their time foraging, 19.1% in looking, 8.7% on body care and 3.5% on other activities (3.1% flying, 0.3% agonism, 0.1%

miscellaneous). The proportion of time spent on each of the four main activity categories varied significantly ($P < 0.01$) over the year (Fig. 1). Foraging dominated the time budget throughout the year, and the proportion of time spent feeding increased significantly from summer through to spring. In contrast, the time spent looking was least in spring and most in autumn. Body care took up little time, except in summer. Flying was most frequent in winter, and agonism from May to July.

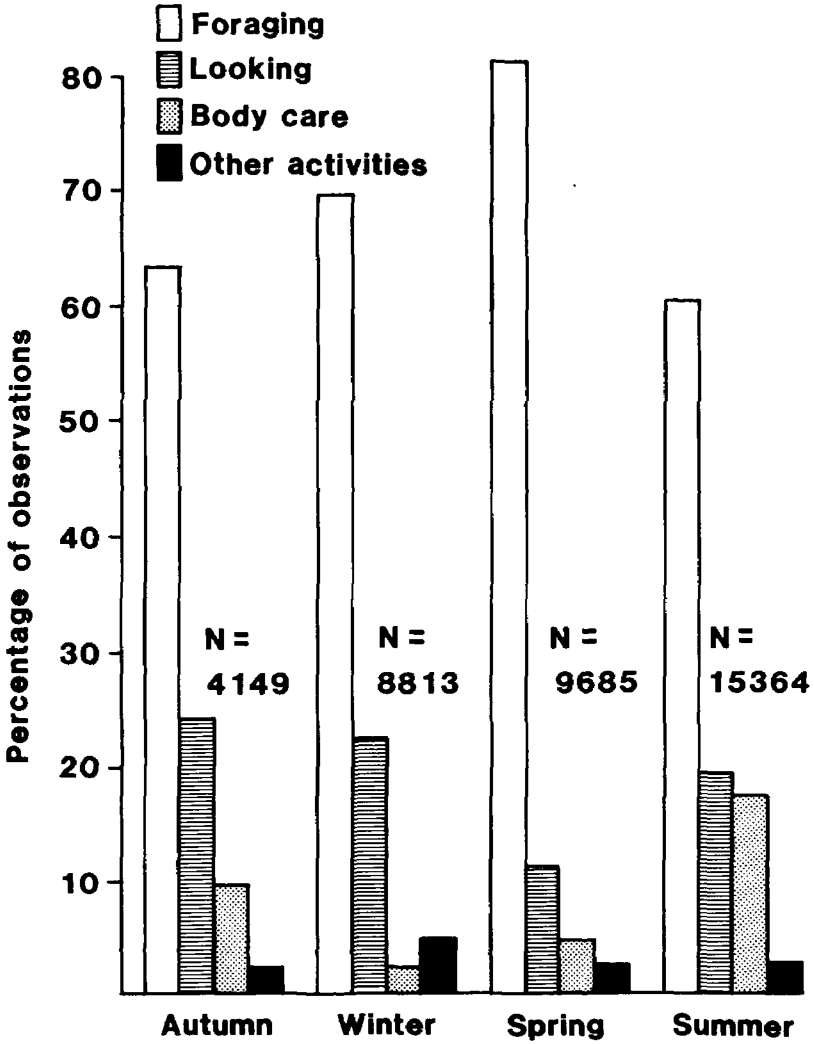


FIGURE 1 — Seasonal time-activity budget of White-faced Herons in coastal pasture, Manawatu

The diurnal trends for each activity were significantly different (Fig. 2). The foraging pattern was significantly bimodal with one peak in the early morning and a higher one in the evening. The pattern was similar in each season except spring, when foraging tended to increase over the day without a morning peak (for full quantitative data see Lo 1982). In all seasons foraging increased strongly from early afternoon onwards.

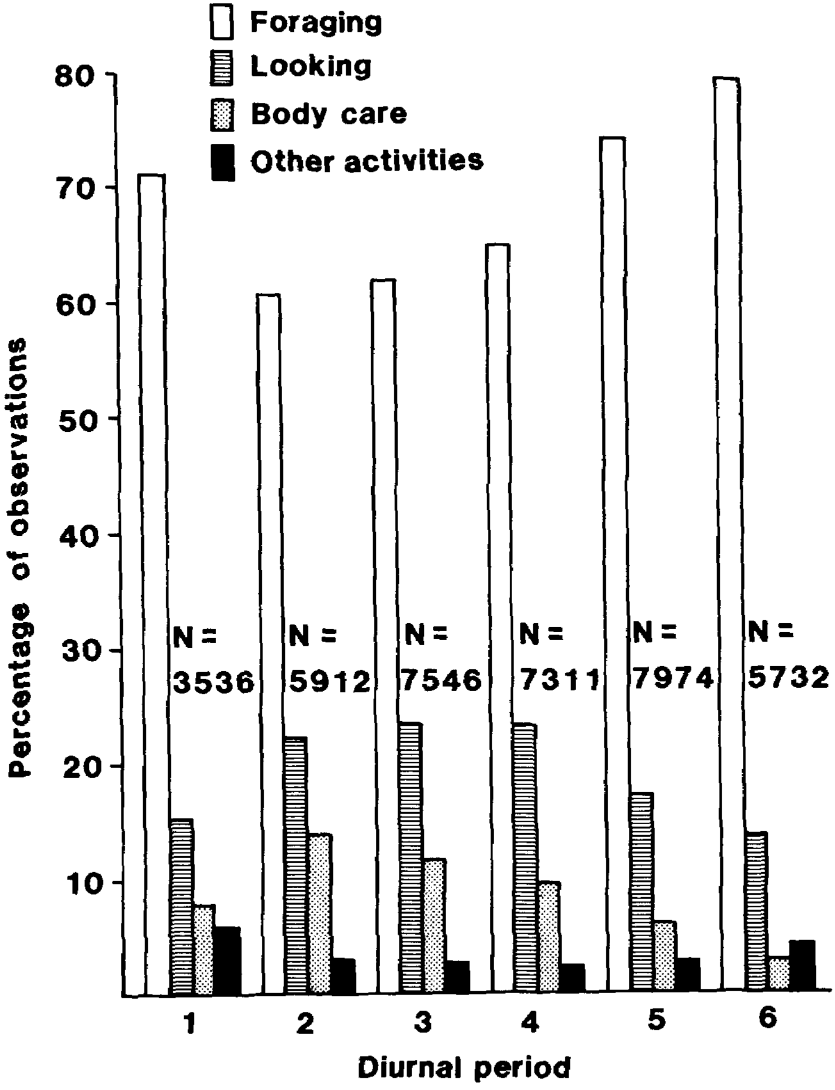


FIGURE 2 — Diurnal time-activity budget of White-faced Herons in coastal pasture, Manawatu

The frequency of looking was significantly greater in mid-morning and early afternoon than earlier or later in the day. In autumn and winter the proportion of time spent looking doubled from about 15% to 33% between early and late morning, and then decreased gradually over the afternoon. This contrasts with spring and summer, when looking tended to occupy a similar proportion of time over most of the day, being low in spring and higher in summer.

Time allocated to body care showed an early peak, and then a significant steady decline. In winter and spring, little time was spent preening during any part of the day, whereas in summer, body care was most frequent in mid-morning and occupied about 17% of time until the evening. Similarly, in autumn, body care occurred most frequently between mid and late morning, before declining over the afternoon as in the other seasons.

Other activities were significantly more frequent at the beginning and end of the day, when the birds flew more. Agonism was infrequent and even throughout the day, and a similar pattern occurred in each season.

## Seasonal and diurnal feeding rates

From a total of 4813 measured rates of feeding, herons averaged 5.2 strikes and 3.5 catches per minute, which was equivalent to capturing prey on 67.3% of strikes. The step rate averaged 38.8 steps per minute. The overall feeding indices (time spent foraging x feeding rates) showed that herons made on average 218 strikes, 147 catches and 1590 steps every hour. There were significant seasonal and diurnal variations in all these measures.

*Seasonal:* Feeding rate data (Table 1) showed that changes in strike and catch rates were similar, except from autumn to winter when the strike rate rose but the catch rate fell. Herons fed at significantly higher rates in spring and summer than in autumn and winter. They were much more likely to be unsuccessful with a strike in winter than in the other seasons, and their horizontal strikes were much fewer in winter and spring than in summer and autumn.

The strike index (time spent foraging x strike rate) was significantly higher in spring than in winter and summer, which were both higher than autumn (Fig. 3). Herons captured significantly more prey per hour in spring and summer than in autumn and winter. The peak of prey numbers caught in spring was shown more clearly when examined month by month. The catch index doubled between September and October (135 to 272 catches per hour), remained high in November (206), and then decreased by half in December (102). The step index showed that herons covered the greatest area when foraging in winter and spring, and the least in summer (Fig. 3).

*Diurnal:* Herons struck at prey more often towards the end of the day (Table 1), but only the step rate and the strike and step indices varied significantly over the day. The strike and catch rates for summer and autumn were low early in the day and higher over the afternoon. In contrast, winter and spring both had bimodal patterns with higher rates at the beginning and end of the day. The percentage of successful strikes varied markedly over the day only in winter, when the birds were significantly more successful up until mid-morning than afterwards. The ratio of horizontal to vertical strikes did not change over the day in winter and spring, but in summer and autumn the proportion of horizontal strikes increased during the middle of the day. The step rate was highest early in the morning, levelling off around midday. In summer it continued to decrease over the afternoon, whereas in the other seasons it increased slightly.

TABLE 1 — Seasonal and diurnal feeding rates for White-faced Herons: strikes, catches and steps per minute; and the percentage of strikes directed horizontally and vertically

| Season | Strike rate | Catch rate | % Successful strikes | Step rate | % Horizontal: vertical strikes |
|---|---|---|---|---|---|
| Autumn | 4.0 | 2.9 | 72.3 | 41.0 | 21 : 79 |
|  | ] * | ] N.S. |  | ] * |  |
| Winter | 4.9 | 2.6 | 52.6 | 44.8 | 2 : 98 |
|  | ] * | ] * |  | ] * |  |
| Spring | 6.2 | 4.2 | 68.1 | 34.8 | 3 : 97 |
|  | ] * | ] * |  | ] * |  |
| Summer | 5.9 | 4.5 | 76.2 | 29.6 | 69 : 31 |
|  | * | * | * | * |  |
| Diurnal period |  |  |  |  |  |
| 1 | 4.8 | 3.3 | 69.6 | 52.4 | 14 : 86 |
| 2 | 4.7 | 3.3 | 71.7 | 40.3 | 26 : 74 |
| 3 | 4.8 | 3.4 | 69.0 | 35.1 | 33 : 67 |
| 4 | 4.9 | 3.2 | 62.9 | 34.2 | 23 : 77 |
| 5 | 5.8 | 3.9 | 66.0 | 34.5 | 25 : 75 |
| 6 | 6.1 | 4.1 | 67.0 | 36.1 | 19 : 81 |
|  | N.S. | N.S. | N.S. | ** |  |

Diurnal period data are means of the seasonal values. N.S. = not significant, **=P<0.01, *=P<0.001, Mann-Whitney U Test between pairs of seasons, ANOVA (F ratio) for seasonal and diurnal variations.

Over the day, herons had a bimodal pattern of feeding intensity, as indicated by the three indices (Fig. 4). After a small early peak in attempts to catch prey, the feeding rate increased from early afternoon onwards. Except in spring, when there was a marked drop around midday, the seasonal patterns were similar to the overall pattern. The step index shows that the area searched by herons was greatest in the early morning, least around midday and increased to a lower peak in the evening.

A total of 104 feeding rates for juvenile herons was recorded in March 1980 and from August 1980 to February 1981. Compared with data from adults in the same months, juveniles had statistically similar strike and step rates, but their catch rate of 2.8 per minute (adults 4.0) was significantly lower. Similarly their percentage of successful strikes (53.9) was significantly less than that of adults (69.5).

### Availability of prey in pasture

In 56 sweep net samples from feeding areas, seven orders of insects and spiders were recorded (Table 2). Diptera were by far the most numerous, comprising mainly small acalypterate flies. Most of the larger insects collected were also from dipteran families – Anthomyiidae, Muscidae and Sarcophagidae. Most samples had a few Hymenoptera (mainly small wasps), Hemiptera (aphids and shield bugs), small Coleoptera and spiders, but few insects of other orders were collected. Other insects occasionally found were damselflies, crane flies, chironomids, and small butterflies. Significantly more insects were collected in summer and autumn than in winter and spring. Feeding and non-feeding areas had a similar range of families and number of insects (299 and 244 per sample respectively), except that grasshoppers (Orthoptera) were not recorded in feeding area samples.

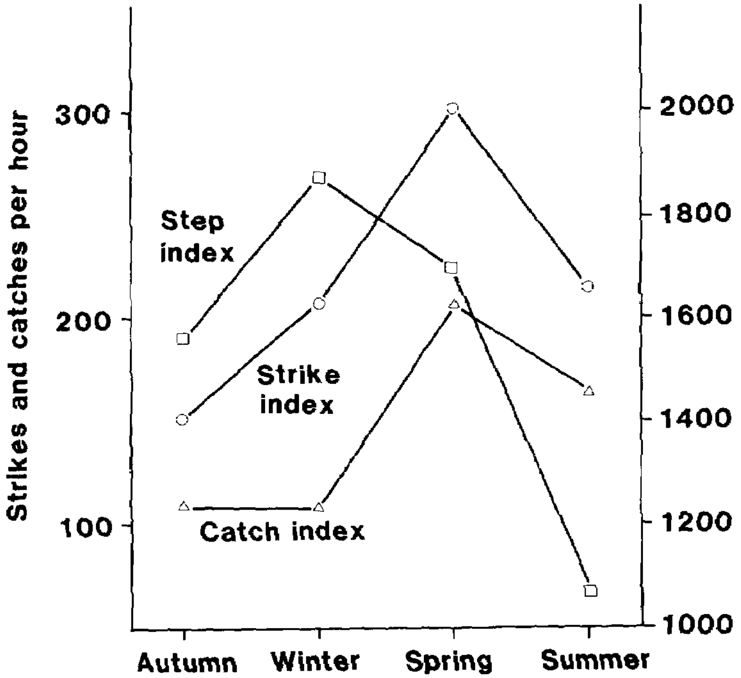


FIGURE 3 — Mean seasonal indices of strikes, catches and steps by White-faced Herons in coastal pasture, Manawatu

The 56 turf-soil samples from feeding areas produced 7816 earthworms (206.0 g dry weight, n = 6214), and the larvae of seven Tipulidae, two unidentified Scarabaeidae, three grass grubs (*Costelytra zealandica*) and 96 slugs (*Deraceros* spp.). The slugs were most abundant in autumn, and scarce in spring and summer. Four species comprised 89.6% of the number and 98.6% of the dry weight of earthworms; the remainder were small unidentified immature worms (Lo 1982). In number and dry weight *Allolobophora caliginosa*, *A. longa* and *Lumbricus rubellus* were roughly of equal ranking and were much more important than the fourth species, *Eiseniella tetraedra* which, although common, was much smaller. Earthworms were numerous in autumn and winter, and became significantly scarcer in spring and summer (Table 3). The mass of worms was greatest in winter

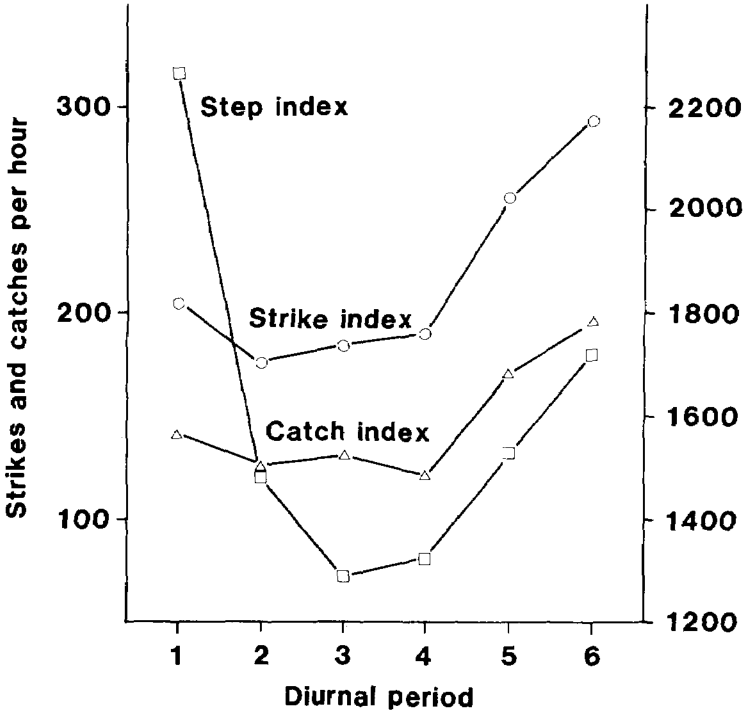


FIGURE 4 — Mean diurnal indices of strikes, catches and steps by White-faced Herons in coastal pasture, Manawatu

TABLE 2 — Seasonal catches of invertebrates per sample by sweep netting from coastal pastures in which White-faced Herons fed, March 1980-February 1981

| Order | Autumn | Winter | Spring | Summer |
|---|---|---|---|---|
| Hemiptera | 7.7 | 1.4 | 1.8 | 0.4 |
| Coleoptera | 4.9 | 1.6 | 0.3 | 1.2 |
| Diptera | 449.6 | 168.5 | 265.0 | 633.2 |
| Hymenoptera | 51.4 | 1.4 | 1.3 | 19.3 |
| Odonata, Neuroptera, and Lepidoptera | 2.1 | 0.1 | 0.3 | 0.4 |
| Araneae | 17.7 | 5.2 | 0.5 | 2.2 |
| Unidentified | 6.2 | 1.6 | 1.1 | 2.9 |
| TOTAL | 539.6 | 179.8 | 270.3 | 649.6 |
| | | * | N.S. | * |
| Samples | 10 | 16 | 19 | 11 |

*=P<0.01, *Mann-Whitney U Test between pairs of seasons*, N.S. = not significant.

and spring and significantly less in summer. Earthworms were more abundant in heron feeding areas than in places not used for feeding (Table 3), but the differences were not significant for both numbers and dry weights. In the seven samples from non-feeding areas, *A. caliginosa*, *A, longa* and *L. rubellus* comprised 94.9% of the 508 worms collected and 99.2% of the 19.0 g total dry weight.

TABLE 3 — Seasonal abundance of earthworms in turf-soil samples from White-faced Heron feeding areas in coastal pasture, March 1980-February 1981, and from feeding and non-feeding areas, July 1980-February 1981

| Season | (Samples) | Number of worms per $m^2$ | Dry weight (g) per $m^2$ |
|---|---|---|---|
| Autumn | (10) | 787 | 14.6 |
| | | N.S. | N.S. |
| Winter | (16) | 876 | 21.9 |
| | | ** | N.S. |
| Spring | (19) | 380 | 19.9 |
| | | * | ** |
| Summer | (11) | 196 | 6.0 |
| Feeding areas | (39) | 464 | 16.8 |
| Non-feeding areas | (7) | 290 | 10.8 |

*=$P<0.01$, **=$P<0.001$, Mann-Whitney U Test between pairs of season, and feeding and non-feeding areas, N.S. = not significant. Autumn dry weight comprises 2 samples.

# DISCUSSION

## Seasonal ecology

The time budget in autumn, when resting and preening occupied a comparatively large proportion of the day, reflected the lack of extra demands (e.g. breeding or moult) on the herons above basic self-maintenance. Because both insect and ground prey were abundant, the low feeding rate suggests that the herons could easily satisfy their energy demands.

In winter herons spent proportionately more time foraging, at the expense of body care, and increased their foraging effort. They made the highest number of strikes and steps per prey item caught, indicating that food was hard to get. In winter, insects, especially large ones, became scarce, although earthworms were abundant, and the herons responded by striking more at the ground. Except for the occasional frog, the only prey large enough to be identified by direct observation were earthworms about bill length (7 cm) or longer. Because more earthworms were identified as prey in winter (18.5% of prey captured) than in autumn (4.1%), spring (5.1%) or summer (1.0%) (Lo 1982), the average size of prey taken was probably greatest in winter. Presumably this compensated for increased metabolic demands in winter when the number of prey taken was similar to that taken in autumn.

Cattle Egrets *(Bulbulcus ibis)* in southern Africa similarly ate earthworms most during winter and least in summer according to their greater availability (Siegfried 1972).

In spring, when foraging most dominated activities, the birds collected large quantities of food from smaller areas than those covered in winter. Earthworms remained abundant, and aquatic prey such as beetles, tadpole shrimps *(Lepidurus apus)* and backswimmers (*Anisops* spp.) were readily available in ponds, drains and surface water, although large insects remained scarce. This feeding peak coincided with the breeding season from August to December (Lo 1984). Most young were raised in October and November, when the increased demand for food led to higher catch indices for these months than in September, when few chicks had hatched, and December, when the young had fledged.

In summer, with breeding completed and the post-nuptial moult advancing, herons spent less time foraging and more resting and preening. Feeding continued at a high rate, however, with birds striking mainly at above-ground prey, taking large numbers of insects but few earthworms, which were scarce. High ambient temperatures should have reduced energy demands, but the herons took more prey than in autumn, suggesting that they had to recover condition after breeding and to cope with the demands of moulting. The high feeding rate in summer may have been partly due to their mainly insectivorous summer diet, insects probably having a lower net energy return than earthworms.

White-faced Herons foraging on farmland at Pukepuke probably had the least food available in summer, when large prey such as earthworms, tadpole shrimps and tadpoles (*Litoria* spp.) were scarce. This shortage may explain the summer movement of many White-faced Herons to harbours and estuaries around New Zealand (Carroll 1970, Pierce 1980, Moore 1984), including the Manawatu estuary (L. J. Davies, pers. comm.), and in Australia (Lowe 1983). This movement is reversed in winter as birds move back on to wet inland pastures.

## Diurnal ecology

The bimodal pattern of foraging in the White-faced Heron is typical of ardeids, which generally forage most near dawn and dusk and rest around midday (Kushlan 1978). The early morning peak in time spent foraging and area searched was probably due to a combination of hunger, cool conditions and more accessible earthworms. With warmer temperatures during the middle of the day, the herons fed less and spent more time resting or preening. In spring, however, under the heavy demands of breeding, the herons continued foraging into the midday "rest" period. In summer any peak of resting would have been obscured by increased preening. As with looking, body care occurred when feeding was less urgent, the most convenient time being just after the morning peak of foraging.

Feeding activity increased over the afternoon as herons spent longer foraging and searched progressively smaller areas for each item. The proportion of earthworms in the prey became less as the day went on, indicating a drop in their availability between morning and evening. Despite this, catch rates increased throughout the afternoon in all seasons, even when insects were scarce, perhaps because the herons fed less selectively towards evening to get as much food as possible before roosting.

### Adult and juvenile foraging success

That adult herons are more efficient than juveniles in food collecting has been demonstrated in the Little Blue Heron *(Florida caerula)* (Recher & Recher 1969), Cattle Egret (Siegfried 1971, 1972) and Grey Heron *(Ardea cinerea)* (Cook 1978). Adult White-faced Herons also were better than juveniles at gathering food. The inefficiency of juveniles at capturing prey means that they must forage longer and expend more energy obtaining an equal quantity of food. The much higher death rate of first-year herons than of older birds (Kahl 1963) must at least partly be caused by this lack of experience.

### Prey sampling

Herons preferred to forage in wet pasture and avoided dry pasture, which had fewer earthworms, although the difference in worm abundance was marginally non-significant. A high water table brings earthworms to the soil surface (Edwards & Lofty 1977), and so they were available to herons most in winter, less in autumn and spring, and least in summer. This was confirmed by the seasonal percentages of prey we recognised by direct observation as earthworms.

In summer, drier pastures had fewer ground and aquatic prey than in other seasons but insects became abundant. Although many of the insects collected in sweep net samples were too small to be taken by herons, larger ones, including damselflies, shield bugs, beetles, flies and bees were found in regurgitated pellets (Lo 1982). Grasshoppers, which herons ate also, were not recorded in feeding area samples, which illustrates the limitations of the sweep net method and the somewhat arbitrary distinction between feeding and non-feeding areas.

## ACKNOWLEDGMENTS

We thank Kay Clapperton, Barrie Heather, Ed Minot, Ralph Powlesland, and Eric Spurr for their constructive comments on this paper. Dr Minot also gave invaluable assistance with the statistical analyses. The hospitality of Andy Garrick and Andy Grant (NZ Wildlife Service Officers at Pukepuke Lagoon), Harry Ellison, and Peter Barber made field work easier. We also thank friends and members of the Botany and Zoology Department of Massey University who helped in many ways during the study, and the NZ Wildlife Service for contributing towards travel costs.

## LITERATURE CITED

ALTMANN, J. 1974. Observational study of behaviour: sampling methods. Behaviour 49: 227-267.
CARROLL, A. L. K. 1967. Foods of the White-faced Heron. Notornis 14: 11-17.
CARROLL, A. L. K. 1970. The White-faced Heron in New Zealand. Notornis 17: 3-24.
COOK, D. C. 1978. Foraging behaviour and food of Grey Herons *Ardea cinerea* on the Ythan estuary. Bird Study 25: 17-22.
CSIRO 1970. The Insects of Australia. Melbourne University Press, D. F. Waterhouse (ed.).
EDWARDS, C. A.; LOFTY, J. R. 1977. Biology of Earthworms. London: Chapman and Hall.
FORDHAM, R. A. 1978. Differential intensity of Moorhen *(Gallinula chloropus [Rallidae])* feeding at dawn and dusk in spring. NZ J. Ecol. 1: 109-117.

HANCOCK, J.; ELLIOTT, H. 1978. The Herons of the World. London: London editions.

KAHL, M. P. 1963. Mortality of Common Egrets and other herons. Auk 80: 295-300.

KUSHLAN, J. A. 1978. Feeding ecology of wading birds. Pages 249-298 *in* Wading Birds. Research report 7 of the National Audubon Society.

LO, P. L. 1982. Ecological studies on the White-faced Heron *(Ardea novaehollandiae novaehollandiae* Latham 1790) in the Manawatu. MSc thesis, Massey University.

LO, P. L. 1984. Breeding of the White-faced Heron in coastal Manawatu. Notornis 31: 95.

LOUISSON, V. M. 1972. Feeding in the White-faced Heron *(Ardea novaehollandiae)* at Robinson Bay, Akaroa Harbour. BSc (Hons) thesis, University of Canterbury.

LOWE, K. W. 1983. Feeding behaviour and diet of the White-faced Heron *Ardea novaehollandiae* in Westernport Bay, Victoria. Corella 7: 101-108.

MARTIN, N. A. 1977. Guide to the lumbricid earthworms of New Zealand pastures. NZ J. Exp. Agric. 5: 301-309.

MEDDIS, R. 1975. Statistical Handbook for Non-statisticians. London: McGraw-Hill.

MOORE, P. J. 1984. Foraging and social behaviour of the White-faced Heron at Pauatahanui Inlet. Notornis 31: 285-299.

PIERCE, R. J. 1980. Seasonal and long-term changes in bird numbers at Lake Wainono. Notornis 27: 21-44.

RECHER, H. F.; RECHER, J. A. 1969. Comparative foraging efficiency of adult and immature Little Blue Herons *(Florida caerula)*. Anim. Behav. 17: 320-332.

RECHER, H. F.; RECHER, J. A. 1980. Why are there different kinds of herons? Trans. Linn. Soc. N.Y. 9: 135-158.

SIEGFRIED, W. R. 1971. Feeding activity of the Cattle Egret. Ardea 59: 38-46.

SIEGFRIED, W. R. 1972. Aspects of the feeding ecology of Cattle Egrets *(Ardea ibis)* in South Africa. J. Anim. Ecol. 41: 71-78.

SPURR, E. B. 1967a. Observations on the winter activities of the White-faced Heron. BSc (Hons) thesis, University of Canterbury.

SPURR, E. B. 1967b. Observations on the winter feeding of the White-faced Heron. BSc (Hons) thesis, University of Canterbury.

PETER L. LO *and* R. A. FORDHAM, *Department of Botany and Zoology, Massey University, Palmerston North. Please address any correspondence to RAF.*

★

# SHORT NOTE

## T. R. Hacket and the Okarito kiwis

Thomas Ridge Hacket (c.1830-1884) was the son of Dr Thomas and Amelia Hacket. He had experience as a mining engineer in England and Europe before migrating to New Zealand, arriving in October 1857. His brother James Henry and his sisters Harriet and Mary Elizabeth joined him in Nelson, where he was employed as manager of the Dun Mountain Company's copper mine. He lost his job when the company went broke, but he remained in Nelson and showed Hochstetter over the workings in 1859. Dr (later Sir) David Monro wrote of "young Hacket" at that time; he was about 29 years old. In 1860 he joined the surveyor John Rochfort on an expedition to the mouth of the Buller River, thence overland to the Grey, inspecting the coal outcrops there. Rochfort married Elizabeth Hacket in 1863, but she died in 1864.

Hacket turned up next (1863) at Oamaru, meeting Dr James Hector and getting a job as assistant geologist in the Geological Survey of Otago, with R. B. Gore, clerk and meteorologist, J. Buchanan, draughtsman and botanist, and William Skey, laboratory assistant, as his colleagues. From Queenstown in 1864 he did the first climb of Double Cone on the Remarkables and sounded Lake Wakatipu. At the Dunedin Exhibition in 1865 Hacket served as a Juror for nine classes of exhibits of varying descriptions: gold ores, chemical substances and products, vegetable substances, railway plant, locomotives and carriages, manufacturing machines and tools, machinery in general, agricultural instruments, metal manufactures and general hardware, cutlery and edge tools. He was awarded a silver medal for "his merit as the first person to draw attention to the commercial value of the discovery of chrome ore in New Zealand" and his "zealous services" generally to the exhibition. He had brought to notice the Dun Mountain chrome ore and had opened up a mine in Aniseed Valley in 1861; chrome specimens were exhibited by "Messrs Levien and Hacket".

When Hector moved to Wellington in 1865 to found the Colonial Museum and Geological Survey, he employed Hacket as a field assistant, first in southeast Otago, then in northwest Nelson (1866) and later (1867) on the West Coast. Eventually Hacket worked on the Okarito district, writing an account of its geology that Hector published in 1869, after Hacket had left for Australia.

During his Okarito stay, Hacket corresponded with his boss, Hector, on a variety of topics (and occasionally wrote to Gore to ensure action in case Hector was absent). These letters, now in the Hocken Library, University of Otago, are well written, in a clear handwriting, and have an attractive informal style. He addressed Hector confidently as "My dear Hector" and signed the letters "Believe me, Yours sincerely" or "very sincerely, T. R. Hacket". They were obviously on friendly terms. Hector appreciated Hacket's confident ability and tolerated his cheeky familiarity. Hector had apparently asked him to collect kiwis and roas (referred to as "Rohis") for the new Colonial Museum. The extracts that follow document one side of their correspondence on this subject.

My dear Hector, Okarito, 1 August 1867

Yours of 8th July duly received . . . I hope you have written me about the kiwis, viz Do you want live ones, skeletons, or skins? . . .

Okarito 28 Sept. '67: I wrote you by last mail enclosing Geol. Report and Section. Today I succeeded in securing one of the Rohis and the Egg of which I before wrote you. The Egg will be sent by the post with this in a coffee tin, the bird will go up by the S.S. Bruce to Hokitika to be forwarded, and it is to be hoped that better luck will attend it than the last one sent. It is a fine creature in beautiful condition and eats worms most ravenously. Having kept alive for so many weeks it is to be presumed that he will still thrive in captivity, especially with so good an appetite. Price £3 for the bird and Egg . . .

Remember me to Gore, Skey and Buchanan . . .

P.S. I have spoken to some people about the Greebs *(sic)* and am promised some skins.

Okarito 9 Oct. (1867): . . . I have not heard from you for a long time tho' I am very anxious about the Rohi and your opinion of my description of the district . . .

Yours very sincerely, T. R. Hacket

My dear Gore, Hokitika, 1 Nov '67

I forwarded a few days back 2 skins of the Rohi addressed to the Dr . . . Should he not be in Wellington I would advise you to get them prepared and stuffed at once by your birdstuffer as they may else spoil – They are very valuable from their peculiarities and scarcity.

I hope the Egg arrived safely . . .
Awaiting your kind reply believe me, Yours very sincerely,
T. R. Hacket

My dear Gore,
Hokitika 24 Nov '67

Yours of 3rd duly recd. in which you tell me that the Egg arrived so I presume that you got it unbroken about which I was anxious. You say the kiwi skin arrived but you do not say how many. There should be 3 of them.

I am obliged to you for putting down my name for the N.Z. Society and now enclose £1.1 as my subscription . . .

Yours very sincerely, T. R. Hacket

My dear Hector,
Hokitika 30 Nov '67

I was rather disappointed with your last of 27 Oct as it only answered mine about the Coal, but for this information my best thanks . . .

As regards my ac/. against you I hardly like charging you with kiwis or Rowis which either escaped or died on the road besides which Gore only acknowledged *a skin* instead of 3 skins.

However, I enclose the total and you may pass which items you please.

The private ac/. against you I find by my book to be £1.8 . . .

You promised me £10 for reporting on the Wellington Wairarapa with 63 specimens . . . Believe me, Yours very sincerely,
T. R. Hacket

The following account accompanied this letter:

N.Z. Museum. Dr to J. R. Hacket

| | | | |
|---|---|---|---|
| Sept. 1867 | 1 kiwi skin forwarded | | 10 |
| | 1 Live kiwi, died | £1 | |
| | 1 Live Rohi and egg (Tizard)<br>(Egg and skin forwarded) | £2 | 10 |
| | Skinning and preparing do. | | 10 |
| | 1 Rohi skin (paid Cooper) forwarded, | | 10 |
| | carriage & freight, 1 box s.b. and of 1 Rohi | | 10 |
| | 1 Live Rohi, Escaped at Hokitika | £1 | 15 |
| | Total | £7 | 5 |

Note added by Gore in Wellington:

"Doctor. The only things that arrived at the Museum were

Kiwi's Egg
do. Skull and bones
3 skins, two of which were rotton *(sic)*
and had to be buried: the other was set up.
R. B. Gore 21.12.67."

Here the record ended because Hacket sailed from Hokitika to Melbourne in January 1868 "to try my luck", as he wrote, "with the Buller mine"; he was trying to raise capital for his venture. He stayed in Australia for a decade, continuing his correspondence with Hector.

From Hacket's letters, it seems that he knew two species of *Apteryx* in the Okarito district, one as the kiwi, which has remained as a general term for the genus but probably referred to the South Island Brown Kiwi, and the other as the Roa (or Rohi). According to Oliver (1930, *New Zealand Birds*, p.60), stories about a large kiwi or roaroa were current before 1871. Buller, in his first paper (1865, *Essay on the Ornithology of New Zealand*), quoted Rochfort as describing the Roaroa as "a kiwi about the size of a turkey" under the name *Apteryx maxima*. This manuscript name, attributed to Verreaux, cited by Bonaparte, has since been dismissed as a *nomen nudum*, because it was published without a description or indication. In the *Catalogue of the Colonial Museum, Wellington* (1870), Hector listed *"Apteryx australis* Shaw. Great Kiwi, Tokoeka; *A. Oweni* Gould. Grey Kiwi; and *A. Mantelli* Bartl. Common brown Kiwi", adding "? Apteryx Maxima Verr." in italics, indicating that it was among the Museum's desiderata.

Haast claimed to have heard the loud call of the Roa in the Alps, but it was not until the summer of 1870-71 that Canterbury Museum received two specimens from a collector in Westland (perhaps W. Bills, who later provided Buller with a series). The first two specimens were named *Apteryx haastii* by T. H. Potts (*Trans. NZ Inst.* 4: 204-5) in a paper to the Philosophical Society of Canterbury on 2 August 1871. The first was collected "high on the ranges" and the second "probably from the ranges above Okarita" *(sic)*. Hutton's *Catalogue of the Birds of New Zealand*, issued in late 1871 (after September, when the Introduction was written), lists *?Apteryx maxima* Verreaux as the Roa-roa, based on the Canterbury Museum material, and his critical notes (p.76) described the tarsus and foot of a giant specimen from the Aorere headwaters, Nelson. Apparently the single surviving Hacket skin was *A. australis*.

It thus seems that T. R. Hacket in 1867 obtained *Apteryx haastii* Potts about 3 years before Canterbury Museum received the type specimens, but that his efforts were frustrated by his own lack of elementary taxidermic skill and by the inadequacies of coastal shipping services in the 1860s. Hector had collected Crested Grebes during his Otago explorations, but Hacket left for Australia before he could obtain grebes of any species in Westland.

The Okarito kiwis appear to have been Hacket's only contribution to ornithology, to judge from his later letters to Hector (in the National Museum, Wellington) reporting on his activities as a mine surveyor and goldfield commissioner and passing on news about Australian geologists. Some of his Australian letters are summarised elsewhere (Fleming, in press: *Aust. J. Earth Sciences*). He returned to Nelson late in 1878 and tried to develop a copper-chrome prospect on land he owned in Aniseed Valley. He remained a bachelor and died in Nelson in 1884.

I am grateful to Mrs Helen Lewis, Nelson (through Miss Nancy Adams, Wellington), for information on the Hacket family and to the Hocken Library for permission to quote extracts from Hacket's letters in the Hector Papers (MS 443), Hocken Library, Dunedin. Details of Hacket's part in the 1865 Dunedin Exhibition are from "Reports and awards of the jurors", printed for the Commissioners, Dunedin, 1865.

C.A. FLEMING, *42 Wadestown Road, Wellington 1*

# BEHAVIOUR AND AFFINITIES OF THE MAGELLANIC CORMORANT

By DOUGLAS SIEGEL-CAUSEY

## ABSTRACT

The pair-bonding, recognition, defence, and courtship behaviour of the Magellanic Cormorant *(Phalacrocorax magellanicus)* is described. Its displays indicate that its closest relatives are the Pelagic and Red-faced Cormorants of the North Pacific, and that its similarities to the Guanay *(P. bougainvillii)* are only superficial. The affinities of the Magellanic Cormorant appear to lie with the cliff shags as a member of the *Stictocarbo* complex, rather than with the blue-eyed shag *(Leucocarbo)* complex.

## INTRODUCTION

The Rock Shag or Magellanic Cormorant *(Phalacrocorax magellanicus)* is an important member of the Fuego-Patagonian avifauna. Its breeding colonies are throughout the region encompassing the Falkland Islands (Islas Malvinas), the Argentine Patagonian coastline, and Tierra del Fuego. A few colonies have been found on the Pacific coast as far north as Isla Chiloe, Chile, but this species seems to prefer the colder Atlantic waters (Murphy 1936, Johnson 1965).

The Magellanic Cormorant has broad preferences in nest sites, building nests on a range of slopes from steep cliffs to small tops of isolated rocks (Reynolds 1932, Murphy 1936, Johnson 1965, Jehl *et al.* 1973). Colonies are limited in size by available habitat, and some are small isolated groups of nests (Reynolds 1935, de la Peña 1980). The scanty data available indicate that there is moderate post-breeding dispersal in winter. Adults and juveniles are found as far north as Peninsula Valdez on the Atlantic coast (Boswall & Prytherch 1972, Jehl *et al.* 1973). What happens after breeding to the Falkland Island birds is not known.

Except for some cursory notes on morphology, distribution, and natural history (see Humphrey *et al.* 1970 for a review), little has been published about the Magellanic Cormorant. As part of a larger study on the biogeography and systematics of the Magellanic Cormorant, I observed the courtship behaviour during the mid and late breeding season, and in this paper I compare it with that of other members of the Phalacrocoracidae in order to reach a better understanding of its systematic position within the family.

## METHODS

From 23 to 27 January 1985, I observed the courtship behaviour of the Magellanic Cormorant in a colony of about 80 breeding pairs on Isla Escobar

NOTORNIS 33: 249-257 (1986)

near Puerto Melo, and a colony of about 120 breeding pairs on Isla Blanca near Camarones, both in Chubut Province, Argentina. During February 1985, I made much fuller observations in a colony of about 130 breeding pairs on Isla Elena, near Puerto Deseado, Santa Cruz Province, Argentina. Observation periods ranged from 1 h to 5 h; the total amount of time spent observing behaviour in the colonies was about 4500 bird-hours.

Observations were made with 7 x 50 binoculars and a 45 x telescope, and I recorded behavioural acts in shorthand and on 35 mm slide film. I sexed birds by body size and behaviour and by the position of individuals during copulation. Behavioural terminology follows van Tets (1965), except where noted.

## BEHAVIOUR

**Locomotion:** On level ground, the Magellanic Cormorant walks with a high-stepping waddle, moving in this way for up to 20 m. On moderate slopes (up to 30°), adults only walk upslope, with their wings outstretched and their neck and body upright. To negotiate small rocks and fissures, they hop with the feet together.

Juveniles try walking down slopes, usually before they are capable of flight, but they often fall forwards on to the ground. On steeper slopes (up to 60°), juveniles fly-walk, using their bill for purchase. They often fall downslope and may even roll into the water. Adults usually fly to move 3 m or more on steep slopes.

The cormorants use both feet together in taking off and in swimming underwater, but in nearshore paddling on the surface they use their feet alternately. Cawkell & Hamilton (1961) described the motion of Magellanic Cormorants underwater as sinuous, possibly because of using alternate strokes, but van Tets (1965) stated that cormorants use simultaneous paddle strokes underwater.

**Nest building:** Nests are composed of filamentous and lamellar algae (e.g. *Desmarestia, Gigartina*) taken from tidal drifts on beaches and woven into a tight nest cup, cemented on the outside by guano (see also Reynolds 1932, Murphy 1936, Johnson 1965, Jehl *et al.* 1973). Nest material is collected only by the male during courtship and mating, but females often bring in small amounts until egg-laying. Before the male begins advertising, he places a small amount of algae on a suitable ledge and stands on it. Often he uses many sites before selecting a permanent one. Once a mate has been selected and courtship has begun, he will land at the nest with about 100 g of material, presenting it to the female during the post-landing display. She grasps the algae and, both holding it, they place the algae on the nest rim, often repeating the movement. Only rarely does the male place the algae on the nest rim directly and fly off for more material. Repeated mutual Nest-indicating (van Tets 1965) is more common.

**Regurgitation:** Before leaving the nest site to feed, Magellanic Cormorants often regurgitated a pellet of food remains and pebbles with rhythmic neck movements accompanied by a rising *gock-gock-gock* . . . sound, followed by the rattle of pebbles and pellet down the cliff face. I heard these sounds continually in the colonies at mid-morning and mid-afternoon, when most nest incubation shifts seemed to occur. The Bounty Island Shag *(Leucocarbo ranfurlyi)* is the only other cormorant known to utter sounds when regurgitating pellets (see Robertson & van Tets 1982), but the calls are difficult to identify and they may have escaped the notice of investigators of other species.

**Take-off:** Van Tets (1965) separated this behaviour into three components: Look, Crouch, and Leap. The Magellanic Cormorant usually does all three movements. In emergency flight or to terminate courtship, one bird simply leaps into the air away from the nest. Otherwise, adults Look by bringing the neck and head down to the horizontal with the body held upright and the neck pointed away from the cliff. The plumage and wings usually are sleeked to the body, but in about 25% of the observations, the neck feathers were erected and the wings held slightly away from the body. The gular pouch is always depressed by the hyoid (Kink-throating of van Tets 1965). The bird then Crouches by lowering its breast abruptly to the ground, and Leaps upwards away from the nest. Once in the air, it utters a rising then quickly falling cry.

On three occasions, when changing incubation shifts, males performed an additional display before Take-off. In this posture, the neck is almost vertical while the head is pointed slightly downwards. The breast and adomen pulsate without any sound being uttered. This display seems similar to the Pre-take-off posture described for the Bounty Island Shag (Robertson & Van Tets 1982).

**Landing:** Magellanic Cormorants, when approaching an occupied site, fly up towards the cliff from below the nest and utter a rising call three or four times. At about 3 m from the nest, the landing adult begins "back-flapping" to reduce speed and brings the feet up above its neck with the soles faced towards the landing site (see Fig. 1a). When landing at an unoccupied site alone, it makes only perfunctory calls and does not bring its feet above the neck. As the soles and webs of the feet are pink, contrasting with the black toes and legs, and as no other species of cormorants is reported to display the feet in such a manner, I believe that this movement in the Magellanic Cormorant has signal value to birds on the ground.

Once landed, the new arrival stretches out its neck and head horizontally, erects its neck feathers, and depresses the gular by the hyoid. It holds this position for about 3 s and rarely (10% of observations) utters a low croak. Afterwards, the bird slowly straightens up, usually (85% of observations) looking away from the landing site (see Fig. 1b). This movement is used both as a recovery after landing and as an appeasement display (van Tets 1965). This display closely resembles the Landing-gape described for the European Shag *P. aristotelis* (Snow 1963), and Post-landing described for the Pelagic, Red-footed, and Red-faced Cormorants, *P. pelagicus, P. gaimardi,* and *P. urile* (van Tets 1965, Siegel-Causey 1986b).

**Hop:** This display is thought to be a symbolic flight (van Tets 1965), usually done in place but often including short flights back and forth from the nest. In the Magellanic Cormorant, the display begins with the body upright, neck arched and bill brought down towards the ground pointed at the feet. The gular pouch is depressed by the hyoid, and then the bird pushes its body

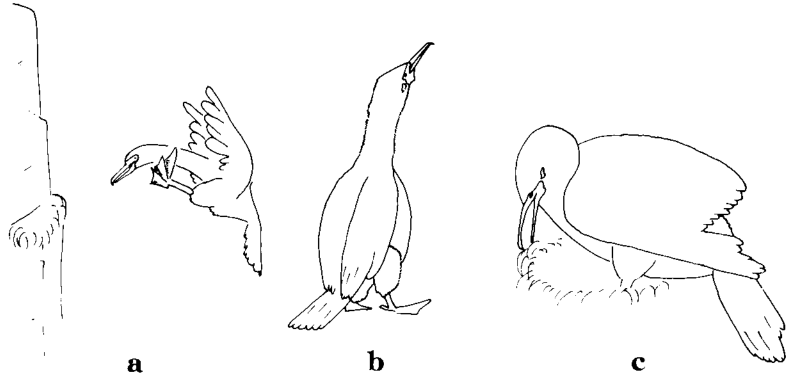


FIGURE 1 — Appeasement displays of the Magellanic Cormorant. (a) Landing display given approaching a nesting cliff; (b) Post-landing, or Hopping; (c) Nest-worrying after a threat display. Figure (a) redrawn from field notes, (b) and (c) from photographs.

vertically off the ground. It brings its feet up in front of its body, as in the Landing display, keeping its head pointed down, and its tail normally leaves the ground. Often (35% of observations) only one foot leaves the ground, and there appeared to be a fair amount of variation in head and tail position, possibly related to steepness of the terrain.

After Hopping, the bird does a Post-landing display, but this display is shorter than when used after landing. Both sexes use this display as part of the general recognition behaviour, but only the female uses it during the courtship sequences. I could detect no difference between sexes in this display, which seems like that of the Pelagic and Red-faced Cormorants (van Tets 1965).

**Stepping:** This deliberate, high-stepping walk is used when the Magellanic Cormorant moves near other nests, generally as a submissive appeasement against attack. The bird points its head straight ahead, holding its neck at about 45°; it erects its head and neck plumage and the gular pouch is depressed by the hyoid. Both adults and juveniles used this walk when leaving the nest, and although neighbours threatened when closely approached, attacks were very rare.

**Threat displays:** Magellanic Cormorants used similar displays in repelling unwanted juveniles, intruding adults, and potential nest predators. Beginning each sequence, and presumably the lowest-intensity threat, was the Stare. The bird holds its head and neck in line, pointed motionless at the intruder. In a similar posture (the Upright Aware display of Snow 1963), it holds its body and neck erect and moves its head up and down; this is the display people commonly encounter when walking through a colony. The Stare is combined usually with Snaking (Siegel-Causey 1978), where the bird points its bill at the intruder, slightly shaking its head sideways. With increased aggression, the nest defender raises its tail, erects its neck feathers, and Thrusts out towards the intruder; Snaking continues but is periodically interrupted by Nest-worrying (see Fig. 1c).

In the rarest form of threat display, presumably highest in intensity, the defender gapes widely, Thrusting strongly out and downwards, and uttering a hoarse croak. These displays differ little from those described for the Pelagic, Red-footed, and Red-faced Cormorants (Siegel-Causey 1986b and pers. obs.).

**Male advertising:** The male Magellanic Cormorant uses two displays during courtship, Darting and Wing-waving, that I did not see females use. The male Darts, holding his body nearly horizontally, erects his back coverts, slightly spreads his wings and holds his neck and head semi-erect. From this position he draws his head back along the midline and then Darts it forward and down in a quick deliberate movement; he opens his bill slightly at the most forward position (see Fig. 2a, b). Throughout the movement, he cocks his tail upwards and depresses the gular with the hyoid. Rarely, he utters a faint click.

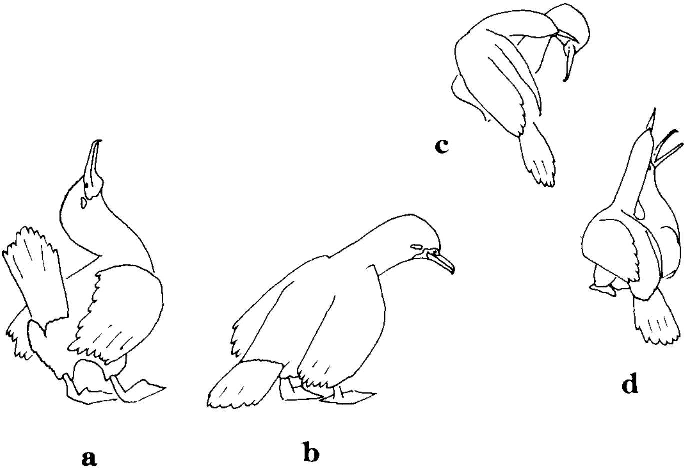


FIGURE 2 — Courtship displays of the Magellanic Cormorant. (a) Beginning and (b) ending phase of Darting by the male; (c) Beginning and (d) ending phases of Throat-clicking by a pair. All figures are redrawn from photographs.

The male Wing-waves usually as the female approaches. He holds his body horizontally with his breast close to the ground and lays his neck along his back with the neck plumage erected and the closed bill pointed up near the tail (see Fig. 3). With the gular still depressed, the tips of the slightly opened wings are lifted irregularly 2-4 times a second in pulses of 1 s each. The males were silent during Wing-waving.

These advertising displays of the Magellanic Cormorant closely match those observed for the Pelagic and Red-faced Cormorants (van Tets 1965, Siegel-Causey, pers. obs.) and agree in outline with those of the Red-footed Cormorant and the spotted shags *P. punctatus* and *P. featherstoni* (van Tets 1974, Siegel-Causey 1986b).

**Recognition:** Magellanic Cormorants use many displays in pair-bonding, nest-relief, and greeting, but few were used only for those purposes. Throat-clicking (Snow 1963) was a mutual display initiated by either sex. The initiating bird taps or touches the other's bill near the tip and then waves its open bill horizontally at the other's face (see Fig. 2c, d). This display commonly is repeated, and it often grades into Head-wagging.

In this display, both birds face the same direction with their bodies held roughly level with the ground and their necks erect. The initiating bird places its neck over that of its mate, and then both move their heads laterally away from the initiator. This display is usually repeated only once; instead, another display such as Nest-worrying, Throat-clicking, Allopreening, and sometimes Hopping, is done by one of the pair.

**Nest-relief:** As the incoming mate approaches the nest, the sitting bird holds its neck vertically and its head nearly horizontally with the bill opened. Snow (1963) described a similar display of the European Shag *(P. aristotelis)* as the Sitting-Gape. Unlike the European Shag, the Magellanic Cormorant does not move its head laterally during the display. Once on or near the nest, the bird taking over initiates Throat-clicking, then Hops and makes a sharp falling cry. The sitting bird usually Nest-worries after this call. The sequence beginning with the Sitting-gape often is repeated 2-3 times before the "out" bird switches places with its mate on the nest. On a few occasions, when the sitting bird had been on the nest for 3-6 hours, it terminated these repetitious preliminaries abruptly by leaving the nest and flying off.

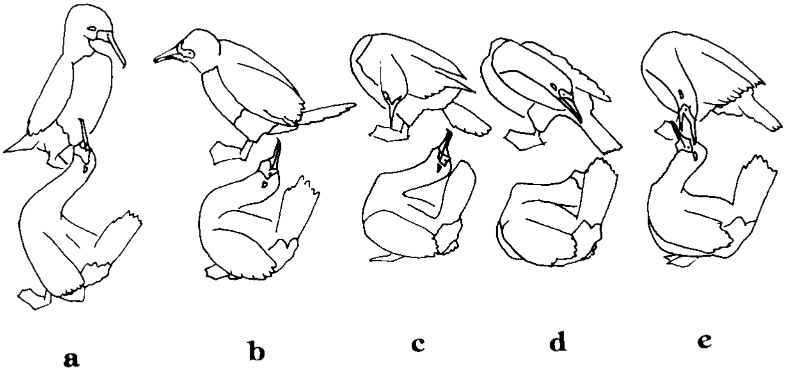


FIGURE 3 — Pairing displays of the Magellanic Cormorant. (a) Initial phase of Wing-waving by the male on the nest after approach by the female, (b) Beginning phase of Hop by female; male is Wing-waving. (c) Conclusion of Hop by female followed by Nest-indicating. (d) Full neck extension by male during Wing-waving; female Gaping. (e) Bill-biting by female and possibly Bowing by male. All figures are redrawn from photographs; the male is on the nest sited on a ledge below the female. This sequence terminated in copulation.

**Courtship:** The courtship sequence begins with the male selecting a site, then Darting and Wing-waving. Eventually, a female approaches, lands near the male, and provokes him into making a series of short calls synchronised with each Wing-wave. The female approaches more closely, Gapes, and then gently nibbles the base of the bill and gular pouch, possibly to induce more Wing-waving (see Fig. 3). After this, at the conclusion of 3-5 Wing-waves, the female Hops. She holds the post-landing display longer than usual with her neck outstretched out over the male. He approaches, arches his neck (the Bowing display of van Tets 1965), and makes a sharp call sounding like *"Ow!"* This cycle can be repeated many times before the male either drives the female away with thrusts or sidles alongside her flank, Head-wags and then mounts. Nest-worrying is interspersed throughout this sequence by the male; in fact, the lack of this display usually (81% of observations) preceded the male driving away the female. This supports Tinbergen's (1953) and Berry's (1976) conclusion that Nest-indicating and Nest-worrying are redirected agonistic behaviours. Bernstein & Maxson (1982) thought otherwise because both partners do this in concert after nest defence, possibly indicating that it was an ownership display. However, van Tets (1965) suggested that many displays evolved from threat to greeting, and thus the use of the same display late in the breeding season as an adjunct to both threat and pair recognition displays may demonstrate the mixed function of the display.

## DISCUSSION

For most authorities, the Magellanic Cormorant is clearly a member of the blue-eyed shag complex (see Murphy 1936, Voisin 1973). The external appearance of adult Magellanic Cormorants is superficially similar to the Guanay *(P. bougainvillii)*, which also is considered a member of the complex, and juveniles appear similar to those of the Kerguelen Shag *P. verrucosus* (Voisin 1970). Researchers have regarded the Magellanic Cormorant variously as a primitive member of the complex (Voisin 1970), as an intermediate form between the Guanay and the Campbell Island Shag *P. campbelli* (Oustalet 1891), or as related to Imperial Blue-eyed Shag *P. atriceps* (Dorst & Mougin *in* Peters 1979).

Such confusion may be a result of inferring phylogeny from similarities in external characters. For example, Falla (1937) and Voisin (1973) summarised the features that distinguish the blue-eyed shags from other cormorants: a fleshy ring of blue (or green) skin around the eye, the presence of dorsal or alar patches of white during breeding and post-breeding periods, flesh-coloured feet, and a metallic sheen to the underparts. They also agreed that the Magellanic Cormorant does not show evidence of the first two features and that many species, including the Magellanic Cormorant, share the other two. Thus, the external similarities between the Magellanic Cormorant and Guanay are left as the rationale for inclusion in the complex. However, such similarities in overall appearance can arise as a result of convergence, sexual selection, or other means. Other modes of investigation may offer more illuminating conclusions.

In most aspects of communication behaviour, the Magellanic Cormorant's affinities lie not with the blue-eyed shags, but with the cliff shags. Unlike the King and Imperial Blue-eyed Shags *(P. albiventer* and *P. atriceps)*, male Magellanic Cormorants do not use Gaping during Wing-waving and have no counterpart to the cyclic Pointing/Darting display of the *Leucocarbo* complex (Siegel-Causey 1986a). Furthermore, the form of the Wing-waving display used by the Magellanic Cormorant is quite like that of the Red-faced Cormorant (van Tets 1965) and unlike the abbreviated form, Gargling, used by blue-eyed shags (van Tets 1974).

The sequence and form of displays used by the Magellanic Cormorant in courtship and pairing support van Tets' (1974) contention that the Red-footed, Pelagic, and Red-faced Cormorants, and the European and Spotted Shags are all members of the *Stictocarbo* complex.

Qualitative comparison of osteological characters of the Magellanic Cormorant with those of the rest of the family unambiguously places it as a member of the *Stictocarbo* complex (Siegel-Causey, pers, obs.). Lucas (1890) thought that its skeleton was most closely similar to that of the Red-faced Cormorant, and Peters (1931) followed this by placing the Magellanic Cormorant between the Red-faced Cormorant and the Guanay. More work on the morphology, ecology, and osteology is required to give a more precise phylogenetic relationship of the Magellanic Cormorant with the rest of the family. I conclude that the Magellanic Cormorant does not belong in the blue-eyed shag complex but instead is a member of the *Stictocarbo* group, the cliff shags.

## ACKNOWLEDGEMENTS

I thank the poeple and administrators of Puerto Deseado, Argentina, for assistance of many kinds, and B. Mayer and Mr and Mrs F. V. T. J. Fauring for hospitality at Puerto Melo, Argentina. I thank E. O. Gonzalez Ruiz and his colleagues in the Direccion Nacional de Fauna Sylvestre, and Raul Clarke, Conservacion de la Fauna, Consejo Agrario Provincial, Provincia de Santa Cruz, for permits. J. Neff, MD, gave me the opportunity to write this article. P. S. Humphrey, B. C. Livezey, and R. M. Mengel assisted in initial drafts. This research was supported by National Science Foundation grant 84-07365 and by the Kansas University Endowment Association.

### LITERATURE CITED

BERNSTEIN, N. P.; MAXSON, S. J. 1982. Behaviour of the Antarctic Blue-eyed Shag *Phalacrocorax atriceps bransfieldensis*. Notornis 29: 197-207.

BERRY, H. H. 1976. Physiology and behavioural ecology of the Cape Cormorant *Phalacrocorax capensis*. Madoqua 9: 5-55.

BOSWALL, J.; PRYTHERCH, R. J. 1972. Some notes on the birds of Point Tombo, Argentina. Bull. Brit. Ornithol. Club 92: 118-129.

CAWKELL, E. M.; HAMILTON, J. E. 1961. The birds of the Falkland Islands. Ibis 103a: 1-27.

HUMPHREY, P. S.; BRIDGE, D. 1970. Apuntes sobre distribucion de aves en la Tierra del Fuego y la Patagonia Argentino. Revista Museo Argentino Ciencias Naturales, Zoologia 10: 251-265.

HUMPHREY, P. S.; BRIDGE, D; REYNOLDS, P. W.; PETERSON, R. T. 1970. Birds of Isla Grande (Tierra del Fuego). Smithsonian Institution: Washington, D. C.

FALLA, R. A. 1937. Birds. Brit. Aust. NZ Ant. Res. Exp. Reports, Series B, Vol. II.

JEHL, J. R., Jr.; RUMBOLL, M. A. E.; WINTER, J. P. 1973. Winter bird populations of Golfo San Jose, Argentina. Bull. Brit. Ornithol. Club 93: 56-63.

JOHNSON, A. W. 1965. The birds of Chile and adjacent regions of Argentina, Bolivia, and Peru. Platt Establ. Graficos: Buenos Aires.

LUCAS, F. A. 1890. Catalogue of skeletons of birds collected at the Abrolhos Islands, Brazil, the Straits of Magellan, and the Galapagos Islands. Proc. U. S. Nat. Mus. 13: 127-130.

MURPHY, R. C. 1936. Oceanic Birds of South America. Vol. II. Amer. Mus. Natur. Hist.: New York.

OUSTALET, E. 1891. Oiseaux. Mission Scientifique du Cap Horn, 1882-1883. Zoologie 6(B): 1-341.

DE LA PEÑA, M. R. 1980. Notas nidologicas sobre Biguaes y Cormoranes (Aves: Anhingidae y Phalacrocoracidae). Historia Natural 1: 109-112.

PETERS, J. L. 1931. Check-list of Birds of the World. Harvard Univ. Pr.: Cambridge, Mass.

PETERS, J. L. 1979. Check-list of Birds of the World. Second edition. Harvard Univ. Pr.: Cambridge, Mass.

REYNOLDS, P. W. 1932. Notes on the birds of Snipe, and the Woodcock Islands, in the Beagle Channel. Ibis (Ser. 13, 2): 34-40.
REYNOLDS, P. W. 1935. Notes on the birds of Cape Horn. Ibis (Ser. 13, 5): 65-100.
ROBERTSON, C. J. R.; VAN TETS, G. F. 1982. The status of birds at the Bounty Islands. Notornis 29: 311-336.
SIEGEL-CAUSEY, D. 1978. Defense behaviour in two species of cormorants (Aves: Phalacrocoracidae). Unpubl. M.S. thesis, Univ. California, Irvine.
SIEGEL-CAUSEY, D. 1986a. The courtship behavior and mixed-species pairing of King and Imperial Blue-eyed Shags *(Phalacrocorax albiventer* and *P. atriceps).* Wilson Bull. (in press).
SIEGEL-CAUSEY, D. 1986b. Behaviour of the Red-footed Cormorant *(Phalacrocorax gaimardi).* Notornis (submitted).
SNOW, B. K. 1963. The behaviour of the Shag. Brit. Birds 56: 77-103, 164-186.
VAN TETS, G. F. 1965. A comparative study of some social communication patterns in the Pelecaniformes. Ornithol. Monogr. 2: 1-88.
VAN TETS, G. F. 1974. Australasia and the origin of shags and cormorants, Phalacrocoracidae. Proc. Intern. Ornithol. Congr. 16: 121-124.
TINBERGEN, N. 1973. Fighting and threats in animals. New Biology 14: 2-24.
VOISIN, J. -F. 1970. On the specific status of the Kerguelen Shag and its affinities. Notornis 17: 286-290.
VOISIN, J. -F. 1973. Notes on the blue-eyed shags (Genus *Leucocarbo* Bonaparte). Notornis 20: 262-271.
ZAPATA, A. R. P. 1967. Observaciones sobre aves de Puerto Deseado, Provincia de Santa Cruz. El Hornero 10: 351-378.

DOUGLAS SIEGEL-CAUSEY, *Museum of Natural History, University of Kansas, Lawrence, Kansas 66045, USA*

★

# SHORT NOTES

## Asiatic Black-tailed Godwit harried by Bar-tailed Godwits

On 7, 11 and 21 June 1986 we observed an Asiatic Black-tailed Godwit *(L. limosa melanuroides)* at the ARA Ponds, Mangere. The bird was in partial breeding plumage with rufous neck, throat and breast and dark barring on the lower breast and sides.

On all three occasions it was persistently harried by members of a flock of 300 Bar-tailed Godwits *(Limosa lapponica)* whenever it tried to roost among them or near them. On two of our three visits it was eventually forced to fly from the roost, chased a considerable distance by three or four Bar-tailed Godwits, and did not return.

Falla *et al.* (1979, *The New Guide to the Birds of New Zealand*, Auckland: Collins) state that this species "may be looked for wherever Bar-tailed Godwits occur" and Heather & Brathwaite (1985, in *Complete Book of New Zealand Birds*, Sydney: Reader's Digest) state that "the species may associate with the bar-tailed godwit". Although the two species may associate there may clearly be considerable antagonism towards solitary Black-tailed Godwits, behaviour that does not seem to have been recorded.

We also noted that the bird had a narrow but distinct white tip to its tail, a feature recorded by Heather & Brathwaite (1985, page 192) for both the Hudsonian Godwit *(L. haemastica)* and *L. l. melanuroides* but by Falla *et al.* for Hudsonian only. Various foreign guides we consulted confirmed that both races of *L. limosa* also have a narrow white tail-tip.

JOHN DOWDING, 79 *Monarch Avenue, Auckland 10* and
GEOFF ARNOLD, 5 *Marua Road, Ellerslie, Auckland 5*

## Petrels off Ninety Mile Beach

A large flock of Thin-billed Prions *(Pachyptila belcheri)*, which included five other seabird species, was seen unusually close inshore along Ninety Mile Beach on 31 May 1986. At 1200 hours NZST I and five others were travelling down the beach after completing the monthly beach patrol. Opposite Motupia Island AH pointed out a large number of prions flying north above the incoming breakers. Several prions flew over the beach itself. The weather was squally, with strong south-west winds.

At the Bluff PM and I spent 30 minutes watching the seabirds travelling north. They were present from Hukatere to Motupia Island, a distance of 41 km, in a band about 400 metres wide. I estimated that 50 000 to 70 000 prions were along the coast. By 1400 hours, the number of birds passing Hukatere had decreased markedly, indicating the tail end of the flock.

The great majority of birds were Thin-billed Prions, identified by the tiny amount of black on the tail and the distinctive white facial pattern (confirmed by PH, pers. comm.). Their fresh plumage, a clear grey upper surface with a thinly defined 'M' wing marking, would indicate that these were "probably birds of the year which left their South Indian Ocean nest-sites in mid February or early March" (PH, pers. comm.).

A Broad-billed Prion *(P.vittata)* and several Fairy Prions *(P. turtur)* were also seen. Some Blue Petrels *(Halobaena caerulea)* with conspicuous white tail tips were noted at the Bluff, and at Hukatere (CW *per* AH).

At least 4000 Short-tailed Shearwaters *(Puffinus tenuirostris)* were estimated to be present on migration. They were seen singly at intervals of 50-100 metres, keeping about 100 metres offshore.

One mollymawk *(Diomedea* sp.*)* was seen among the prions (PM, pers. comm.).

Three weeks later, on the 21 June beach patrol, two Grey-headed Mollymawks *(D. chrysostoma)*, one Light-mantled Sooty Albatross *(Phoebetria palpebrata)*, one dying Mottled Petrel *(Pterodroma inexpectata)*, eight Short-tailed Shearwaters, four Sooty Shearwaters *(Puffinus griseus)*, and four unidentified prions were found among 51 beach-washed birds (LH, pers. comm.).

This beach patrol confirmed the presence of Short-tailed Shearwaters but gave no indication of the great numbers of prions along the beach on 31 May.

I thank David Crockett, Alison and Laurie Howell, Pat Miller and Chris Wetzel for their comments and contributions. I am grateful to Peter Harper for his help.

GEORGE WATOLA, *P.O. Box 3, Kerikeri*

# THE SEXUAL DIMORPHISM OF SNARES CAPE PIGEONS

## *(Daption capense australe)* *

By P. M. SAGAR

## ABSTRACT

The males of Snares Cape Pigeons breeding at the Snares Islands are larger than females, especially in head plus bill length, mid-toe plus claw, bill length, bill depth, tarsus, and weight. By using the measurements head plus bill length and mid-toe plus claw, one can reliably sex about 82% of the Snares Islands birds. The amount of sexual dimorphism is similar in both races of cape pigeon. The importance of having a wide range of calls during breeding is favoured as the reason for dimorphism having developed in fulmarine petrels.

## INTRODUCTION

Cape Pigeons are fulmarine petrels, a group which is sexually dimorphic e.g. Northern Fulmar *Fulmarus glacialis* (Dunnet & Anderson 1961), Antarctic Fulmar *F. glacialoides* (Mougin 1967), Cape Pigeon *Daption capense capense* (Pinder 1966), Snow Petrel *Pagodroma nivea* (Croxall 1982), and Northern and Southern Giant Petrels *Macronectes halli* and *M. giganteus* (Hunter 1984). Sexual dimorphism is evident in most petrels, males tending to be larger than females except in storm petrels, where they may be smaller (Bourne 1985).

The Snares Cape Pigeon *(D. c. australe)* breeds at the Snares, Antipodes, Bounty, Auckland, and Campbell Islands (Kinsky 1980). This race is smaller and darker than the nominate race (Watson 1975), which breeds at higher latitudes. Measurements of Snares Cape Pigeons are available from a small number of museum specimens (e.g. Oliver 1955) but not from live birds of known sex.

The easiest time to sex live petrels is during the laying season. Therefore, when my November 1985 visit to the Snares Islands coincided with the laying period of Snares Cape Pigeons, I took the opportunity to obtain some information from live birds. The objectives were to measure and weigh live Snares Cape Pigeons of known sex so as to study their sexual dimorphism and to compare these results with data for the nominate race.

## METHODS

A sample of 95 breeding Snares Cape Pigeons was captured and measured at the North Promontory, North East Island, the Snares Islands (48°02′S,

---

* University of Canterbury Snares Islands Expeditions Paper No. 62

166°36′E) between 4 and 18 November 1985. All birds were caught at marked nest sites either just before egg-laying or during the first two incubation shifts. Because they were breeding I could assume that these birds were at least five years old (Beck 1969), which should eliminate any age-related size variation. Both birds of a pair were caught at 43 nests, but at nine nests only the male was caught.

Eight measurements were taken from each bird: head plus bill length (Nugent 1982), bill length, bill width,bill depth, tarsus, and mid-toe plus claw were measured to the nearest 0.1 mm with vernier calipers; wing length to the nearest 1.0 mm with a steel tape; and weight to the nearest 5 g with a 1000 g Pesola spring balance. I measured most birds; the rest were measured by Colin M. Miskelly.

Each bird was sexed by cloacal examination (Serventy 1956), a particularly reliable method because laying was at its peak.

The measurements were subjected to a stepwise discriminant function analysis (Nie *et al.* 1975). This analysis chooses the single measurement which is best for discriminating between the sexes and, by placing the other measurements in a series of decreasing value as discriminators, gives an optimal set of measurements. An index of sexual dimorphism (female/male x 100, see Croxall 1982) was calculated for each measurement. This index indicates the degree of sexual dimorphism, where a result of 100 shows no difference but lower and higher results show that males are larger or smaller respectively than females. Although the index is useful when comparing the degree of sexual dimorphism between species, it cannot be used to sex birds.

## RESULTS

Males were significantly larger than females in all measurements (Table 1). Dimorphism was least marked between bill width and wing length. The best discriminators were head plus bill length (HB) and mid-toe plus claw (MTC) and are used for Figure 1. However, as there is some overlap a 2-variable analysis was completed to obtain a classification score:

$$(0.48568 \times \mathrm{HB}) + (0.2592 \times \mathrm{MTC}) - 53.17596.$$

A negative result for this equation indicates that the bird is a female and a positive result indicates a male. Use of this equation on birds of known sex resulted in 81.4% of females and 84.6% of males being correctly assigned to sex.

Males were significantly heavier than females ($P<0.001$) just before laying, even though each female was carrying an egg. The males were heavy before starting the long, first incubation shift. Straight after laying, mean female weight was 347 g ($n=47$) but by the time females started their first incubation shift their mean weight was 421 g ($n=21$). Males lost weight during their first incubation shift. Thus comparing the weight of birds at one colony from year to year or the weight of birds at different colonies has little value unless the birds are at the same stage of the breeding cycle.

Although wing length, the longest linear measurement, is the easiest to record, it was the least useful measurement in determining sex.

TABLE 1 — The relative sexual dimorphism in body measurements of live Snares Cape Pigeons

| Measurement | Mean ± 1 standard deviation (Range) | | F d.f.1 & 93 |
|---|---|---|---|
| | Male (N = 52) | Female (N = 43) | |
| Head + bill length (mm) | 78.47 ± 1.51<br>(74.6 - 81.8) | 75.87 ± 1.67<br>(71.8 - 79.4) | 63.74 *** |
| Bill length (mm) | 31.22 ± 1.18<br>(27.8 - 34.9) | 29.90 ± 1.05<br>(27.8 - 32.3) | 32.18 *** |
| Bill width (mm) | 15.32 ± 0.64<br>(13.8 - 17.0) | 14.86 ± 0.72<br>(13.2 - 16.3) | 10.52 ** |
| Bill depth (mm) | 12.97 ± 0.63<br>(11.8 - 14.4) | 12.39 ± 0.60<br>(11.1 - 13.6) | 21.29 *** |
| Wing length (mm) | 267.08 ± 5.91<br>(254 - 276) | 264.07 ± 7.24<br>(241 - 280) | 4.97 * |
| Tarsus (mm) | 45.07 ± 1.57<br>(41.7 - 48.6) | 43.80 ± 1.82<br>(40.7 - 47.3) | 13.31 *** |
| Mid-toe + claw (mm) | 61.29 ± 1.58<br>(57.8 - 65.3) | 59.11 ± 1.96<br>(54.0 - 63.1) | 35.82 *** |
| Weight (g) | 452.00 ± 40.00<br>(345 - 577) | 419.00 ± 31.00<br>(342 - 476) | 19.67 *** |

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

The index of sexual dimorphism calculated for each measurement was 92.7 (weight), 95.5 (bill depth), 95.8 (bill length), 96.4 (mid-toe plus claw), 96.7 (head plus bill length), 97.0 (bill width), 97.2 (tarsus), and 98.9 (wing length). The mean index for all measurements was 96.3.

## DISCUSSION

Snares Cape Pigeons, like other fulmarine petrels, have males larger than females. By using the measurements of head plus bill length and mid-toe plus claw, one can correctly sex about 82% of live birds. A similar degree of sexual dimorphism has been shown for Northern Fulmars (Dunnet & Anderson 1961) and Snow Petrels (Croxall 1982). The two species of giant petrels have a greater extent of dimorphism in weight than these species (Croxall 1982). Because of this sexual dimorphism one can correctly assign to sex a large proportion of the fulmarine petrels at their breeding colonies or on adjacent seas.

Both races of cape pigeon have a similar extent of sexual dimorphism, even though the southern race is slightly larger than the Snares Cape Pigeon. The index of sexual dimorphism in weight for breeding *D. c. capense* on Signy Island was 92.1 (Croxall 1982), which compares well with my 92.7for *D. c. australe.* Pinder (1966) showed that the bill length, wing length and

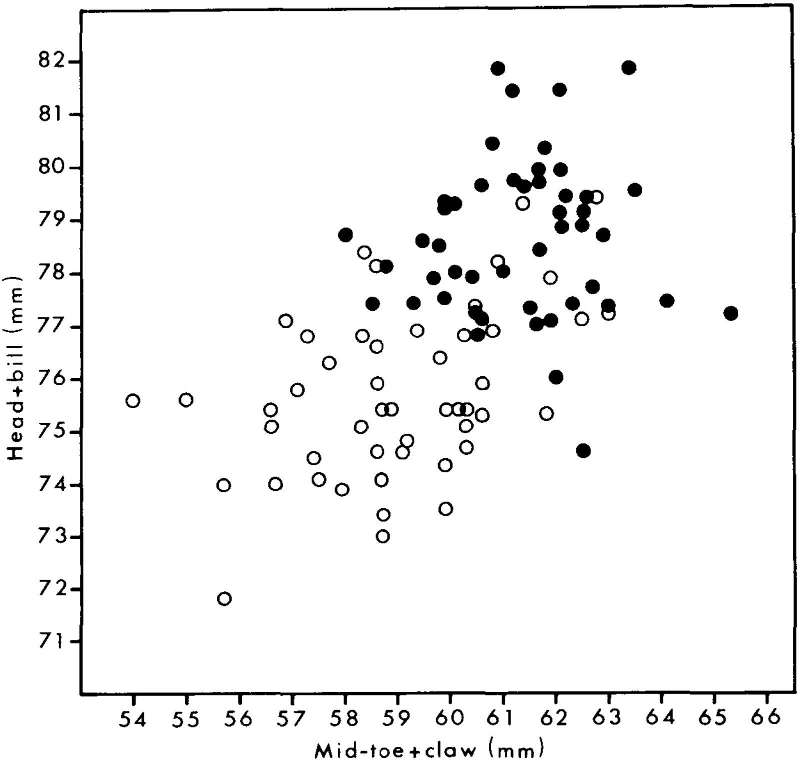


FIGURE 1 — Measurements for head plus bill length and mid-toe plus claw of live Snares Cape Pigeons of known sex from North East Island, the Snares Islands. O = females (n = 43); ● = males (n = 52)

tarsus of males were larger than those of females in *D. c. capense* breeding on Signy Island. Calculation of indices of sexual dimorphism from his data results in 95.5 (tarsus), 96.8 (bill length), and 99.6 (wing length). These indices are also similar to those obtained from Snares birds. Unfortunately measurements reported from birds at other breeding colonies do not distinguish between the sexes.

Several explanations have been proposed for the development of sexual dimorphism in fulmarine petrels. Hunter (1983) suggested, for giant petrels, that interspecific and intersexual competition at carcasses led to selection for larger males, their bill letting them feed more easily on carrion. However, this argument would apply equally to females and so could explain how larger males have gained an advantage only after sexual dimorphism had developed.

Males do more incubating and brooding than females in both species of giant petrels (Hunter 1984), in Cape Pigeons (Pinder 1966) and in Snow Petrels (Brown 1966). In the Wandering Albatross *(Diomedea exulans)*, which has similar sexual dimorphism, incubating males have a lower rate of weight loss than females, which offsets their longer incubation spans (Croxall &

Ricketts 1983). However, because fulmarine petrels have much shorter incubation periods than other procellariforms (Croxall 1984), different rates of weight loss are unlikely to explain sexual dimorphism in cape pigeons.

The most plausable explanation, suggested by Croxall (1982) for Snow Petrels, is that sexual dimorphism may be a simple way of increasing the range of calls the birds have. Guillotin & Jouventin (1980) showed that body weight was correlated with the sound frequency of the voice in Snow Petrels, and Isenmann (1970) showed that calls are important in the recognition of individuals. Calls seem to be just as important for cape pigeons, especially during courtship and when birds meet at the nest. These aspects of fulmarine petrel biology need special study.

## ACKNOWLEDGEMENTS

I thank my wife Joy for her help and encouragement throughout the project and her comments on the manuscript. I thank Colin Miskelly, who helped with the field work and commented on the manuscript, Barrie Heather and Graham Nugent for their comments on the manuscript, and Richard Holdaway for running the computer programme. The Department of Lands and Survey granted permission to visit the island.

### LITERATURE CITED

BECK, J. R. 1969. Food, moult and age of first breeding in the Cape Pigeon, *Daption capensis* Linnaeus. Br. Ant. Sur. Bull. 21: 33-44.

BOURNE, W. R. P. 1985. Petrel. *In* A Dictionary of Birds. B. Campbell & E. Lack (eds.). Calton: Poyser.

BROWN, D. A. 1966. Breeding biology of the Snow Petrel *Pagodroma nivea* (Forster). Aust. Nat. Ant. Res. Exp. Sci. Rep. Ser. B 89: 1-63.

CROXALL, J. P. 1982. Sexual dimorphism in Snow Petrels *Pagodroma nivea*.Notornis 29: 171-180.

CROXALL, J. P. 1984. Seabirds. *In* Antarctic Ecology. R. M. Laws (ed.). London: Academic Press.

CROXALL, J. P.; RICKETTS, C. 1983. Energy costs of incubation in the Wandering Albatross *Diomedea exulans*. Ibis 125: 33-39.

DUNNET, G. M.; ANDERSON, A. 1961. A method of sexing living Fulmars in the hand. Bird Study 8: 119-126.

GUILLOTIN, M.; JOUVENTIN, P. 1980. Le pétrel des neiges à Pointe Géologie. Le Gerfaut 70: 51-72.

HUNTER, S. 1983. The food and feeding ecology of the giant petrels *Macronectes halli* and *M. giganteus* at South Georgia. J. Zool., London 200: 521-538.

HUNTER, S. 1984. Breeding biology and population dynamics of giant petrels *Macronectes* at South Georgia (Aves: Procellariiformes). J. Zool., London 203: 441-460.

ISENMANN, P. 1970. Contribution à la biologie de reproduction du pétrel des neiges *(Pagodroma nivea* Forster); le problème de la petite et de la grande forme. L'Oiseau 40: 99-134.

KINSKY, F. C. (convener). 1980. Amendments and additions to the 1970 annotated checklist of the birds of New Zealand. Notornis (Supp.) 27: 1-23.

MOUGIN, J.-L. 1967. Etude écologique des deux espèces de fulmars: le fulmar atlantique *(Fulmarus glacialis)* et le fulmar antarctique *(Fulmarus glacialoides)*. L'Oiseau 37: 57-103.

NIE, N. H.; BENT, D. H.; HULL, C. H. 1977. SPSS Statistical Package for Social Scientists. New York: McGraw-Hill.

NUGENT, G. 1982. Sexing Black-backed Gulls from external measurements. Notornis 29: 37-40.

OLIVER, W. R. B. 1955. New Zealand Birds (2nd ed.) Wellington: Reed.

PINDER, R. 1966. The Cape Pigeon, *Daption capensis* Linnaeus, at Signy Island, South Orkney Islands. Br. Ant. Sur. Bull. 8: 19-47.

SERVENTY, D. L. 1956. A method of sexing petrels in field observations. Emu 56: 213.

WATSON, G. E. 1975. Birds of the Antarctic and Subantarctic. Washington D.C.: American Geophysical Union.

P. M. SAGAR, *Fisheries Research Division, Ministry of Agriculture & Fisheries, P.O. Box 8324, Christchurch*

# SHORT NOTES

## Breeding of Antarctic Terns *(Sterna vittata bethunei)*

Antarctic Terns are known to have an extended breeding season in the New Zealand subantarctic (Oliver 1955, Bailey & Sorensen 1962, Warham & Bell 1979). Falla *et al.* (1979) recorded eggs from November to January. Recently Sagar (1985) noted that breeding varied from island to island. He recorded that laying at the Snares occurred in late October and November and that on Campbell Island there were eggs from late November to late January.

In 1969, Warham & Bell (1979) found two single Antarctic Tern eggs, one downy chick and one fully feathered chick at Reef Point, Antipodes Island, on 31 January and four one-egg clutches on 10 March.

At the Bounty Islands, Robertson & van Tets (1982) recorded two nests with single eggs on 18 November 1978, and in April 1927, Oliver (1955) saw Antarctic Terns carrying small fishes to cliff ledges, where evidently there were young birds.

Eggs in March at Antipodes Island and feeding young in April at the Bounty Islands seem unusually late compared with the records from other New Zealand subantarctic islands, but this probably reflects that published field observations are few rather than any real differences between islands. Two recent expeditions to the subantarctic support this view.

During the 1985 subantarctic cruise of HMNZS *Monowai*, RMFSS and RHT observed an Antarctic Tern colony on the eastern side of Reef Point, Antipodes Island. Nesting terns were seen on their first visit to the area on 1 March. The next day, 34 adults were counted in the vicinity and nests were found, ten of which contained one egg each. On 4 March, two more nests were found with single eggs at sites empty on 1 March, showing that laying was still underway. A last check on 8 March showed terns still incubating single-egg clutches and no chicks. RMFSS and RHT saw no fledged young near Reef Point, but several were seen flying with adults around other Antarctic Tern colonies 2-4 km away on 3 March.

GAT was stationed on Campbell Island from April 1984 to April 1985. During this stay he noted aspects of Antarctic Tern ecology. He found eggs in Antarctic Tern nests from 13 October to 21 February, recorded first chicks on 19 February and saw very recently fledged chicks on nest sites on 31 March and 2 April.

Perhaps Antarctic Terns can raise two broods a year, as suggested by Stead (Oliver 1955), or late nesting may represent a second laying by failed breeders. On Campbell Island, Norway rats may cause nest failure, as well as Southern Great Skuas *(Catharacta skua lonnbergi).* GAT found one egg damaged by rats at a tern colony on 31 March, although fledgling chicks were raised on the main island in spite of this predation.

Not only is the nesting season prolonged but also courtship activity apparently extends throughout the year. At Campbell Island, GAT saw two adult terns almost in breeding plumage chasing on 1 July, one with a small fish in its bill. On 29 July, some birds in full breeding plumage were alighting on coastal ledges, displaying and calling as if they were selecting nest sites. By 2 September, pair displays included active swooping at approaching intruders. One pair was seen on 6 September doing "fish flights", alighting and displaying together on coastal ledges and attacking nearby Southern Black-backed Gulls *(Larus dominicanus)*. Terns in both breeding and non-breeding plumage were present in all months. Perhaps the onset of post-nuptial moult varies in terns according to the local nesting season.

Sagar (1985) also noted that, although the normal clutch of Antarctic Terns is one, it is sometimes two. All 12 clutches seen by RMFSS and RHT and the six clutches reported by Warham & Bell (1979) from Antipodes Island were of single eggs. Two-egg clutches seem to be commoner at Campbell Island. GAT found seven one-egg clutches and one two-egg clutch. Bailey & Sorensen (1962) reported that "while often the nests contained one egg, the complete set is two" (p.275). Sorensen collected seven sets of one egg and one of two eggs. Other Campbell Island nests recorded during the 1940s expeditions and in the late 1950s had six one-egg and four two-egg clutches. Bailey & Sorensen (1962) noted that the 1941 party recorded two eggs per nest freshly laid on 28 November. At the Auckland Islands both one-egg and two-egg clutches have been found from the end of November to mid-February (Oliver 1955, RHT pers. obs), but more information on Antarctic Tern breeding there is needed to compare with the other subantarctic islands.

Finally, Falla *et al.* (1979) recorded that Antarctic Terns nest near the sea and on cliffs up to 120 m a.s.l. RHT, on 22 January 1969, found a breeding colony of Antarctic Terns at 500 m a.s.l. near the summit of Mt Fizeau, Campbell Island.

We thank the Captain, officers and crew of HMNZS *Monowai* for their logistic assistance and the Department of Lands and Survey for support of the Campbell Island research and for permission to land on these Nature Reserves.

## LITERATURE CITED

BAILEY, A. M.; SORENSEN, J. H. 1962. Subantarctic Campbell Island. Denver: Denver Mus. Nat. Hist.

FALLA, R. A.; SIBSON, R. B.; TURBOTT, E. G. 1979. The New Guide to the Birds of New Zealand. Auckland: Collins.

OLIVER, W. R. B. 1955. New Zealand Birds. 2nd Ed. Wellington: Reed.

ROBERTSON, C. J. R.; VAN TETS, G. F. 1982. The status of birds at Bounty Island. Notornis 29: 311-336.

SAGAR, P. M. 1985. Antarctic Tern. *In* Complete Book of New Zealand Birds. Sydney: Reader's Digest.

WARHAM, J.; BELL, B. D. 1979. The birds of Antipodes Island, New Zealand. Notornis 26: 121-169.

R. M. F. S. SADLEIR[1]; R. H. TAYLOR[2], and G. A. TAYLOR[2], *Ecology Division, DSIR, Lower Hutt[1] and Nelson[2]*

## Mortality, interference and injury at Whitehead nests

During the summers of 1983/84, 1984/85, and 1985/86, we investigated breeding of Whiteheads *(Mohoua albicilla)* on Little Barrier Island. We found 78 nests and gathered evidence indicating the existence of 13 further nests. One nest was re-used. Usually, Whiteheads bred in primary pairs with secondary individuals which sometimes fed nestlings and fledglings (terminology after D. Dow, 1980, *Emu* 80: 121-140); we thus refer to breeding "groups" in the following notes on mortality, interference and injury at nests.

### Predation

*1984/85:* On 23 November, nest 11 (height 5 m), which was beside the rubbish pit, was apparently preyed on by kiore *(Rattus exulans)* on the day the two eggs were due to hatch. One broken egg with rat tooth marks and identical to the egg left in the nest was on the ground 10 m away. The other egg was retrieved from the nest after several days when it was clear that the nest had been abandoned. The full-term embryo from it is in the Auckland Museum (reg. no. B2144). The rubbish pit attracted many rats, making this nest a likely contender for kiore predation. No other nests were known to be preyed on by kiore.

On 26 November, nest 34 (height 30 m) contained large chicks (judged by their calling). As we walked away an uproar of Whitehead calling broke out overhead, and the Whiteheads chased a Long-tailed Cuckoo *(Eudynamys taitensis)* from the vicinity of the nest. When checked 24 h later this nest had failed. This was the only time that we saw Whiteheads chasing a cuckoo and the cuckoo may have preyed on the nest.

*1985/86:* On 30 October, a Tui *(Prosthemadera novaeseelandiae)* was probing into nest 7 when the female returned to continue incubation. The Tui pulled out the nest lining and, on being attacked by the Whitehead, flew off. The female settled on the nest but several hours later had abandoned it, presumably as a result of this incident.

### Interference at nests

One definite case of interference by other Whiteheads was observed in 1984/85. At nest 24, the male of a neighbouring nest (44 m away) was twice seen to prevent the incubating female from returning to the nest, on one occasion for 12 min. Her mate was present and although agitated did not attempt to drive off the neighbour. This female had five unsuccessful nests, the most recorded during the study.

Evidence from nest 24 and other groups indicated that some groups contained two breeding pairs. Our data are anecdotal, but we suggest that dominance relationships within a group may result in decreased breeding success for one pair (which is presumably subordinate). A similar result was noted for the Splendid Wren *(Malurua slendens)* by R. B. Payne, L. L. Payne & I. Rowley (1985, *Behaviour* 94: 108-127).

Tui and Bellbirds *(Anthornis melanura)* often approached Whitehead nests and peered at the incubating female. Females either crouched into the nest or gave alarm calls, but they never left, and were not attacked by the intruders.

On 30 December 1984, at nest 41 (height 10 m), the 1-year-old male Saddleback *(Philesturnus carunculatus)* which lived in the general area of the bunkhouse persistently approached the nest despite being mobbed by the Whiteheads. After about 10 min it plucked a chick from the nest (weight 7.0 g, age 4-5 days), carried it to a nearby branch, and dropped it. We returned the uninjured chick to the nest, which contained two other nestlings, and one chick was eventually reared successfully. This Saddleback was an unusually tame bird which often followed us to nests. He pecked at chicks in two other nests, but his behaviour was probably not typical. He had a mate in 1985/86 and did not interfere with Whitehead nests, to our knowledge.

### Early fledging

On 17 November 1984, a Tui feeding in pohutukawa *(Metrosideros excelsa)* flowers around nest 3 caused the two chicks to leave the nest at 16 days (about two days early). The adult Whiteheads often attacked Tui and Bellbirds feeding in these flowers. We rescued the chicks from the ground and placed them in the tree, but next day a Tui attacked the chicks, mortally injuring one of them. The other survived.

During several windy days in mid-December 1984, three newly fledged chicks from three different nests were found on the ground. One was in a dry creekbed, and the parents could not find another which was hidden under a log. These two were unlikely to have survived if we had not rescued them. A dead chick was found beneath one of these nests two days before the live chick was found. A dead chick found by A. and M. Dobbins on 6 January 1986 came from a nest which chicks were due to leave about four days later. It appears that Whitehead chicks will leave the nest early if there is disturbance nearby. Such chicks are unlikely to survive because the parents continue to feed any chicks left in the nest. Mortality of chicks was high during the last week of the nesting period, and we believe that much of this mortality is related to some chicks leaving the nest early.

### Starvation

Two healthy chicks were banded in nest 32 on 12 December 1984, before a 3 day storm (the only major storm of the season). Both chicks apparently starved to death during the storm because, when checked on 17 December, they had been dead at least 24 h. Both were emaciated and had developed little since banding. Three adults were feeding the chicks in this nest.

### Injury

Both tarsometatarsi of one of three chicks in nest 32 were found to be broken when the chicks were removed for banding on 12 December 1984. We "splinted" one leg with a band. Both legs healed and the chick was reared successfully.

## ACKNOWLEDGEMENTS

We thank A. and M. Dobbins for assistance on Little Barrier and the Hauraki Gulf Maritime Park Board for permission to work there. T. Robinson typed the manuscript. Funding was provided by the New Zealand Lottery Board, the New Zealand Wildlife Service, the Auckland Institute and Museum, and the University of Canterbury Grants Committee.

IAN G. McLEAN, *Department of Zoology, University of Canterbury, Christchurch;* B. J. GILL, *Auckland Institute and Museum, Auckland;* LESLEY P. CURTHOYS, *7220 92A Ave, Edmonton, Alberta, T6BOV3, Canada*

★

## LETTER

The Editor, 10 June 1986

Sir,

### The correct name of *Rallus hodgeni*

I am sorry to see that Dr Olson (*Notornis* 33: 32) wants to return to the early 19th century habit of correcting scientific names because they were considered to have been "incorrectly formed". In the present case the author (R. C. Scarlett) named the new fossil species for the owners of Pyramid Valley Swamp, but chose the family name of the brothers as the dedication name *(hodgeni)*. There is no unequivocal indication that this was an error for *hodgenorum*. For all we know, the wives of the Messrs Hodgen are co-owners of the swamp, and what ending would then be appropriate?

Even though Art. 31c suggests renaming incorrectly formed dedication names, ornithologists generally have placed stability and convenience higher than adherence to Latin grammar. For instance, Frank M. Chapman described in 1931 a South American bird as *Brachygalba lugubris naumburgi*, dedicating it to Elsie Naumburg. In order not to disturb stability, no one in the 55 years since then has "corrected" it to *naumburgae*.

*Rallus hodgeni* has not only priority, but is also a simpler and shorter dedication name. Why then abandon it owing to application of the anachronistic article 31c?

ERNST MAYR, *Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138*