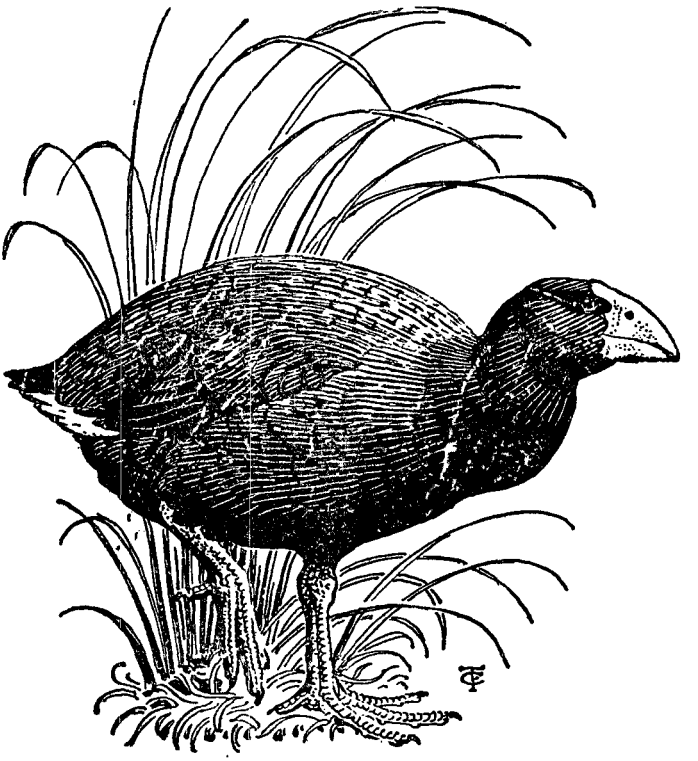
NOTORNIS



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References: If listed, these should be in the form of the following examples:

1. Atkinson, I. A. E., 1964: Feeding stations and food of the North Island Saddleback in August. Notornis 11, 2, 93-97.

2. Buller, W. L., 1888: A History of the Birds of New Zealand (2nd ed.) 2 vols., the author, London.

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NOTORNIS

In continuation of New Zealand Bird Notes

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Contents of Volume 18, No. 4: December, 1971

ECTOPARASITIC INSECTS ON BIRDS AND MAMMALS OF THE KERMADEC ISLANDS

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ABSTRACT

Ectoparasitic insects of birds and mammals of Raoul and Meyer Islands, Kermadec Islands, are recorded. Included are 52 Phthiraptera, 4 Diptera and 4 Siphonaptera, of which 40 Phthiraptera, 2 Diptera (**Stomoxys calcitrans** and **Ornithoica exilis**) and 1 Siphonapteron are new records for the islands. A simple key to the main groups of ectoparasites is given. Attention is drawn to the need for quarantine measures to prevent introductions of further pest species to the islands.

INTRODUCTION

During the Ornithological Society of New Zealand's Expedition of November 1966 - January 1967 to the Kermadec Islands (cf. Merton, 1970), the majority of bird species nesting on Raoul Island and Meyer Island were examined for ectoparasites. The results of this survey for ectoparasitic insects are presented below, and the records from the 1908 expedition of Oliver, and specimens collected by Sorensen in 1944, are also included. Ectoparasitic mites are at present being studied by my colleague, Dr. G. W. Ramsay, and will form the subject of a later paper. A tick, *Ornithodorus capensis,* has already been recorded (Ramsay, 1968).

Because some of the ectoparasites of mammals also attack birds, all mammalian ectoparasites are included. Only feral mammals (goats and rats) were examined, and other ectoparasites which were not recorded may occur on the farm animals (cattle, pigs, sheep, dogs and poultry).

Ectoparasites were collected from mammals which had been trapped or shot. Some bird ectoparasites were collected from dead specimens, but the majority were taken from living birds. This involved placing the bird (with its head projecting) in a polythene bag, together with a pad of cellulose wadding soaked in ethyl acetate, for 15 minutes. Larger birds had their feet tied. Following removal from the plastic bag, the bird was thoroughly ruffled over a large white plastic tray, untied, and released. The contents of the bag were then tipped onto the tray, and ectoparasites were picked up with a moist squirrel-hair brush, with the aid of a hand lens, and placed in 70% ethyl alcohol. This method of collection is efficient for ectoparasitic insects, but many mites are missed because of their small size.

Nests and burrow linings were collected after being abandoned, and their fauna was extracted with Tulgren funnels*. A few ectoparasitic insects were collected in pitfall traps, especially on Meyer Island, near nests and burrows. The flies were netted (*Stomoxys*, mosquitoes), or caught during "delousing" operations (Hippoboscidae).

* A Tulgren funnel is basically an enclosed metal funnel, in the upper part of which is an electric lamp. Heat and light and desiccation drive the Arthropoda and other small animals from the sample below the lamp, and they fall into a jar of 70% ethanol beneath the funnel.

Collections of Mallophaga from a few Procellariiformes and Charadriiformes are now reasonably adequate, but the same cannot be said of fleas and Hippoboscidae. Future visitors to the islands would do well to concentrate on the last two groups, but without neglecting Mallophaga.

Previous records of ectoparasites from the Kermadec Islands may be found in Johnston and Harrison (1912, Mallophaga), Edwards (1961, *Halipeurus*), Hilgendorf (1917, Siphonaptera), Smit (1965, Siphonaptera) and Belkin (1968, Culicidae). These earlier records are included below. Most of the species noted were recollected by the O.S.N.Z. Expedition, and many new records are added. All specimens listed from the O.S.N.Z. Expedition are in the Entomology Division collection (Nelson), apart from some duplicates not listed which are in the British Museum (Natural History), London. Most of the earlier collected material is in the Dominion Museum (Wellington — Oliver's collection of 1908) or in the Canterbury Museum (Christchurch — Sorenson's collection of 1944).

The terrestrial fauna of the Kermadecs is generally poor and fragmentary, many major groups represented on older islands being entirely absent. This is due mainly to the geological youth of the Kermadecs and their distance from faunal sources. Ectoparasites of birds are particularly suited for transport to such islands. Mallophaga are intimately associated with their hosts throughout their life cycle from egg to adult, and usually show a high level of host specificity, so their geographical distribution is generally that of their hosts. Other ectoparasites are less closely associated with their hosts, and usually show less host specificity, so their distribution is more similar to that of non-parasitic invertebrates than is the case of Mallophaga.

Some host species have, elsewhere in their ranges, ectoparasites which have not been found on Kermadec populations of the hosts. For example, Pukekos often harbour *Pseudomenopon concretum* in addition to *Rallicola lugens*. Elsewhere in various parts of its extensive range, the Sooty Tern is parasitised by *Actornithophilus incisis, A. piceus, Austromenopon atrofulvum* and *Saemundssonia petersi* in addition to *Quadraceps birostris*. Some of these apparent absences may reflect inadequate collecting, but this seems unlikely in the Starling, of which 18 specimens were examined. It is probable that Kermadec Starlings harbour only *Brueelia nebulosa, Menacanthus mutabilis* and *Sturnidoecus sturni*, and that other Mallophaga often or sometimes associated with this host *(Myrsidea cucullaris* and *Menacanthus spiniferus)* are absent.

Kermadec populations of land birds and non-migratory seabirds have probably been founded by few individuals. These founders may have carried only part of the normal Mallophagan fauna occurring on the species in the source area.

Mallophaga normally have little effect on healthy adult hosts, who keep them fairly well controlled by preening, but they can cause irritation in young or sick birds, who may damage themselves by scratching. Fleas, Hippoboscids, mosquitoes and *Stomoxys* can cause extreme irritation by their bites, and may transmit various diseases or internal parasites from one host to another.

There are no previous published records of the Biting Fly *Stomoxys calcitrans* from the Kermadecs. As discussed in more detail below, it appears that this fly was probably introduced to Raoul from New Zealand in late 1963. The Biting Fly is a nuisance to stock and man, and it is important to ensure as far as possible by appropriate quarantine measures that no other pests are introduced to Raoul in future.

I wish to thank the Council of O.S.N.Z. for the opportunity to take part in the Kermadec Islands Expedition. Most members of the Expedition assisted with collecting ectoparasites, but particular mention must be made of the enthusiasm of Messrs. D. V. Merton, D. E. Crockett and C. R. Veitch. Mr. A. T. Blake, farm manager on Raoul from October, 1965, to October, 1967, provided information about *Stomoxys* and collected various Arthropoda. I am greatly indebted to the following specialists for identifying ectoparasitic insects: Dr. Theresa Clay (Phthiraptera), Mr. L. J. Dumbleton (Culicidae), Dr. T. C. Maa (Hippoboscidae) and Mr. F. G. A. M. Smit (Siphonaptera).

Dr. Clay, Professor R. L. C. Pilgrim, Mr. D. V. Merton and Dr. G. R. Williams kindly read and criticised a draft of this paper. Most of their suggestions have been incorporated. Professor Pilgrim tested the key and provided a list of the Mallophaga collected by J. H. Sorensen in 1944.

I thank Dr. D. F. Waterhouse and the Melbourne University Press for permission to reproduce Figs. 15 and 16 (from Insects of Australia), and Drs. H. K. Townes and J. N. Belkin for permission to reproduce Fig. 13.

A KEY TO ADULTS OF THE MAIN GROUPS OF ECTOPARASITES ON THE KERMADECS

Specific (and often generic) identification of ectoparasites is a matter for specialists. The following key is intended only as a guide for recognition of the main groups of ectoparasites in the field, and needs to be used with caution. Several Kermadec birds have not yet been examined adequately for ectoparasites, and it is possible that other genera of ectoparasites which have not yet been collected will be found later. In fleas, the genera *Ceratophyllus* (on domestic poultry) and *Ctenocephalides* (on dogs and cats) may have been overlooked in the past, or could be introduced in future, so they have been included in the key in square brackets [ ]. Providing that the recorded host associations are borne in mind when using the key, few misidentifications should occur.

In the major divisions of the key, characters which can be seen with a hand lens, or at least with a stereoscopic microscope, have been used. In some of the generic separations it has been necessary to use characters which are only visible under fairly high magnifications, and may in a few cases require examination of slide-mounted, macerated specimens with a compound microscope. In almost all cases, however, host relationships will give a very strong clue to identity without recourse to microscopical examination. Note that most characters apply only to adults.

The Key to Mallophaga owes much to that of Blagoveshchenski (1967). The photographs of Mallophaga are of cleared, slide-mounted specimens.

1. With 8 legs. Body not divided into distinct head, thorax and abdomen (ticks and mites) ..... Acarina
— With 6 legs. Body divided into distinct head, thorax and abdomen (insects) 2
2. Wings present (flies) ..... Diptera — 3
— Wings absent 6
3. Relatively slender, long-legged flies with long, many segmented antennae (mosquitoes) ..... Culicidae — 4
— Stouter, short-legged flies with short, 3-segmented antennae 5
4. Large, blackish-brown mosquitoes (Fig. 13). Usually on coast. ..... *Opifex*
— Smaller, very slender, light-brown mosquitoes. Usually inland. ..... *Culex*
5. Flattened, leathery flies (" louse flies " Fig. 14) ..... Hippoboscidae
— Convex flies with fairly soft integment ..... *Stomoxys* (Muscidae)
6. Body flattened laterally (fleas) ..... Siphonaptera — 7
— Body flattened dorsoventrally (lice) ..... Phthiraptera — 12
7. Comb present on posterior edge of pronotum 8
— Pronotal comb absent 10
8. With a comb on genal margin of head. On cats, dogs, straying to man ..... [*Ctenocephalides*]
— Without comb on head 9
9. Front of head angled anterior to antennal insertions, with minute frontal tubercle. On domestic poultry, starlings, etc. ..... [*Ceratophyllus*]
— Front of head evenly rounded, without frontal tubercle. On rats. ..... *Pygiopsylla*
10. Front of head with a prominent trapezoid tubercle. In birds' nests ..... *Parapsyllus*
— Front of head without tubercle 11
11. Mesothorax with a pleural rod. Head with a row of setae parallel to its posterior margin (Fig. 16). On rats ..... *Xenopsylla*
— Mesothorax without a pleural rod. Head with a single seta on each side near posterior margin (Fig. 15). On man, dogs, pigs, etc. ..... *Pulex*
12. Head relatively small, mandibles absent. On mammals (sucking lice) ..... Anoplura
— Head relatively large, mandibles present. On birds; a few species on mammals (biting lice) ..... Mallophaga — 13
13. Antennal grooves present, antennae usually concealed (Figs. 1-3). Third antennal segment wineglass-shaped. Maxillary palps present ..... Amblycera, Menoponidae — 14
— Antennal grooves absent, antennae not concealed, projecting (Figs. 4-12). Third antennal segment not wineglass-shaped. Maxillary palps absent ..... Ischnocera — 19
14. Head with ventral spine-like processes 15
— Head without ventral processes 16

15. Head with a pair of gular processes. On Procellariiformes ..... *Ancistrona*
— Head without gular processes but with postpalpal processes. (Fig. 3). On Passeriformes ..... *Menacanthus*
16. First two antennal segments with large expansions. On Anseriformes ..... *Trinoton*
— Antennae without large expansions 17
17. Head semilunar (Fig. 2). On Charadriiformes and Procellariiformes ..... *Austromenopon*
— Head trilobed 18
18. Side of head deeply emarginate (Fig. 1); head width/length not exceeding 1:3. Form elongate.
On Charadriiformes ..... *Actornithophilus*
On Procellariiformes ..... *Longimenopon*
— Side of head weakly emarginate; head width/length about 1:8. Form broader. On Galliformes ..... *Menopon*
19. Antennae 3-segmented (Fig. 4). One claw on each leg. On mammals ..... Trichodectidae
— Antennae 5-segmented (Figs. 5-12). Two claws on each leg. On birds ..... Philopteridae — 20
20. Pterothorax (fused meso-and metathorax) rectangular with concave or straight approximately parallel lateral margins (Figs. 5, 6, 9). Body elongate. Usually on wing feathers 21
— Pterothorax trapezoidal or pentagonal, with markedly diverging lateral margins (Figs. 7, 8, 10-12). Body less or not elongate. Rarely on wing feathers 25
21. Head without thick lateral setae on clypeus 22
— Head with a thick lateral seta on each side of clypeus. On Anseriformes ..... *Anaticola*
22. Form very elongate and slender, abdomen with sides fairly straight. (Fig. 5). On Procellariiformes ..... *Halipeurus*
— Form less elongate, abdomen with sides more strongly curved (Figs. 6, 9) 23
23. Lateral abdominal butresses absent (Fig. 6). On Procellariiformes ..... *Naubates*
— Lateral abdominal buttresses present 24
24. Head scarcely longer than broad. Antennae strongly modified in ♂. On Pelecaniformes ..... *Pectinopygus*
— Head length/width exceeding 1:4. Antennae similar in both sexes (Fig. 9). On Charadriiformes ..... some *Quadraceps*
25. Body relatively slender, short or oblong, usually with narrow head and narrow abdomen (Figs. 7, 8). Mainly on body plumage, sometimes on head and neck 26
— Body short and broad, with broad head and broad abdomen (Figs. 10-12). Mainly on feathers of head and neck 30
26. Carina at anterior margin of head entire dorsally (Figs. 7,8). On Passeriformes ..... *Brueelia*
— Carina at anterior margin of head interrupted dorsally 27

27. A movable projection (trabeculus) present on each side of head just in front of base of antenna.
On Alcedinidae ..... *Alcedoecus*
On Charadriiformes ..... *Carduiceps*
— Trabeculi absent 28

28. Postgena with only one long seta on each side. Antennae much stouter in ♂ than in ♀. On Gruiformes ..... *Rallicolla*
— Postgena with more than one long seta on each side. Antennae similar in the two sexes 29

29. Clypeus with transparent anterior margin reaching only to carinae. On Charadriiformes ..... some *Quadraceps*
— Clypeus with transparent anterior margin reaching clypeal suture. On Charadriiformes ..... *Lunaceps*

30. A movable appendage (trabeculus) in addition to a fixed projection (conus) on each side of head, just in front of antennal insertions. On Passeriformes ..... *Philopterus*
— Trabeculi absent 31

31. Abdominal pleurites with ventral wedge-shaped processes. On Anseriformes ..... *Anatoecus*
— Abdominal pleurites without ventral processes 32

32. Tergites of abdomen entire. Head dorsally with 1-3 pairs of peg-like setae (Fig. 11). On Procellariiformes ..... *Trabeculus*
— Tergites of abdomen divided by median membranous areas. Head without peg-like setae 33

33. Frontal carina with a posterior transverse branch (Fig. 10). On Procellariiformes, Pelecaniformes, Charadriiformes ..... *Saemundssonia*
— Frontal carina with a posterior transverse branch (Fig. 12). On Passeriformes ..... *Sturnidoecus*

ORDER PHTHIRAPTERA

Anoplura (sucking lice) are found only on mammals, and Mallophaga (biting lice) occur chiefly on birds. Mallophagan species are normally restricted to a single, or a few closely related host species, but may occur occasionally as stragglers on other birds. A genus of Mallophaga may exceptionally be confined to a single genus of birds (e.g. *Apterygon* on *Apteryx)*, but usually is found on members of a family (e.g. *Alcedoecus* on Alcedinidae), an order (e.g. *Halipeurus* on Procellariiformes), or even several orders (e.g. *Saemundssonia*). As indicated in the preceding key, the body form of Mallophaga is related to the part of the host's plumage which they normally inhabit, as a result of differential selection pressures due to preening. (Short, stout lice can maintain themselves on neck and head, but would soon be eliminated from wings.)

As the distribution of a louse is usually that of its host, localities have been omitted from the following list. All the lice were collected on Raoul I. and Meyer I. during December 1966 and January 1967, apart from some species recorded previously from the Kermadecs by Johnston and Harrison (1912) and others collected by J. H. Sorensen in 1944 (indicated by (S)), which are marked with an asterisk *. When the record is not the type host (i.e. the host

species from which the louse was originally described), the name of the type host is given in square brackets [ ]. Johnston and Harrison's names have been brought up-to-date (cf Hopkins and Clay, 1952).

FAMILY MENOPONIDAE

Actornithophilus ceruleus (Timmermann, 1954). Fig. 1.
Procelsterna cerulea albivitta — ♀. [*P. c. cerulea*]

**Actornithophilus limosae* (Kellogg, 1908) (S)
Limosa lapponica baueri

**Actornithophilus timidus* (Kellogg, 1896)
Pluvialis dominica fulva

Actornithophilus sp.
Pterodroma hypoleuca nigripennis — ♀. "Certainly a straggler" (T. Clay, *in litt.*).

**Ancistrona procellariae* Westwood, 1874
Pelagodroma marina albiclunis. [*Daption capensis*]

Ancistrona sp.
Pterodroma hypoleuca nigripennis — nymph.

Austromenopon atrofulvum (Piaget, 1880)
Anous m. minutus — 2♀♀. [?]

Austromenopon becki (Kellogg, 1906). Fig. 2.
Phaethon rubricauda roseotincta — 2♀♀. [*P. aethereus mesonauta*]

**Austromenopon meyeri* (Giebel, 1874)
Limosa lapponica baueri

Austromenopon sp.
Puffinus p. pacificus — ♀

Austromenopon sp.
Procelsterna cerulea albivitta — ♀

Longimenopon sp.
Pterodroma hypoleuca nigripennis — ♀

Menacanthus mutabilis Blagoveshchenskii, 1940. Fig. 3.
Sturnus v. vulgaris — 3♂♂, 5♀♀, 5 nymphs

**Menacanthus stramineus* (Nitzsch, 1818) (S)
Gallus domesticus [*Meleagris gallopavo domestica*]

Menacanthus sp.
Prosthemadera n. novaeseelandiae — ♀

Menacanthus sp.
Turdus philomelos — ♀ nymph.

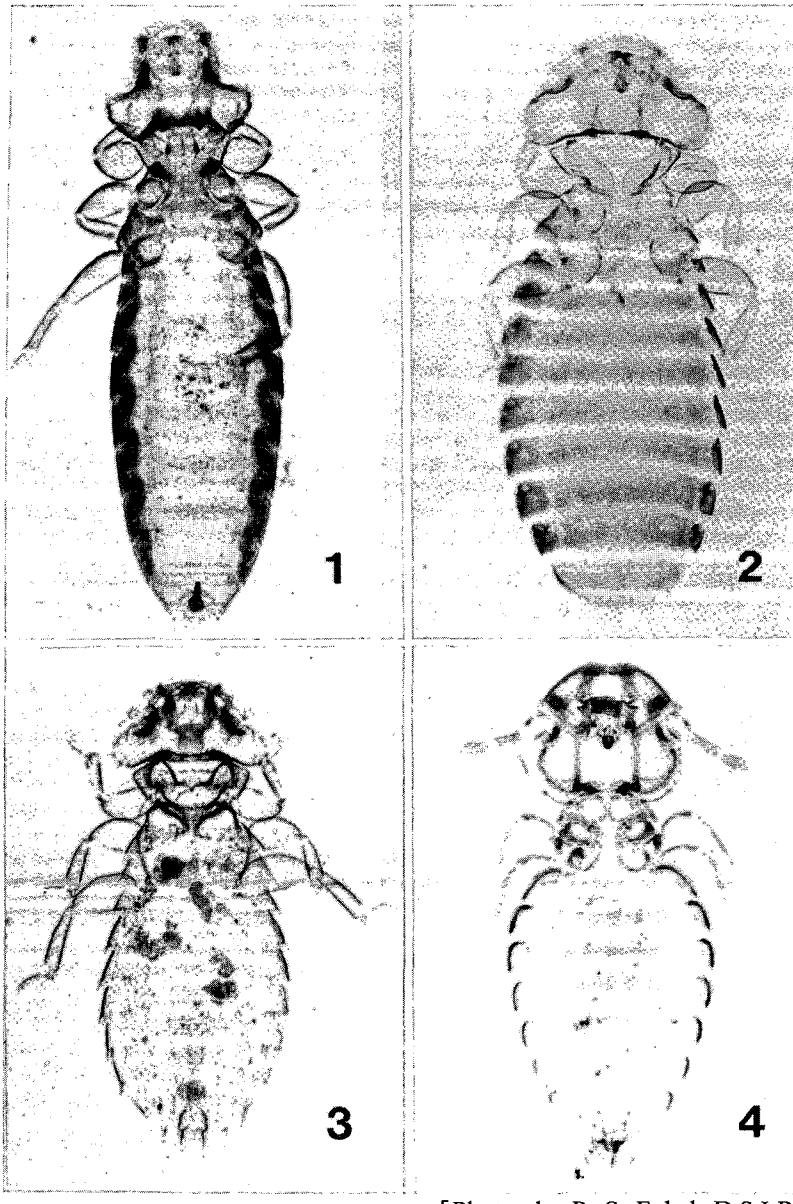
Menacanthus sp.
Turdus m. merula — ♀

**Menopon gallinae* (Linnaeus, 1758) (S)
Gallus domesticus

**Trinoton querquedulae* (Linnaeus, 1758) (S)
Anas s. superciliosa [*A. c. crecca*].

FAMILY TRICHODECTIDAE

Damalinia caprae (Gurlt, 1843). Fig. 4.
Capra hircus — many ♂♂, ♀♀, few nymphs.



[Photos by B. S. Eykel, D.S.I.R.

FIGURE 1: *Actornithophilus ceruleus,* ♀ (length 2.1 mm) from Grey Ternlet.

FIGURE 2: *Austromenopon becki,* ♀ (length 2.4 mm) from Red-tailed Tropic Bird.

FIGURE 3: *Menacanthus mutabilis,* ♂ (length 1.5 mm) from Starling.

FIGURE 4: *Damalinia caprae,* ♂ (length 1.3 mm) from Goat.

FAMILY PHILOPTERIDAE

Alcedoecus sp.
Halcyon sancta vagans — 8 adults.

Anaticola crassicornis (Scopoli, 1763)
Anas s. superciliosa — 1 nymph. [*Anas p. platyrhynchos*]

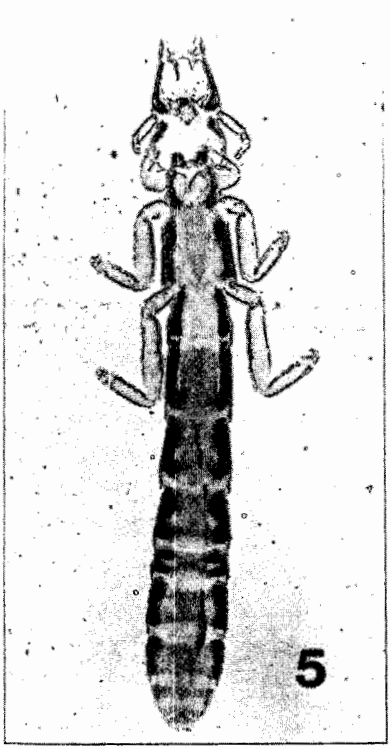
**Anatoecus dentatus* (Scopoli, 1763) (S)
Anas s. superciliosa [*A. p. platyrhynchos*]

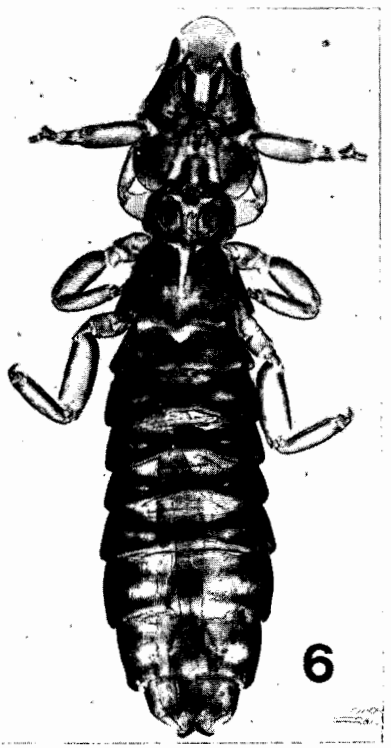
Brueelia merulensis (Denny, 1842). Fig. 8.
Turdus m. merula — 5 ♂ ♂, 3 ♀ ♀

Brueelia nebulosa (Burmeister, 1838) Fig. 7.
Sturnus v. vulgaris — many ♂ ♂, ♀ ♀, nymphs.

Brueelia sp. nov.
Prosthemadera n. novaeseelandiae — 5 adults.

Brueelia sp.
Turdus philomelos — nymph.





[Photos by B. S. Eykel, D.S.I.R.

FIGURE 5: *Halipeurus kermadecensis,* ♂ (length 3.6 mm) from Kermadec Petrel.

FIGURE 6: *Naubates harrisoni,* ♂ (length 3.8 mm) from Wedge-tailed Shearwater.

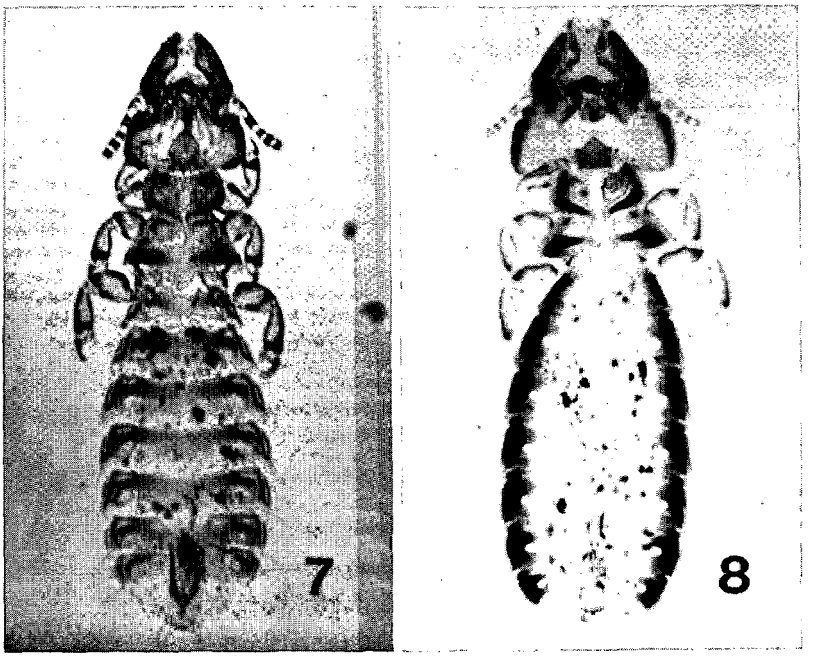


FIGURE 7: *Brueelia nebulosa*, ♂ (length 1.5 mm) from Starling.
FIGURE 8: *Brueelia merulensis*, ♂ (length 2.2 mm) from Blackbird.

**Carduiceps cingulatus lapponicus* Emerson, 1953 (S)
Limosa lapponica baueri

Halipeurus kermadecensis (Johnston and Harrison, 1912). Fig. 5.
Pterodroma neglecta — many ♂♂, ♀♀, nymphs.

Halipeurus leucophryna Timmermann, 1960
Pterodroma hypoleuca nigripennis — many ♂♂, ♀♀, nymphs. [*Pt. leucoptera masafuerae*]

Halipeurus mirabilis Thompson, 1940
Puffinus p. pacificus — 5♂♂, 11♀♀, 48 nymphs. [*P. p. chlororhynchus*].

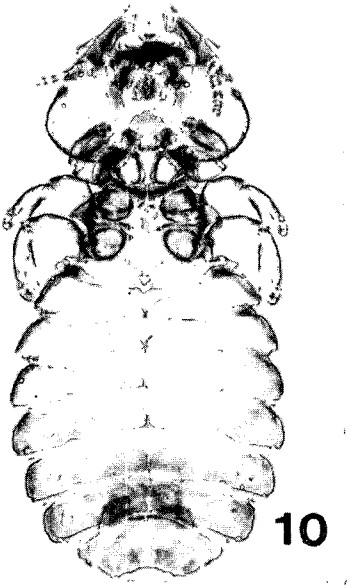
**Halipeurus pelagicus* (Denny, 1842)
Pelagodroma marina albiclunis. [*Hydrobates pelagicus*].

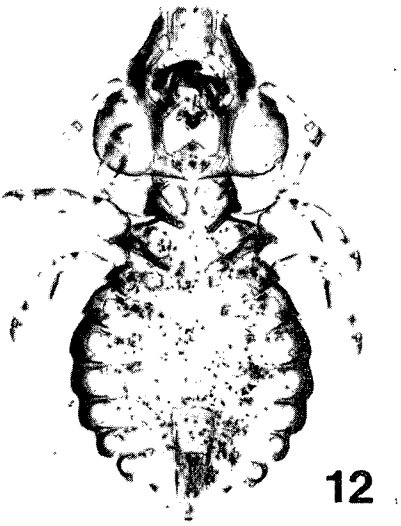
**Halipeurus placodus* Edwards, 1961
Puffinus assimilis kermadecensis. [*Puffinus a. tunneyi*].
Recorded by Edwards (1961), not taken by O.S.N.Z., and apparently not yet represented in any New Zealand collection.

**Lunaceps phaeopi* (Denny, 1842)
Numenius phaeopus variegatus

Naubates harrisoni Bedford, 1930. Fig 6.
Puffinus p. pacificus — 3♂♂, 2♀♀, 9 nymphs [*P. gravis*].

**Pectinopygus annulatus* (Piaget, 1880) (S)
Sula dactylatra personata [*Sula leucogaster*]





[Photos by B. S. Eykel, D.S.I.R.

FIGURE 9: *Quadraceps hopkinsi apophoretus,* ♂ (length 1.7 mm) from Grey Ternlet.

FIGURE 10: *Saemundssonia hexagona,* ♀ (length 3.2 mm) from Red-tailed Tropic Bird.

FIGURE 11: *Trabeculus fuscoclypeatus,* ♂ (length 1.3 mm) from Kermadec Petrel.

FIGURE 12: *Sturnidoecus sturni,* ♂ (length 1.5 mm) from Starling.

Philopterus turdi (Denny, 1842)
Turdus philomelos — ♀
Quadraceps birostris (Giebel, 1874)
Sterna fuscata — 17 ♂♂, 19 ♀♀
Quadraceps h. hopkinsi Timmermann, 1952
Anous m. minutus — 12 ♂♂, 18 ♀♀, nymph ["*Anous minutus melanogenys*"]
Quadraceps hopkinsi apophoretus Timmermann, 1969. Fig. 9.
Procelsterna cerulea albivitta — holotype ♂, allotype ♀, 4 ♂♂, 4 ♀♀ paratypes.
Rallicola lugens (Giebel, 1874)
Porphyrio porphyrio melanotus — 34 adults, 1 nymph [*P. poliocephalus*].
**Saemundssonia hawaiiensis* (Kellogg and Chapman, 1902)
Pluvialis dominica fulva
Saemundssonia hexagona (Giebel, 1874). Fig. 10.
Phaethon rubricauda roseotincta — ♀
**Saemundssonia limosae* (Denny, 1842) (S)
Limosa lapponica baueri
**Saemundssonia numeniicola* (Johnston and Harrison, 1912)
Numenius phaeopus variegatus
Saemundssonia puellula Timmermann, 1965
Puffinus p. pacificus — ♂, ♀
**Saemundssonia scolopacisphaeopodi* (Schrank, 1803)
Numenius phaeopus variegatus
Saemundssonia sp.
Pterodroma hypoleuca nigripennis — 4 nymphs
Sturnidoecus sturni (Schrank, 1776). Fig. 12.
Sturnus v. vulgaris — many ♂♂, ♀♀, nymphs.
Sturnidoecus sp.
Prosthemadera n. novaeseelandiae — 4 nymphs
Trabeculus fuscoclypeatus (Johnston and Harrison, 1912). Fig. 11.
Pterodroma neglecta — many ♂♂, ♀♀, nymphs.
Trabeculus hexacon (Waterson, 1914) sens. lat.
Puffinus p. pacificus — many ♂♂, ♀♀ nymphs; *Pterodroma hypoleuca nigripennis* – 5 ♂♂, 8 ♀♀. [*Procellaria aequinoctialis*]

SUBORDER ANOPLURA (SIPHUNCULATA)

FAMILY HOPLOPLEURIDAE

Polyplax spinulosa (Burmeister, 1839)
Rattus norvegicus — 6 ♂♂, 7 ♀♀

ORDER DIPTERA

The Kermadecs are free from many of the common groups of biting flies such as sandflies (or blackflies: Simuliidae), biting midges (Ceratopogonidae) and horseflies (Tabanidae).

FAMILY CULICIDAE

Adult mosquitoes bite almost all terrestrial vertebrates, although most species seem to have preferred hosts. The natural hosts of all species occurring originally in New Zealand are probably birds, but several native mosquitoes frequently attack man and introduced

mammals. Some native mosquitoes transmit avian virus diseases. Both species recorded here were known previously from the Kermadecs (Belkin, 1968).

Culex pervigilans Bergroth, 1889

A few larvae were collected from a cattle trough and Tui Lake (Raoul I.) in December, and adults emerged in January. This species is the dominant and most widespread mosquito of the New Zealand area. It can be a serious nocturnal domestic pest on the mainland, but apparently does not readily attack man out of doors. It was not observed feeding on Raoul. According to Belkin, Kermadec specimens (both adults and larvae) differ substantially from New Zealand populations, but material is very limited. Thus it would be desirable to collect more specimens from Raoul.

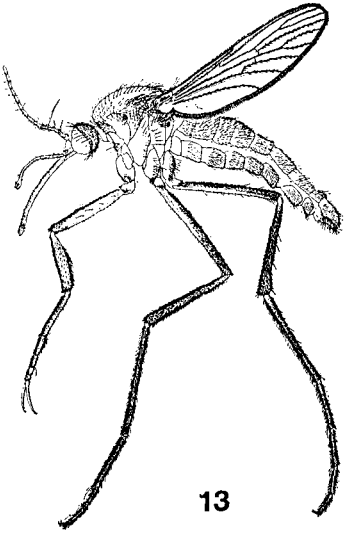


FIGURE 13: *Opifex fuscus*, ♂ (length about 5 mm) (after Belkin, 1968).

Opifex fuscus Hutton, 1902. Fig. 13.

Larvae were common to abundant in saline pools in the splash zone above HWM on Raoul and Meyer Islands. Adults were observed feeding on birds (Kermadec Petrel and Sooty Tern) on Meyer Island, and on man (frequently and painfully) at Fishing Rock and on Meyer Island.

Opifex adults rarely leave the shore, but on two occasions during warm moist nights they came to light in fair numbers at our camp on Low Flat. This species is the common coastal "Saltwater Mosquito" of New Zealand.

FAMILY MUSCIDAE

Stomoxys calcitrans (Linnaeus, 1758)

This species is commonly known as the Biting Fly in New Zealand, and as the Stable Fly in some overseas countries. Larvae breed in decaying vegetable matter of all kinds, including silage and compost heaps. Adults are vicious biters of domestic mammals, particularly cattle (in which they can cause substantial lowering of beef or milk production), and man. They can transmit mechanically various diseases and internal parasites. On Raoul, Biting Flies were common in the vicinity of the farm, on Low Flat and at Denham Bay, and occurred elsewhere in clearings and on the coast. Two were observed (biting) on North Meyer Island. They caused considerable annoyance to both man and cattle. They were also observed biting feral goats, but not birds.

Stomoxys was not observed on Raoul until early in 1965 (A. T. Blake, pers. comm.), and was thought to have been introduced with straw in the crate of a bull taken to Raoul from New Zealand in November, 1963. The crate was taken ashore with the bull in it, and was cleaned out on land before being returned to the ship.

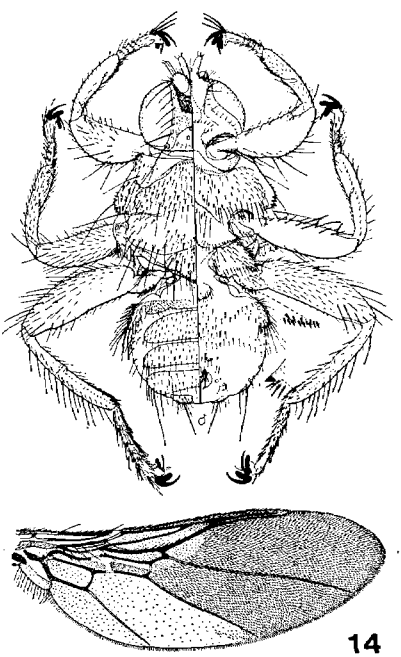


FIGURE 14: *Ornithoica exilis* (length about 3 mm) (after Ferris, 1927). Top left: dorsal view. Top right: ventral view (wings removed in both). Bottom: right wing.

FAMILY HIPPOBOSCIDAE

This family includes flattened leathery flies which parasitise birds or mammals. Females give birth, one at a time, to full-grown larvae which pupate almost immediately in nest material or in a protected place. Previous New Zealand records (cf. Maa, 1969) are *Ornithomyia opposita* Walker, 1849 (on Psittaciformes and Ploceidae), and *Melophagus ovinus* (Linnaeus, 1758) (the Sheep Ked). Other genera and species occur, but need further study.

Ornithoica exilis (Walker, 1861). Fig. 14.

Meyer I., on *Cyanoramphus novaezelandiae cyanurus,* 19 Jan. 1967, D. V. Merton — ♀; Raoul I., 9 Jan. 1967, on *Rattus norvegicus,* C. R. Veitch — ♀.

These are the first records of this species from the New Zealand area. It is widely distributed in the Oriental region, Indonesia, Micronesia, Australia, Solomon Islands, New Hebrides, Loyalty Is., Fiji and Samoa. It has been recorded from many groups of birds, including 11 other genera of parrots, but does not normally parasitise rats, and apparently the specimen on *Rattus* was a straggler. Dr. Maa writes *(in litt.)* that these are unusually small, and one of the southernmost records of *O. exilis.*

ORDER SIPHONAPTERA

Fleas are not normally as specific in their host associations as lice. Their larvae live in debris in nests, regular resting places, etc., and only the adults are parasitic. The life cycle of bird fleas is usually closely correlated with the nesting cycle of the host, but mammal fleas have a less sharply defined breeding season. The known flea fauna of the New Zealand area has been recorded by Smit (1965).

FAMILY RHOPALOPSYLLIDAE

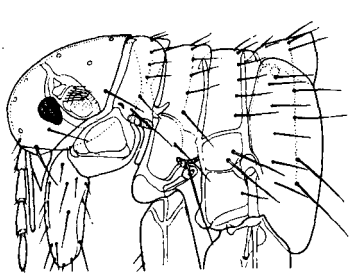
Parapsyllus sp.

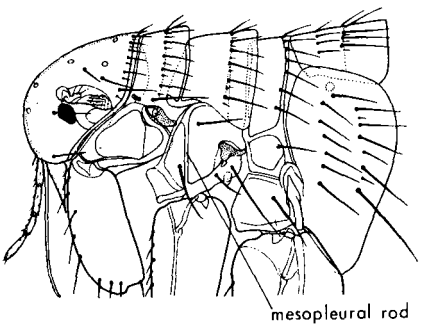
Meyer I., nest of *Puffinus p. pacificus,* 19 Jan. 1967, D. E. Crockett — ♀. Mr. Smit writes *(in litt.)* that this may be an undescribed species, but more specimens are needed for certain identification. Five species of the genus have been recorded in New Zealand (Smit, 1965), their hosts being Procellariiformes, shags, penguins and the Kea.

FAMILY PYGIOPSYLLIDAE

Pygiopsylla hoplia Jordan and Rothschild, 1922

Raoul I., mainly Low Flat area, on *Rattus norvegicus,* Dec. 1966 and Jan. 1967, 25 ♂♂, 22 ♀♀. This flea was erroneously recorded as *P. hilli* by Hilgendorf (1917). Other New Zealand records, chiefly from *R. exulans* (including a Kermadec record) are given by Smit (1965). It is a very common flea in Australia, where its main host appears to be *Peremeles* (bandicoot).





15 16

FIGURE 15: *Pulex irritans* (length 2.6 mm) anterior part of body.

FIGURE 16: *Xenopsylla vexabilis* (length 3.2 mm) anterior part of body (after Dunnet, 1970).

FAMILY PULICIDAE

Pulex irritans Linnaeus, 1758. Fig. 15.

Recorded from "Denham Bay, Raoul Island, 1910 [sic — probably 1908], from sand, W. R. B. Oliver," by Smit (1965). This species, the "Human Flea," was not collected by the O.S.N.Z. Expedition.

Xenopsylla vexabilis Jordan, 1925. Fig. 16.

Raoul Island, from *Rattus norvegicus* (6 ♂♂, 2 ♀♀), Jan. 1967. This species was wrongly recorded as *X. cheopis* (from *R. exulans*) by Hilgendorf (1917). It is an Australian species, which in New Zealand is associated mainly with *Rattus exulans* (Smit, 1965).

HOST AND PARASITE LIST

Information is listed below in the following sequence: scientific name of host, common name of host, number of individuals examined for ectoparasites by the O.S.N.Z. Expedition, Mallophaga; Anoplura; Diptera and Siphonaptera. When no specimens were examined, the records are of Johnston and Harrison (1912), or from the collection made by Sorensen, except for the Kermadec Little (Allied) Shearwater (Edwards, 1961). Records of ectoparasite stragglers are given (in brackets).

BIRDS

PROCELLARIIFORMES

Pterodroma neglecta (Kermadec Petrel) — 5.

Austromenopon sp., *Halipeurus kermadecensis, Trabeculus fuscoclypeatus; Opifex fuscus.*

Pterodroma hypoleuca nigripennis (Black-winged Petrel) — 4.
(*Actornithophilus* sp.) *Ancistrona* sp., *Halipeurus leucophryna, Longimenopon* sp., *Saemundssonia* sp., *Trabeculus hexacon.*

Puffinus p. pacificus (Wedge-tailed Shearwater) — 3.
Ancistrona sp., *Austromenopon* sp., *Halipeurus mirabilis, Naubates harrisoni, Saemundssonia puellula, Trabeculus hexacon; Parapsyllus* sp.

Puffinus assimilis kermadecensis (Kermadec Little Shearwater) — 0.
Halipeurus placodus, Saemundssonia sp., *Trabeculus* sp.

Pelagodroma marina albiclunis (Kermadec Storm Petrel) — 0.
Ancistrona procellariae, Halipeurus pelagicus.

PELECANIFORMES

Phaethon rubricauda roseotincta (Red-tailed Tropic Bird) — 2.
Austromenopon becki, Saemundssonia hexagona.

Sula dactylatra personata (Masked Booby) — 0.
Pectinopygus annulatus.

ANSERIFORMES

Anas s. superciliosa (Grey Duck) — 1.
Anaticola crassicornis, Anatoecus dentatus, Trinoton querquedulae.

GALLIFORMES

Gallus domesticus (Domestic Fowl) — 0.
Menacanthus stramineus, Menopon gallinae.

GRUIFORMES

Porphyrio porphyrio melanotus (Pukeko) — 4.
Rallicola lugens.

CHARADRIIFORMES

Pluvialis dominica fulva (Pacific Golden Plover) — 0.
Actornithophilus timidus, Saemundssonia hawaiiensis.

Numenius phaeopus variegatus (Asiatic Whimbrel) — 1.
Lunaceps phaeopi, Saemundssonia numeniicola, S. scolopacisphaeopodis.

Limosa lapponica baueri (Eastern Bar-tailed Godwit) — 0.
Austromenopon meyeri, Actornithophilus limosae, Carduiceps cingalatus lapponicus, Saemundssonia limosae.

Sterna fuscata (Sooty Tern) — 3.
Quadraceps birostris; Opifex fuscus.

Anous m. minutus (White-capped Noddy) — 3.
Austromenopon atrofulvum, Quadraceps h. hopkinsi.

Gygis alba royana (White Tern) — 1.
(no ectoparasites).

Procelsterna cerulea albivitta (Grey Ternlet) — 3.
Actornithophilus ceruleus, Austromenopon sp., *Quadraceps hopkinsi apophoretus.*

PSITTACIFORMES

Cyanoramphus novaezelandiae cyanurus (Kermadec Parakeet) — 6.
Ornithoica exilis.

CORACIIFORMES

Halcyon sancta vagans (N.Z. Kingfisher) — 2.
Alcedoecus sp.

PASSERIFORMES

Turdus philomelos (Song Thrush) — 1.
Brueelia sp., *Menacanthus* sp., *Philopterus turdi.*

Turdus m. merula (Blackbird) — 2.
Brueelia merulensis, Menacanthus sp.

Prosthemadera n. novaeseelandiae (Tui) — 8.
Brueelia sp. nov., *Menacanthus* sp., *Sturnidoecus* sp.

Sturnus v. vulgaris (Starling) — 18.
Brueelia nebulosa, Menacanthus mutabilis, Sturnidoecus sturni.

MAMMALS

PRIMATES

Homo sapiens (Man).
Opifex fuscus, Stomoxys calcitrans; Pulex irritans.

RODENTIA

Rattus exulans (Polynesian Rat) — 0.
Pygiopsylla hoplia, Xenopsylla vexabilis.

Rattus norvegicus (Norway or Brown Rat) — 5.
Polyplax spinulosa; Pygiopsylla hoplia; Xenopsylla vexabilis; (Ornithoica exilis).

ARTIODACTYLA

Capra hircus (Goat) — 2.
Damalinia caprae; Stomoxys calcitrans.

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THE WEIGHT OF THE KIWI AND ITS EGG

By BRIAN REID
Wildlife Service, Department of Internal Affairs

I. NORTH ISLAND BROWN KIWI *Apteryx australis mantelli*

It is believed widely that this bird lays an egg which, relative to its body size, is the largest known. Furthermore, the egg is stated to equal one-fourth (Romanoff and Romanoff, 1949; Welty, 1962) or even as much as one-third (Fisher and Peterson, 1964) of the adult body weight which is given as 1.8 kg (Van Tyne and Berger 1959; Welty 1962) or 2.0 kg (Romanoff and Romanoff, 1949). Falla (1964) weighed a female that was accidentally killed when on the point of laying. The specimen weighed nearly eight pounds (3.6 kg) but this included a fully developed one-pound (450 g) egg in the lower oviduct. In this particular example the egg was a little over one-seventh of the body weight and Falla cautioned that — " There have been speculative assertions that the egg is roughly one-quarter of the weight of an adult bird without due reference to the age and sex of the adult quoted." Although this example is cited in some more recent literature (Lack, 1968; Johns, 1970), the New Zealand Department of Education still reiterated the traditional view in a 1968 issue of its ' School Journal.'

In his first mention of the size of the brown kiwi and its egg, Lack (1968, p. 208) uses Falla's record (i.e. the egg is 14.3% of 3.2 kg); later (p. 286) he uses the same proportionate size (14.3% or one-seventh) but gives the adult weight as 1.8 kg. Along with age and sex, condition is also an important consideration. A female weighing 3.2 kg is carrying excessive fat while one weighing only 1.8 kg is quite emaciated. Data suggest that while a normal sized egg represents more than 14.3% of the weight of a female in average condition, it falls considerably short of the 25-33% mentioned in some accounts.

Weights of Adult Birds: Data are available from two sources; birds killed in the wild and birds retained in captivity.

Wild Birds: Seventy-one specimens sent to the Dominion Museum since 1958 include 54 adults (32 females, 22 males) that were weighed on arrival. The 22 males varied in weight from 1020 to 2590 (mean 1680) g. and the 32 females weighed from 1180 to 3270 (mean 2125) g. Many of these had either bled or starved to death in opossum traps. If emaciated or injured adults are excluded the sample decreases to 13 males with weights varying from 1820 to 2590 (mean 2080) g; and 21 females with weights ranging from 2090 to 3270 (mean 2490) g.

Captive Birds: Between August 1965 and December 1970, 27 of 42 birds held at Mt. Bruce were weighed on arrival; and more than 400 subsequent weighings provide additional information on 19 birds. Many weights record growth or performance of young or sick birds for, of the 42 kiwis held, 18 were either chicks or juveniles and more than half of the adults were injured. Only four (three females. one male) of the adults that were weighed several times (Table 1) were considered to be in good health.

Fairly broad fluctuations occurring in their weights coincided with periods of heavy or light feeding and are regarded as normal.

Weight records for both wild and captive adult kiwis in good condition show females average about 2490g (5 lb 8 oz) and males about 2080g. (4 lb 9 oz).

Egg Size and Weight: Data from two eggs of typical shape (elliptical, with blunt ends) permit calculations of weight for other eggs when the primary dimensions alone are known.

One egg, removed from the oviduct of an injured wild bird that died in captivity, measured 125.4 by 78.6 mm. and weighed 434.6g. The dry shell weighed 22.9g and had an internal volume of 400 ml., and the specific gravity of the mixed contents was 1.029.

The second egg was infertile, had been incubated for 30 days and weighed only 323.4g. The shell measured 121.0 by 71.7 mm., enclosed an internal volume of 323.5 ml. and, when dried, weighed 21.7g. The weight of this egg at laying can be determined by multiplying its internal volume by the relative density of fresh mixed contents and then adding the shell weight, i.e. $323.5 \times 1.029 + 21.7 = 354.6$g.

If the specific gravity of the fresh contents of kiwi eggs is assumed to be constant then, from the weights and measurements of these two eggs, it seems that the fresh weight of a typical egg may be fairly accurately determined from the expression:

$$W = 0.565\ ab^2$$

where a is the length and b is the maximum transverse diameter of the shell.

In both examples the error from this formula is less than one percent, (Table 2) and when the formula was used to determine the fresh weights of 15 measured eggs the following weights were obtained (Table 3).

Two eggs in this series (Nos. 13 and 14), from the Dominion Museum collection, were weighed by F. C. Kinsky. Number 13 weighed 470g., and number 14 weighed 465g. The first was 32g. and the second was 40g. below their calculated weights but both contained chicks — a featherless embryo in number 13 and a half-grown chick in number 14.

Egg Weight and Body Weight: Two females that weighed 3.25 kg (approximately the same weight as the bird discussed by Falla) were of average size but very fat. One of these birds fluctuated considerably and temporarily dropped to 2.15 kg after a fairly long period of light feeding. Fasting by kiwis in captivity is not unusual and this bird remained in good health. Its weight increased when it reverted to a greater food intake but a few months later this kiwi slowly declined and, at death, weighed 1.52 kg.

Body weight is very variable. While it may indicate real differences in overall size between different individuals, it frequently merely emphasises the condition of the bird and/or the fullness of its gut. In any comparison of egg size to body size, the condition, as well as the age and sex of the bird must be taken into account. Whereas an average-sized egg would weigh 28% of this kiwi's terminal weight, it would weigh only 13% of her maximum, very fat, weight.

Table 1. Weights of Healthy Birds in Good Condition at Mt. Bruce

Sex	Numer of Weighings	Weight in Grams Range	Mean
F	12	2130 - 3270	2610
F	3	2190 - 2580	2420
F	16	2210 - 2630	2440
M	6	1850 - 2180	2030

Table 2. Actual and Calculated Weights for Two Measured Eggs.

Egg	Weights (g) Actual	$.565ab^2$	Difference grams	percent
1	434.6	437.7	3.1	+0.71
2	354.6	351.5	.3.1	-0.87

Table 3. Calculated Fresh Weights of 15 A.australis Eggs.

No.	Dimensions (mm)	Weight $.565ab^2$	No.	Dimensions (mm)	Weight $.565ab^2$
1	116.0 x 71.0	330.5	9	122.0 x 81.0	452.0
2	121.0 x 71.7	351.5	10	119.5 x 82.5	459.5
3	127.7 x 73.7	392.0	11	130.4 x 79.0	460.0
4	125.0 x 75.0	397.0	12	127.0 x 83.3	498.0
5	120.5 x 76.5	398.5	13	129.3 x 82.9	502.0
6	123.1 x 77.8	421.0	14	129.6 x 83.1	505.5
7	126.0 x 77.5	427.5	15	135.0 x 82.5	519.0
8	125.4 x 78.6	437.5	*Mean*	125.2 x 78.4	434.8

Table 4. Measurements and Weights of A. oweni Eggs.

Dom.Mus. Number	Measurements (mm)	Internal Volume (ml)	Shell Weight (g)	Fresh Weight $.565ab^2$
6703	108.4 x 71.2	283.9	18.3	310.5
6704	109.5 x 70.9	283.1	19.2	311.0
6705	112.5 x 69.6	282.8	16.9	307.9

Table 5. Egg Weight and Body Weight, A.australis and A. oweni

	A.australis min.	max.	mean	A.oweni min.	max.	mean
Egg Weight	330	519	435	275	368	310
Female Weight	2090	3270	2490	1035	1345	1220
Male Weight	1820	2590	2080	815	1135	1000
Egg as % of:						
Female Weight	15.8	15.9	17.5	26.6	27.4	25.4
Male Weight	18.1	20.0	20.9	33.7	32.4	31.0
M as % of F	87.0	79.2	83.5	78.7	84.3	82.0

An average sized egg, it seems, weighs 435g (15¼ oz) while an average adult female weighs 2490 g (5 lb 8 oz) and an average adult male weighs 2080 g (4 lb 9 oz). Whereas the egg is approximately one-fifth (21%) of the male body weight, it is only one-sixth (17.5%) of the female body weight.

Information supplied recently by the National Zoological Park, Washington, supports this size relationship. A bird laid five eggs between August and December 1969. Three eggs were weighed and averaged 404 g (range: 400-407 g). Seven weighings of this female over an 11-month period gave her a mean weight of 2430 g (range: 2270-2490 g). This bird laid eggs that weighed about 17% of her body weight.

II. LITTLE GREY KIWI *Apteryx oweni*

Weights of Adult Birds: Weights are known for three birds. A male collected from the Rough River, Westland, in 1952, weighed 910 g; and a pair of birds transferred from Kapiti Island to Mt. Bruce in October 1969 are weighed every two weeks. Both birds have kept good health and the weight of the male, which was 910 g at capture, has varied from 815 to 1135 g (mean: 1000 g or 2 lb 3¼ oz) during his first 15 month at the Reserve. The female, who weighed 1305 g at capture, has since varied between 1035 and 1345 g (mean: 1220 g or 2 lb 11 oz).

Egg Size and Weight: The internal volumes of three typical shells from the Dominion Museum collection were obtained by filling these with water and their fresh weights calculated from the expression: $W = 0.565\ ab^2$ (Table 4).

Measurements and calculated fresh weights for nine eggs ranged from 105.4 x 68.0 mm (275 g) to 113.0 x 76.0 mm (369 g) and the mean dimensions of 108.6 x 71.1 mm give a calculated mean weight for the egg of the Little Grey Kiwi of 310 g (11 oz) which is about one-fourth (25.4%) of the mean weight of an adult female at Mt. Bruce.

DISCUSSION

Throughout the various families of birds, smaller species generally have proportionately larger eggs than do their bigger relations. Kiwis are in accord — *A. australis* lays an egg that is equivalent to 17.5 percent of the female body weight and *A. oweni*, which is only half the size, lays an egg that is equivalent to about 25 percent of the mean weight of an average sized female.

Data for both species is summarised in Table 5.

Data compiled by Lack (1968) show several birds weighing less than 400 g. lay eggs which, relative to their body size, equal or are proportionately larger than the egg of the 2500 g brown kiwi. A few species even have an egg:adult weight ratio comparable with that of the 1200 g. Little Grey Kiwi. These latter include some of the *smallest* procellariiformes (storm-petrels) and *smallest* terns weighing less than 100 g., some sandpipers weighing less than 75 g, and the 400 g crab plover *(Dromas)*.

No other birds of similar weight (i.e. between 1000 - 3000 g) lay eggs as large as the kiwis. Those Megapodiidae and Procellariiformes that occur within this size range come closest with eggs

weighing between 10 and 14% of their body weight. Next come the Cracidae (Curassows) with eggs weighing from 7 to 10%, then the Laridae (gulls and terns) with eggs weighing between 6 and 9% of the adult weight.

All Apterygiformes (Kiwis) lay exceptionally large eggs but only a few of the smallest-sized Procellariiformes and Charadriiformes lay eggs that are of comparable relative proportions.

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SHORT NOTE

A SANDERLING AT OPOUTERE

While checking waders on 8/1/71 at Opoutere, on the East Coast at the base of the Coromandel Peninsula, my husband and I found a Sanderling *Calidris alba,* feeding near a flock of Banded Dotterels *Charadrius bicinctus.* The bird was racing back and forth at the crest of the steep ocean beach and pecking rapidly along the line of weed thrown up by the rolling surf. Twice it was seen to run on the same spot, apparently using its feet to disturb sand-hoppers and small flies, and once to run down towards the water. It had a tip-toed look, no doubt because this species lacks a hind toe and moved at an accelerated pace when compared with the run-and-stop action of the Banded Dotterels. This bird was part way into breeding plumage with a brownish tone starting to show on the pale grey back. The dark shoulder patch was well marked and there was some brownish mottling descending from the shoulder area onto the breast. Underparts were white as was the face, particularly around the bill, with a few brownish feathers on the cheeks. The straight black bill and black legs were noted and the bird was put up. If it called we did not hear it over the roar of the surf but a short flight showed its strong white wing-bar and white sided dark tail.

A Sanderling seen at Taramaire, Firth of Thames, by South Auckland members on 11/4/70 was very well coloured with scaly patterned back, well spotted breast and "roughed" cheeks but retained the white ring around the bill. Another seen at Rangiputa Bank, Rangaunu Harbour, on 16/1/71, during the Far North Field Study Course, was completely pale and a perfect example of a bird in eclipse plumage. This bird, in calm conditions, fed at the edge of and just into the water and it was of great interest to me to see that this bird also ran about on the same spot, as the Opoutere bird had done.

— BETH BROWN

COMPOSITION OF A KIWI EGG

By BRIAN REID
Wildlife Service, Department of Internal Affairs

A fresh egg of the North Island Kiwi *Apteryx australis mantelli* that had not lost any water through evaporation weighed 434.6g. The dry shell weighed 22.9 g. or 5.3% of the total weight. The contents were separated, dried at 50-60°C. in a hot air electric steriliser until no further weight loss occurred, and the following data obtained (Table 1). These data, when compared with similar data from eggs of other species, further enhance the achievement of the Kiwi if this particular egg is accepted as typical. Its egg is not only proportionately larger than the eggs of most other birds; it also contains proportionately more yolk and less water than other eggs (Table 2).

Differences in the relative and in the total amounts of organic substances in eggs of various species are determined mainly by the proportion of yolk to albumen in the eggs; and by the water content of these components. On a dry weight basis the chemical composition of the components of most eggs is fairly similar — yolk contains about 31% protein, 65% fat and 2% carbohydrate; while albumen is about 86% protein and 8% carbohydrate (Romanoff and Romanoff, 1949). If it is assumed that the Kiwi egg is no exception and conforms by having a similar water-free composition, then it has the highest gross energy value per unit fresh weight of any egg for which dry weight determinations have been made (Table 3).

The gross energy values were obtained by multiplying the protein and carbohydrates by 4.1 and the fat by 9.2 (see footnote). Calculations suggest that eggs laid by most altricial species (that hatch naked, blind, helpless young) have an energy value of between 1.0 - 1.2 cal/g. while eggs of most precocial special (that hatch alert, mobile, down-covered chicks) contain between 1.7 - 1.9 cal/g. The one kiwi egg that was dried had an energy value estimated at approximately 2.7 cal/g.

The 29 kg (64 lb) female Emperor Penguin and the 2.5 kg (5.5 lb) Kiwi lay eggs of comparable size but the Kiwi egg contains proportionately more yolk (Table 4) and has an estimated energy value of about 1100 calories. The energy in the Emperor egg is calculated (from dry weight data for Adelie penguin eggs, Reid 1965) at about 600 calories. Certain differences in the development and growth of these two species are thought to be influenced by the different yolk (and energy) levels in their respective eggs:—

(a) Incubation time for the Kiwi is approximately 15 days longer; 76 compared with 61 days. (Some Emperor eggs take 66 days to hatch but the shortest period is considered the real incubation time and any extension is thought to result from periods of chilling, etc. In this respect the interval between minimum and

Footnote: When burned in oxygen in a Bomb Calorimeter carbohydrates produce 4.1 cal/g and fats produce 9.3 cal/g. Proteins yield 5.6 cal/g to the bomb but only 4.1 cal/g if burned only to the extent that relatively harmless substances (urea and uric acid) found in animals are produced.

Table 1. Fresh and Dry Weights of the Contents of a 434.6g Kiwi Egg.

	Yolk	Albumen	Total
Fresh Weight (g)	251.4	160.3	411.7
Dry Weight (g)	142.5	19.4	161.9
Water (g)	108.9	140.9	249.8
Percent Water	43.3	87.9	60.7

Table 2. Yolk, Albumen and Water Content of Eggs.

Species	% Composition Yolk	% Composition Albumen	Water Content (%) Yolk	Water Content (%) Albumen	% Composition Water	% Composition Solids
Kiwi (1 Egg)	61.1	38.9	43.3	87.9	60.7	39.3
12* max.	44.6	63.6	51.8	87.9	73.6	26.4
Precocial min.	36.4	55.4	43.3	86.5	69.7	30.3
Species mean	40.0	60.0	48.2	86.8	71.4	28.6
19* max.	28.1	86.8	58.0	90.2	83.3	22.6
Altricial min.	13.2	71.9	55.7	89.0	77.4	16.7
Species mean	21.3	78.7	57.1	89.5	80.9	19.1

* Mainly from Romanoff and Romanoff, 1949.

Table 3. Inferred Approximate Organic Composition and Calculated Energy in Kiwi and in 'Average' Precocial and Altricial Eggs.

Species	Percent Solids Total	Yolk	Albumen	Approx. Composition Prot.	Fat	Carb.	Calc. Energy Cal/g.
Kiwi	39.3	34.6	4.7	14.7	22.5	1.1	2.7
Precocial	28.6	20.7	7.9	13.2	13.6	1.0	1.8
Altricial	19.1	10.0	9.1	10.9	6.6	0.9	1.1

Table 4. Comparison of the Contents (in grams) in an 'Average' Kiwi and Emperor Penguin Egg.

	Total	Shell	Albumen	Yolk	Contents
Kiwi	435	27	159	249	408
Emperor*	470	74	276	120	396

* Prevost, 1961.

maximum incubation time generally seems to be greater in those species breeding in cold or wet environments. The wide range in incubation time for the Emperor probably reflects the adaptive capacity of the embryo to survive sub-optimum conditions which would prove lethal to some species but merely retards the rate of development in others).

(b) The Emperor chick emerges covered with down but the Kiwi embryo grows feathers and these are retained throughout its first year.

(c) To survive, Emperor chicks must be fed within two or three days of hatching but Kiwi chicks remain in their burrow and do not feed until about six days old. It is thought that some may fast during the first 10 or 12 days after hatching (Robson 1958) without apparent ill effect. A Kiwi chick killed outside its burrow (and, therefore, thought to be at least six days old) weighed 281g. and this weight included 54g. of enclosed yolk.

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SHORT NOTE

A WRYBILL IN CENTRAL OTAGO

In October, 1965, while assisting members of the Wildlife Service in their census of birds of the upper Waitaki River catchment, it came as a surprise to me to find a few Wrybill *Anarhynchus frontalis* as far south as the Ahuriri riverbed near Omarama. I noted that their breeding habitat requires extensive areas of uncluttered shingle, and so it occurred to me at the time that perhaps a few stragglers could also be found on the larger shingly riverbeds of Central Otago. For the past four years I have been conducting a census of those areas in late spring, without however recording any Wrybills. Perhaps the most likely riverbed (being closest in direct line to the Ahuriri) was the Hunter, above Lake Hawea, but about eight miles of the broadest shingle stretches were flooded by the raising of the lake level in 1959 by some 60 feet for hydro-electric storage. My survey of this riverbed above the new lake level, conducted on 11 and 12/9/69, revealed no Wrybills. Perhaps I was too early.

On 2/9/69, while searching for a Spur-winged Plover's nest near the mouth of the Matukituki River, west Lake Wanaka, I spotted a single Wrybill about ¾ mile above the mouth. It was busily feeding among brownish algal-covered stones beside the river, and among a scattered flock of 23 Black-billed Gulls and 4 Banded Dotterels. The Wrybill was in breeding plumage and was occasionally harassed by one of the gulls so that it tended to keep very much to itself. Not wishing to disturb it I did not approach closer than about 20 yards so did not establish its sex, although from the sharp delineation and blackness of the pectoral band I should say it was a male.

— PETER CHILD

THE IDENTITY OF NEW ZEALAND'S CANADA GEESE

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ABSTRACT

Canada Geese **Branta canadensis** became established in New Zealand following the introduction of 50 from central or eastern U.S.A. in 1905. In 1920 ten more were brought from western Canada. Examination of plumage, weights and measurements of the present population shows that it belongs predominantly to the giant race **B. c. maxima** *Delacour*. There is a possibility that **B. c. canadensis** interbred to a limited extent with it. Behaviourally and ecologically **maxima** appears very well suited to the South Island habitats in which it multiplied quickly.

The first successful introduction of Canada geese *Branta canadensis* into New Zealand was in 1905, when 50 were introduced by the Government from the U.S.A. (N.Z. Department of Tourist and Health Resorts 1905, Thomson 1922, Donne 1924, Delacour 1954). The only other successful introduction (that is, the birds bred in captivity and their offspring were liberated) was by the North Canterbury Acclimatisation Society, in 1920, of 10 from Vancouver, Canada (North Canterbury A.S. 1920, Delacour 1954). Although a few of the 1905 geese went to game farms in the North Island, it was only in the South Island that they established themselves in the wild. The South Island populations originated from less than 43 birds, for many died in captivity without breeding (Annual Reports of Acclimatisations Societies 1905-25). Regarding the genetic contribution to present populations of the geese imported in 1920, we should note that:—

(a) the 1905 birds had established flocks of up to three hundred in several places throughout their present range before birds from the later importation were liberated (North Canterbury A.S. 1921, 1922, Otago A.S. 1922); and that

(b) 6 of the 10 Vancouver birds were released on private waters well away from the breeding areas in the wild (North Canterbury A.S. 1921).

Thus it is probable that the genetic contribution of this later introduction was small.

At the time of the introductions only five subspecies were recognised (Kortright 1942) and those brought to New Zealand were undoubtedly *B. c. canadensis,* the common Canada goose as then known. But since then 7 more subspecies have been described (Delacour 1954) of which 3 have been separated from the original *canadensis.* Thus the breeding range of modern *canadensis* is but a small part of that original range, quite apart from reductions caused by exploitation and habitat alteration. Furthermore, the identity of our geese has become a matter for speculation.

The 1905 shipment was purchased by T. E. Donne of the Tourist and Health Resorts Department, on behalf of the New Zealand Government (Donne 1924). Donne went to the U.S.A. as Commissioner General for New Zealand at the Louisiana Purchase Exposition in St. Louis, Missouri, and to take delivery of wapiti or elk *Cervus canadensis* made available by President Roosevelt. In addition to these Donne procured a varied assemblage of game birds

and deer, including 50 Canada geese. Examination of Donne's book and Departmental files has not revealed reliable information about where the geese were bought. It is likely that they were obtained in central or eastern U.S.A. from a game dealer because Donne made enquiries about purchasing game during his stay in St. Louis; he made some purchases in Massachusetts and New Hampshire; and the whole collection was assembled at the Zoological Gardens in Washington D.C. before transportation. Nothing is known of the origin of the 1920 importation from Vancouver. Even so, the place of origin may well be misleading since C. Edward Carlson (pers. comm.) points out that " there was considerable traffic in live Canada geese back in 1904 for hunting decoys and other purposes, and it is quite possible that examples of other subspecies could have been included in the lot sent to New Zealand."

Donne (1924) records buying Canada, Snow and Hutchins Geese but does not mention the seller. The name Hutchins Goose then referred to a medium-sized race of the Canada Goose now called the Lesser Canada goose, *B. c. parvipes* (Kortright 1942). But the annual report of the Department of Tourist and Health Resorts (1905) does not record either Snow or Hutchins Geese in the consignment; instead 2 Brant Geese *Branta bernicla* and 4 White-fronted Geese *Anser albifrons* are listed. As far as can be ascertained from the annual reports of Acclimatisation Societies only Canada Geese bred and only they were liberated.

A prominent ornithologist and officer of the North Canterbury Acclimatisation Society, E. F. Stead, has indicated that races of different size were liberated here (Delacour 1954: 157). Unfortunately he gave no further details but Delacour suggested that the smaller race may have been *B. c. taverneri.*

To identify the geese in New Zealand I have compared their dimensions and plumage with descriptions of present North American races. Direct comparisons of live birds by the U.S. Fish and Wildlife Service at Jamestown, North Dakota, have helped to clarify the situation.

RESULTS

Between 1967 and 1970 Wildlife Service staff collected data from various places in Canterbury, and at various times of the year, on weights and dimensions and plumage of Canada Geese. The best opportunities for collecting data were during the annual banding operations at Lakes Ellesmere and Forsyth in January when geese are moulting. Hence there is an excess of data for this season but a scarcity for the winter particularly. In addition, many hunters in Canterbury weighed a large number of geese during the special shooting season around Lake Ellesmere (January to March). Because of the changing (increasing) weight of geese during this special season, comparisons with North American data would have had doubtful value.

Weights

Geese are at their lowest weight during the non-flying period of the post-breeding moult, and are heaviest in winter. The comparisons at both these times (Tables 1 and 2) show that New Zealand geese come within the range of weights of the Giant Canada Goose, *B. c. maxima.*

TABLE 1: A comparison of the weights of non-flying, moulting Canada geese in North America and New Zealand. North American data from Hanson (1965, pp. 22-23). According to Hanson, *Branta canadensis interior* is the next largest subspecies to *B. c. maxima*.

Subspecies	Locality	Season	Adult Weight (gms.) Males			Females		
			No.	Mean	SD*	No.	Mean	SD
maxima	Missouri, U.S.A.	July '63	55	4626	-	74	3830	-
"	L.Forsyth, N.Z.	Jan. '69	24	4360	319	24	3625	322
"	S. Dakota, U.S.A.	July '63	20	4135	-	17	3579	-
"	L.Forsyth, N.Z.	Jan. '70	58	4078	268	45	3320	235
interior	Akimiski, CANADA	July-Aug.	45	3946	-	30	3349	-

* Standard deviation.

TABLE 2: A comparison of wintering weights of Canada geese in North America and New Zealand. North American data from Hanson (1965, pp. 20-21) and from Elder (1946, p. 96).

Subspecies	Locality	Winter Weight of Males (gms.) Adults			Yearlings			Juveniles		
		No.	Mean	SD	No.	Mean	SD	No.	Mean	SD
maxima*	Round Lake, U.S.A.	7	6525	893	-	-	-	9	5963	747
" *	Ohio, U.S.A.	8	6132	587	-	-	-	-	-	-
"	Canterbury, N.Z.	15	5154	572	7	4808	332	6	4613	486
" *	Rochester, U.S.A.	13	4884	354	11	4411	212	20	4261	418
moffitti*	Utah, U.S.A.	3	4093	290	1	4275	-	-	-	-
interior*	Illinois, U.S.A.	31	4069	304	7	3960	249	37	3615	318
" +	"	41	4055	281	with adults			91	3547	349

		Winter Weight of Females (gms.) Adults			Yearlings			Juveniles		
		No.	Mean	SD	No.	Mean	SD	No.	Mean	SD
maxima*	Round Lake, U.S.A.	13	5514	598	-	-	-	3	5245	694
" *	Ohio, U.S.A.	5	5387	845	-	-	-	-	-	-
"	Canterbury, N.Z.	14	4489	327	3	4233	160	11	4103	304
" *	Rochester, U.S.A.	7	3868	267	11	3690	247	15	3821	315
moffitti*	Utah, U.S.A.	-	-	-	-	-	-	1	3080	-
interior*	Illinois, U.S.A.	10	3561	268	4	3466	313	35	3071	249
" +	"	40	3280	399	with adults			77	3074	290

* Hanson

\+ Elder

It would appear that the moulting *B. c. interior* weighed by Hanson (1965: 22) were unusually heavy, for their mean weights are hardly less than wintering weights of this race (compare Tables 1 and 2).

TABLE 3: A comparison of exposed culmen lengths of the larger races of Canada geese in North America with those of New Zealand specimens. North American data from Hanson (1965, p. 32). All data are for adults and yearlings combined.

Subspecies	Source	Exposed culmen (mm.)					
		Males			Females		
		No.	Mean	SD	No.	Mean	SD
maxima	U.S. Museums	16	60.0	1.4	5	56.8	2.5
"	South Dakota	13	58.6	2.9	8	53.5	1.7
"	N.Z.	39	56.5	2.1	32	52.6	1.9
moffitti	U.S. Museums	14	54.6	2.1	10	51.6	2.5
canadensis	"	15	56.1	3.1	11	51.0	2.8
interior	Illinois	110	53.7	2.8	92	49.8	2.4

TABLE 4: A comparison of mid-toe plus claw lengths of the larger races of Canada geese in North America with those of New Zealand specimens. North American data from Hanson (1965, p. 35).

Subspecies	Source	Mid-toe plus claw (mm.)					
		(a) in Immatures					
		Males			Females		
		No.	Mean	SD	No.	Mean	SD
maxima	Illinois	14	110.8	9.4	22	100.3	4.0
"	New Zealand	9	99.8	5.2	10	91.9	3.7
"	Manitoba	21	97.5	3.5	8	92.0	3.7
interior	Illinois	15	92.8	4.5	11	87.9	3.3
		(b) in Adults and Yearlings					
		Males			Females		
		No.	Mean	SD	No.	Mean	SD
maxima	U.S. Museums	12	98.3	5.0	5	92.4	6.8
"	New Zealand	72	98.1	3.6	89	91.4	4.4
moffitti	U.S. Museums	8	94.6	3.9	-	-	-
canadensis	"	7	90.1	3.1	3	87.3	0.2

The heaviest weight taken during this study has not been included in Table 2 because this adult male was held in captivity. It weighed 7122 gms. (15.7 lbs). Judging by all weights taken during this study, 14 lbs (6350 gms) is the normal limit in the wild and is attained by some adult males during winter.

Dimensions

Tables 3 and 4 compare measurements of exposed culmen and mid-toe and claw. Length of bill (exposed culmen) is just below that range reported by Hanson (1965) for several populations of *maxima* but the length of mid-toe and claw is within the range of *maxima.*

Variation in Weights and Dimensions

As *maxima* is the largest race, interbreeding can only be with races of smaller size. If interbreeding of races had happened on a large scale one would expect that the degree of variation in dimensions and weights in the interbred population would exceed that in the pure races. Casual observers have suggested that the size of our geese is so variable that much interbreeding seems likely to have occurred. However, natural variation due to age, sex and condition can result in some birds among healthy geese being simultaneously twice as heavy as others.

In Tables 1 to 4, the standard deviation (SD) of each mean is listed where available. It is a measure of the extent of variation in the sample. Comparison of these reveals that the variation in

FIGURE 1 — Adult male Giant Canada Goose *Branta canadensis maxima* at Lake Ellesmere, New Zealand, January 1970. Note the pale breast and dark mantle; the forehead patch and shape of the posterior edge of the cheek patch, characters found in some members of this race; and the metacarpal spur on the wing, most prominent in adult males.

New Zealand geese, at least in these dimensions, does not exceed that in the larger races in their native land. All the populations of *maxima* for which Hanson presents data, and the New Zealand population, tend to have greater variation than other races cited.

Plumage

These geese are light-breasted; in a few the entire under surface of the body is pearly white.

TABLE 5

The occurrence of some plumage characters in 87 adult Canada geese examined at Lakes Forsyth and Ellesmere in January 1970 (moulting).

Plumage character	*Occurrence percent*
White feathers on the forehead	6
Upper posterior part of white cheek patch having a backwards extension	47
More or less white feathers in a ring round base of black neck	9
Upper back (mantle) behind black neck pale like upper breast	3

Four other characters in the plumage were of particular interest. Their occurrence in our geese is tabulated (Table 5). Hanson (1965) found that forehead spotting (Figure 1) is frequently found in populations of *maxima,* but may be absent; it is " quite rare " in other subspecies. Of the shape of the cheek patches Hanson states " . . . the presence of a small, often hooklike, extension near the top of the posterior margin of the cheek patches may be regarded as an excellent indicator of a *maxima* population " (1965: 37). This character is common in our geese (Figure 1).

However, white neck rings are hardly noticeable in New Zealand geese. Delacour (1951, 1954), describing *maxima,* writes that " a white ring at the base of neck is often present " and Hanson (1965) agrees. Some of our geese do have white or partly-white feathers at the base of the black. But few occur on each bird and there is little contrast with adjacent cream-coloured feathers so that a neck ring is practically never visible in the wild. I was very surprised, however, to find that two specimens made into study skins at the Dominion Museum clearly showed white neck rings that had not been apparent in the natural state. The contraction of the neck in preparation of the skin had brought the white feathers together to make the ring visible.

As the subspecies in New Zealand has been, until now, called *B. c. canadensis* (Fleming 1953, Imber and Williams 1968), we examined the colour of the upper back which in *canadensis* is the same as the upper breast. Only 3 percent had this cream colour right over the upper back, the others being buffy brown as on the back.

Colouration of the Goslings

It is noticeable in a few newly-hatched families that some goslings are almost uniformly pale yellow on the face whereas others are darker around the eye and on the crown, and are generally more olive-green. The paler goslings markedly predominate, and these

agree with descriptions of *maxima* (and *moffitti*) goslings given by Delacour (1954). Darker goslings may be related to *B. c. canadensis.*

DISCUSSION

Plumage characters, weights and measurements indicate that the New Zealand populations are predominantly Giant Canada Geese. It appears that there has been some interbreeding with a slightly smaller subspecies, probably the Atlantic Canada Goose *B. c. canadensis.* These are subspeciies very likely to have been obtained by Donne in 1904-5. The range of *maxima* in the wild once included Missouri, and this is the race that breeds in the centre of North America east of the Rocky Mountains (Hanson 1965). Donne may also have obtained geese from a game dealer in Massachusetts which is within the range of *B. c. canadensis.*

The geese that came from Vancouver are a mystery. E. F. Stead has apparently suggested that these were smaller birds (Delacour 1954: 157). They may have been western Canada geese *B. c. moffitti* which, being nearly identical in colour with *maxima* but slightly smaller, would by now have lost their identity through interbreeding.

Nevertheless, although having some slightly smaller dimensions such as bill length, New Zealand geese are almost identical with Giant Canada Geese in North America as described by Hanson.

This has recently been confirmed. T. A. Caithness (New Zealand Wildlife Service) visited the Northern Prairie Wildlife Research Center of the U.S. Fish and Wildlife Service in Jamestown, North Dakota, in 1969. Biologists at the Center expressed interest in the geese in New Zealand and suggested direct comparisons be made. Accordingly, eggs were collected from Lake Forsyth and from the Waimakariri river headwaters and sent to Jamestown the same year. Six goslings were hatched and their development was compared, under similar conditions, with that of the Center's own Giant Canada goslings. Harvey K. Nelson, Director of the Center, has informed us as follows (letter of 6 April 1970): "Generally speaking the New Zealand goslings have exhibited characteristics very similar to other Giant Canadas in all the comparisons that we have made to date." Growth in length of the tarsi was nearly identical, as was the age at full development of the primaries and age at commencement of the first body moult. At 13 weeks of age the New Zealand goslings were heavier by about 300 grammes. Their weight then was just below winter weights of juveniles here, shown in Table 2.

Furthermore, H. C. Hanson has identified as *maxima* several geese taken at random from Lake Ellesmere and photographed by C. F. Yocom (Yocom 1970).

When we consider some of the characteristics of the Giant Canada Goose, it is not so surprising that it became established so quickly in the South Island.

It is not a highly migratory subspecies and some populations are sedentary. There is little scope or need for migration in New Zealand. "It readily accepts the proximity and protection of man" (Hanson 1965) and thus will breed in captivity given suitable conditions. The popular method of acclimatising these and other birds at the time was to breed in captivity, liberating the progeny. About half the geese imported and kept in captivity for several years bred within 3 or 4 years (Imber in prep.). Referring to *interior* and

canadensis, Dawson (1968) states that " even when captured and kept in captivity for long periods, these wild migrants frequently refuse to take family-rearing responsibilities seriously, and fail to nest."

But most important in their establishment was the type of habitat to which they were introduced in New Zealand. In North America, in Hanson's words (1965: 43), " with minor exceptions, its primary range has been confined to the tall-grass and mixed prairie areas with their lake and marsh complexes . . ." This habitat (biome) closely resembles the South Island's tussock grasslands (tall-tussock and short-tussock) which lie to the east of the Southern Alps as the prairies lie to the east of the Rocky Mountains. Into this grassland habitat, with its multitude of large and small lakes and associated marshes, these geese were liberated. For Giant Canada Geese the South Island's tussock grasslands are probably the next best place to home.

New Zealand's climate is mainly temperate (Robertson 1960) whereas that of the North American prairies is continental. However, Hanson (1965: 198) observes that " no other subspecies of wild goose in North America nests over so large an area or one which includes such a diversity of habitats and climates." The majority of South Island breeding grounds have the mean January temperature about 63°F (17°C) and about 110 frost-free days per year. These are at the low end of the range reported by Hanson (his Table 28) for breeding localities in North America but winters here are correspondingly milder.

The Giant Canada Goose was thought to be extinct for many years (Delacour 1951, 1954) but was re-discovered in 1962 in Minnesota. Hanson determined that there were about 55,000 wild birds in North America in 1963, and up to 14,000 in private collections (1965: 204). The present New Zealand populations are estimated to have a combined annual peak between 15,000 and 20,000 birds (Imber and Bucknell in prep.). Thus New Zealand populations represent a fair proportion of the total numbers of the biggest wild goose.

ACKNOWLEDGEMENTS

I wish to thank the many goose hunters who have sent in information on weights of geese; the North Canterbury Acclimatisation Society and officers of the Wildlife Service who have assisted in field operations; the Northern Prairie Wildlife Research Centre and Harvey K. Nelson for giving us full information about the eggs sent there; T. A. Caithness and E. S. Bucknell for assistance in the egg operation and in other ways; W. J. Pengelly for collecting much winter data; and Drs. G. R. Williams, J. A. D. Flack and J. A. Mills for criticism of the manuscript.

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SHORT NOTE

DOLLAR-BIRD NEAR DARGAVILLE

A Dollar Bird or Broad-billed Roller *Eurystomus orientalis* was on or around Mr. Clive Wood's farm in Waihue Valley, nine miles north of Dargaville, from 3rd to 16th May 1971. Mr. and Mrs. Wood watched it periodically during its stay; on 6th May I spent two periods totalling three hours closely observing the bird with 10 x 50 binoculars and a x 30 telescope at ranges down to 30 feet, in good light.

The farm on which the Dollar Bird was observed is pasture land with totara trees singly or in clumps. The bird was first sighted perched on a gatepost and some days later was noticed by passers-by on a fence-post not far away. Its usual feeding perches were the "cups" on the crossbars of power and telephone poles close to the homestead. For the first few days it used these high perches regularly from about 1000 - 1400 hours and again from 1600 - 1800 hours, by which latter time it was nearly dark. Heavy rain which fell one day made no difference to the bird's routine. After some days the duration of its visits decreased but it still came twice daily. Its habit was to sit motionless for periods of 5 - 15 minutes; at intervals it flew, first sideways and downwards, then round in a wide arc of 90 - 100 feet ending with an upward swoop back to a perch. At other times of day it was observed to perch on a dead limb of a gum tree about 60 feet above ground, on a 15 foot dead sapling, and on a power line. No record of any call. Flight buoyant, wing beats strong but fairly slow; in flight the wings are broad but taper sharply towards the tip and the "dollar" marks, barely visible on the closed wing, are clearly seen. The black tail, square-ended at rest, is spread at take-off and landing. When perched the bird has a short-necked stocky appearance; the large head, flattened on the crown, large brown eye under heavy brows and broad flattened bill with upper mandible slightly hooked at the tip are noticeable field features; the reddish feet are usually hidden. Length about 12 inches. Head brownish, upper surface brownish green, wing coverts greenish blue; "dollar" patches on the primaries white with a bluish tinge. Bristly green feathers on chin; a striking bright blue streak on throat; under surface green, tinged smudgy brownish on breast. The dusky brown bill with only a very small but detectable reddish area at the base of the lower mandible indicated that the bird was not fully mature.

Photographs, though not suitable for reproduction, show the bird on, leaving and returning to its perch, and have been inspected by Mr. F. C. Kinsky, Dominion Museum. I am grateful to Mr. A. T. Edgar for discussions during preparation of this note, and to Mr. Kinsky for his comments on the draft. — C. D. CLUNIE

RINGED PLOVER IN THE FIRTH OF THAMES

By JOHN & BETH BROWN, H. R. McKENZIE and R. B. SIBSON

A Ringed Plover *Charadrius hiaticula* which reached the Firth of Thames probably in the southern spring of 1970, is now known to have spent the ensuing summer on the Miranda coast. When first found at full tide on the afternoon of 6/12/70, it was squatting among thin vegetation on an old flattened shellbank at Taramaire. Nearby were about 45 Wrybills, 19 Curlew Sandpipers, 8 Red-necked Stints, 1 Broad-billed Sandpiper, 1 Large Sand Dotterel; and one other small sandpiper which was subsequently identified as *Calidris bairdi;* so that there was ample scope for making comparisons. At least two pairs of New Zealand Dotterels *C. obscurus* were holding breeding territories not far away; but Banded Dotterels *C. bicinctus,* of which several pairs formerly bred along this stretch of coast, were missing.

As was only to be expected, there was at first some doubt about the identity of the stranger. Darker and smaller than *leschenaulti* and about the size of a female *bicinctus* it had a strikingly patterned head; a dark breast band; a complete white collar narrower at the back; a short stubby bill; yellowish orange at the base and black towards the tip. When it stood up its legs were seen to be orange yellow. So different was it from other small plovers or dotterels normally seen in New Zealand, that it was clearly either a Ringed Plover *hiaticula* or a Little Ringed Plover *dubius.* But the pattern of the markings on the head and the white wing stripe which it showed when put to flight at once ruled out *dubius;* and confirmed that yet another arctic migrant could be added to the New Zealand list.

H.R.McK. took notes on the facial pattern — forehead white, with narrow dark band over the base of bill and broad dark band above the white; rather faint eyestripe over and to back of eye; chin and throat white; crown grey; below eye a dark area, not black.

The dominant colour of the back and upper wing surface was an even darkish brown; underparts were white and a white bar tipped the tail. From observations made on several subsequent sightings it was believed to be not a first year bird but a sub-adult female.

It is now generally agreed that the Ringed Plovers of Europe and Asia fall into two subspecies, *hiaticula* and *tundrae,* of which *hiaticula* has spread across the north Atlantic and breeds in Greenland and northeast Canada. The very closely related Semipalmated Plover *C. semipalmatus* of north America, though often treated as a full species, is now known to interbreed with *hiaticula* in Baffin Land (8). *Semipalmatus* is not common in Alaska (2) and old *semipalmatus* records for north-east Siberia have been disproved. The Long-legged Ringed Plover *C. placidus* which has a more southerly range in eastern Asia is rather surprisingly treated by Dementiev and Gladkov (3) as a subspecies of *hiaticula;* but Vaurie comments that it is so distinct that it must be allowed to retain full specific status.

Though typical *tundrae* are smaller and darker than *hiaticula,* some Russian ornithologists have been unwilling to grant that they

are subspecifically distinct; and the situation is complicated because it appears that specimens of Ringed Plovers from north eastern Siberia differ from *tundrae* and are virtually indistinguishable from typical *hiaticula* of western Europe and the British Isles.

The Ringed Plover is sometimes cited as a species which exemplifies ' leap frog-migration.' Whereas those Ringed Plovers which breed in the temperate climate of western Europe are rather sedentary or move hardly further south in winter than the Mediterranean, the northern breeders *(tundrae)* are highly migratory and seasonally travel thousands of miles. The winter quarters of *tundrae* are in Iraq, Arabia and Africa as far south as the Cape. In autumn Ringed Plovers from northeast Asia travel southwest passing to the north of India to cross Asia and winter especially in eastern Africa. To India they are described as a " straggler or very rare winter visitor "; and Ceylon is credited with few authentic sightings (9). The Ringed Plover is not recorded from Malaysia.

From time to time, as happens with other strongly migratory species from Siberia which normally head southwest towards Africa, e.g. Yellow Wagtail *Motacilla flava,* Wheatear *Oenanthe oenanthe,* off-course wanderers reach Australia or the islands immediately to the north. A Ringed Plover was reported from Australia as long ago as 1865. Since then at least two more have occurred; and one which was collected has been proved, on careful examination of the feet, not to be *semipalmatus.* Elsewhere in the south-west Pacific two reported sightings of Ringed Plover have come from the Rewa estuary, a magnet for arctic migratory waders near Suva, Fiji. So far these sightings lack confirmation. Any Ringed Plovers which have reached New Zealand or south-eastern Australia have travelled virtually due south instead of taking the normal south-westerly route (v. map).

On the day of its discovery the Ringed Plover was studied at close quarters not only by the writers but also by Barbara Burch, Gillian Eller, Brigid Pike, Joan Trollope, N. M. Gleeson, T. R. Harty, D. A. Lawrie and some boys from the King's College Bird Club.

From later sightings which are now to be listed, it is known to have spent the rest of the summer at Miranda and the last reported sighting may indicate that it was intending to overwinter a little further south in the Firth of Thames near Waitakaruru where the main wintering flock of Wrybills is usually to be found.

13/12/70. 7.15 a.m. Weather calm; birds undisturbed; conditions excellent. John P. Croxall, John Jenkins, Barbara Parris, Joan Sibson and R.B.S. were in position before full tide and were able to examine at leisure much the same gathering of small waders as had been noted a week before. It was agreed that the Ringed Plover was too vividly marked to be a first-year bird, but was probably an adult (or sub-adult) female in winter plumage. The presence of a single Baird's Sandpiper was confirmed. J.P.C. had once been lucky enough to see one in Wales ! Other small arctic migrants noted were: Curlew Sandpiper 22; Red-necked Stint 10+; Broad-billed Sandpiper 1; Large Sand Dotterel 1.

20/12/70. Full tide about noon. Ringed Plover still present in the same place and in much the same company. The heat and glare on the shell were not helpful. One small sandpiper or ' peep ' not seen before was a puzzle. J.A. and Beth Brown, R.B.S.

[J. A. Brown

FIGURE 1 — Ringed Plover at Miranda, Firth of Thames, December 1970.

[J. A. Brown

FIGURE 2 — Ringed Plover at Miranda, Firth of Thames, December 1970. A summering Wrybill is squatting in the background.

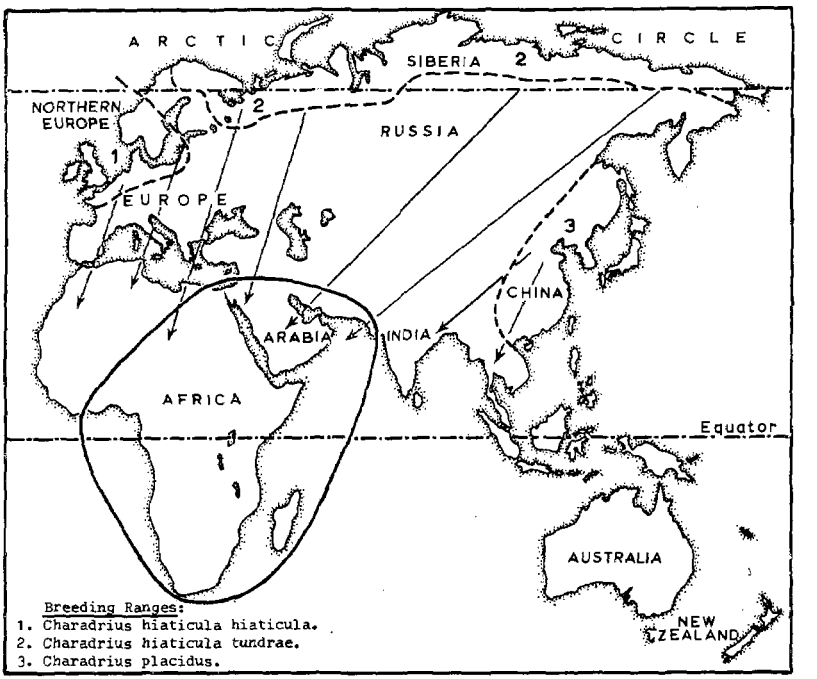

FIGURE 3 — Arrows mark direction of normal autumn migration. The main winter quarters of *tundrae* are marked by a ring. After Salomonsen, Dorst, Dementiev and Gladkov.

1/2/71. Big tide. Among the shellbanks near the old lime-works, the Ringed Plover stood conspicuously apart on a ridge. Other small arctic waders were not so easily spotted among 2,000 or more Wrybills; and precise counts were well-nigh impossible. The Ringed Plover stayed near the Wrybills and was not in the least attracted to a loose flock of c.50 Banded Dotterels, which kept their distance, away from the main concentration of small waders. Once again the Ringed Plover's behaviour at high tide was most accommodating, so that it was well seen by Dr. and Mrs. J. H. Seddon, Simon Towle, H.R.McK., Joan Sibson and R.B.S.

28/2/71. A very big tide at 9.30 a.m. had bought not only thousands of shore-birds but also a multitude of observers to the mouth of the Miranda Creek. Again the Ringed Plover stood out plain to see, together with two Large Sand Dotterels on the fringe of some 3,000 Wrybills. Apart from the waders, 18 Little Terns *Sterna albifrons* had flown in from the southern shore of the firth, which is their more favoured haunt (Notornis 10, 91-92).

6/3/71. Rather a modest afternoon tide; but a very satisfying mixed assemblage of the smaller arctic waders included 1 Ringed Plover, 2 Large Sand Dotterels, 16+ Curlew Sandpipers of which nine were well-reddened, 4+ Red-necked Stints. Again the Ringed Plover showed no inclination to join the 50+ Banded Dotterels.

This was a King's College Bird Club trip led by R. N. Buttle and R.B.S.

29-30/3/71. Ringed Plover present and just loafing in a large flock of Wrybills. H.R.McK.

29/5/71. The Ringed Plover was located by Sylvia Reed and B.B. near Kairito Creek. It and a single Red-necked Stint were attached to a comparatively small breakaway flock of c.250 Wrybills. This date seems to provide conclusive evidence for over-wintering. If the Ringed Plover does not travel south with the main body of Wrybills in spring, it may well be found again at Miranda during the summer of 1971-72.

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SHORT NOTE

JOTTINGS ON WELCOME SWALLOWS IN NORTHLAND

Runaruna (Hokianga County)

In 1967/68 there were nine occupied nests in a limited area near my home at Runaruna. In 1970/71 there were fifteen occupied nests in the same area.

On 25/10/70 I found two nests attached to vertical surfaces; both were made of mud, straw and rootlets, lined with sheeps' wool and feathers, and each containing one dead juvenile Welcome Swallow. One of the chicks was about ten days old and had died in the nest; the other, fully fledged, was hanging below the nest with one foot entangled in the sheeps' wool. From the amount of excreta in the nest it seemed that the parents had continued to feed the chick for a few days after it could normally have flown. Insect remains in the excreta included *Tipulidae* (Diptera) and *Carabidae* (Coleoptera).

Aupouri Peninsula (Mangonui County)

A survey made during the January 1971 Study Course showed that most bridges in the area have now been occupied, and that other sites, i.e. buildings, covered water-tanks, jetties, old boats, overhanging cliffs and shallow caves are being increasingly used. One nest, in a culvert at Houhora, was attached entirely to the inner side of festoons of Kikuyu grass *(Pennisetum sp.)* hanging over the entrance.

Miss E. Madgwick tells me she has seen a nest attached to an old sack hanging over a rafter in an open shed at Pukepoto, and also one nearby, in a corrugated iron tank lying on its side; both were used successfully in the 1969/70 breeding season.

Nest Materials

Nests made of the sandy muds available in the Far North appear to be less durable than those further south which are constructed of clay muds. This is less noticeable in nests attached to culverts and buildings than in nests under bridges, which are exposed to vibration from passing traffic.

My thanks are due to Mr. A. T. Edgar for his help with this note.

— R. S. COWAN

NOTES ON THE OCCURRENCE OF WADERS IN FIJI

By J. B. SMART

ABSTRACT

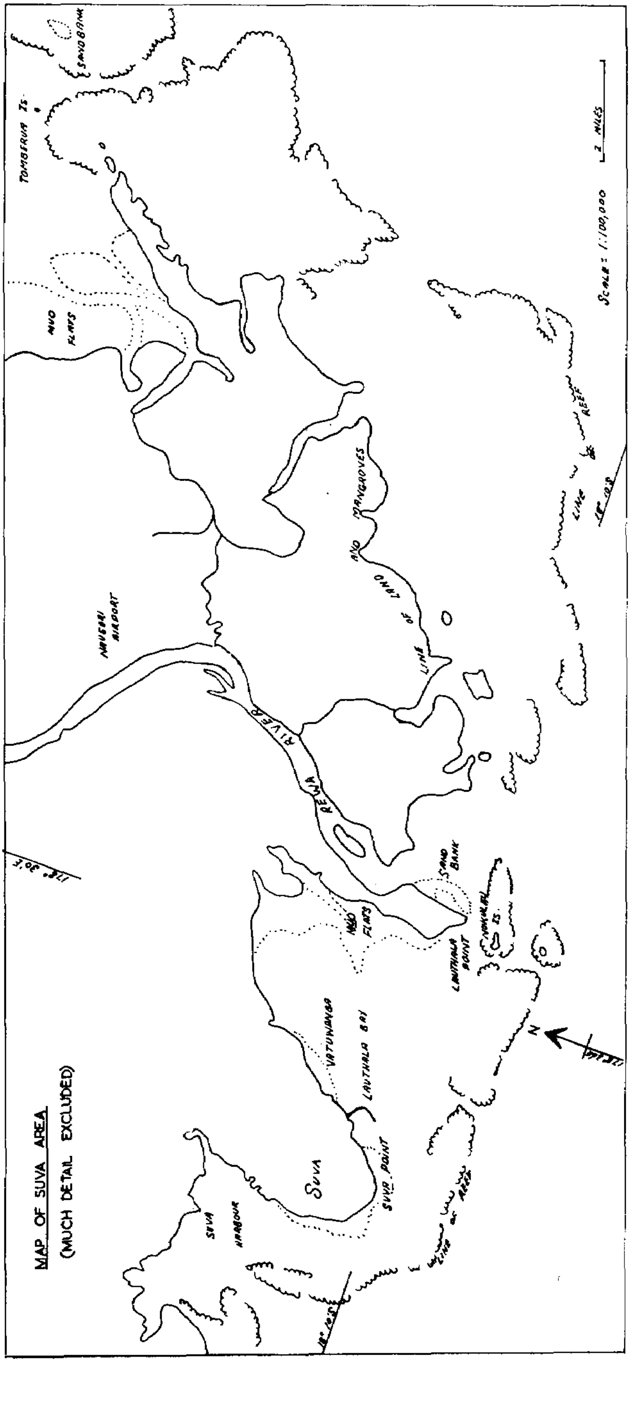
This paper lists the waders recorded in Fiji, summarises information on them collected by the writer during nearly three years residence in Fiji, 1969 to 1971, and compares wader counts made at Parengarenga Harbour, New Zealand, and at Rewa sandbank, Fiji, in January - February, 1971.

The Fiji group of islands situated in the South-West Pacific around latitude 18° South and the 180° meridian is visited annually by migratory waders but there is little recorded data on their occurrence. In recent years Mayr 1945 (9) and the Morgans 1965 (11) have recorded one migratory wader from New Zealand and eight from the holarctic region and one additiional species was noted by Morris (12); while Sibson 1965 (16) and Mercer 1967 (10) have also written about waders but do not add to the species list. During the period January, 1969, to September, 1971, the writer was resident in Fiji and made additional sight records of four species and one race. The complete species list is shown in Table I.

The writer lived in Suva and most observations were made in that area. Waders can be seen on the shore at Suva Point and Vatuwanga at low tide; and at high tide can be found roosting on barges in Suva harbour, on the playing fields at Suva Point and Lauthala Bay and on the sea wall and breakwater at Lauthala Bay. The largest concentration of waders around Suva can be found roosting at high tide on a sandbank at Lauthala Point at the mouth of the Rewa river, from where they spread out over the extensive area of exposed reefs and mudbanks in the vicinity at low tide. This is the sandbank where the Morgans recorded their largest flocks and where the writer found most of the scarcer birds. Sibson's observations were made on the adjoining Nukulau island. Another favourite high tide roost is on a sandbank near Tomberua island in Bau Waters and there is a smaller roost at Nasilai. All these places are shown in the accompanying map.

There is little information about the occurrence of waders on the other islands although the writer has heard verbal reports of large numbers of shore birds at the mouth of a river on the eastern side of Ono island and on mudflats at Ono-i-Lau island. Ono-i-Lau is at the extreme south-east corner of Fiji and could well be a convenient resting place for birds flying north from New Zealand.

Waders are notoriously difficult to identify in non-breeding plumage and the conditions under which they occur in Fiji are no better than elsewhere. In addition to the normal difficulties the presence of a Lesser Frigate Bird *Fregata ariel* overhead may scare birds away prematurely and Whimbrel can also be a nuisance. The writer found most difficulty with small dotterel due to the presence of different species in non-breeding plumage at the same time from both the northern and the southern hemispheres. All observations were made with 8x binoculars.


MAP OF SUVA AREA
(MUCH DETAIL EXCLUDED)
NAUSORI AIRPORT
REWA RIVER
LINE OF LAND AND MANGROVES
LINE OF REEF
MUD FLATS
SAND BANK
LAUTHALA POINT
LAUTHALA BAY
VATUWANGA
SUVA
SUVA POINT
SUVA HARBOUR
SCALE: 1:100,000
2 MILES
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The Morgans made counts of Pacific Golden Plover on the Suva Point playing fields at high tide; and of other waders on the adjoining shore at half tide when they are congregated in groups quite close to the sea wall. The writer also made counts in the same locality, shown in Table II. These counts were made when opportunity offered and at no particular time in relation to the tide.

Some waders occur at Suva throughout the year. Although none were seen at Suva Point on 17th June, 1969, this was probably due to the state of the tide at the time and not to the absence of birds in the area. Most of the birds occurring on the shore at Suva Point and Vatuwanga were thought to be discrete from those roosting at high tide on the Rewa sandbank, although the Long-billed Curlew, Whimbrel and some of the Eastern Bar-tailed Godwit probably roosted at Rewa. For a period the Pacific Golden Plover on the shore at Suva Point did not use the adjoining playing fields, possibly as a result of too much interference from games players. The Wandering Tattler using the same shore flew to either Lauthala Bay or to Suva harbour to roost at high tide; and occasional birds could be found resting with Crested Tern *Sterna bergii* on beacons in shallow water.

Some counts were also made at the Rewa sandbank where counting was much more difficult due to the larger numbers of birds. These counts are shown in Table III. The sandbank is practically deserted at low tide and counts at this time give no indication of the number of birds in the vicinity.

The counts at the Rewa sandbank suggest that the first returns of Wandering Tattler and Eastern Bar-tailed Godwit occur towards the end of July; and that these are followed by Pacific Golden Plover and Turnstone in September and by Whimbrel by the end of September or in early October. The largest number of birds occurred in November. These trends are generally confirmed by the Suva Point counts where the numbers are smaller. Insufficient counts were made from March to May to determine the period of main passage migration but these indicate that departures had been largely completed by the end of the first week in May.

Many birds can be seen in breeding plumage just before their departure in April; and a sudden increase of numbers in breeding plumage at this time is taken to indicate the presence of passage migrants from further south. Over-summering birds are predominantly in non-breeding plumage although some show traces of breeding plumage. The presence of returning migrants in August and September is indicated by increased numbers retaining some breeding plumage, particularly noticeable in Wandering Tattler, Turnstone and Pacific Golden Plover. Both the Banded Dotterel and the Mongolian Dotterel assume breeding plumage before they leave and thus make their idntification certain, at least at this time.

Notes on individual species follow:—

1. Pacific Golden Plover *Pluvialis dominica fulva:*

This may be the commonest wader in Fiji and certainly has the widest distribution. It is found both inland and on the shore, occurring along rivers where there are gravel banks, on rice fields,

and on airfields and playing fields where the grass is kept close cut. It is also the most common wader occurring on areas of open mud on the landward side of mangrove swamps, and is usually the most numerous species on the Rewa sandbank.

Some birds over-summer but the larger numbers begin to return from their breeding grounds in September. First return in 1969 was noted at Nausori airfield near Suva on 11th September and large numbers had returned to the Rewa sandbank by 20th September. Return may have been slightly earlier in 1970, indicated by a few birds in nearly full summer plumage at the Rewa sandbank on 29th August. In 1926 Belcher 1929 (1) noted an arriving flock of 40 to 50 birds flying inland on 16th September, including one bird in an exhausted condition. He also noted that they departed from the cultivated fields in the Rewa valley between 12th and 19th April, 1927. By 27th September, 1970, the birds at the Rewa sandbank were blotchy in appearance and fast losing their black underparts; although one bird still had traces of a black belly on 22nd November.

Around Suva they prefer to roost on playing fields at high tide where they are quite discrete from the Wandering Tattler which roost elsewhere, but where they may be joined by a few Turnstone and Eastern Bar-tailed Godwit. Large numbers also roost on the Rewa sandbank where they usually occur on the landward side of the mixed wader flock and where they are much more spread out over the available roosting area than the other species.

2. Banded Dotterel *Charadrius bicinctus:*

This migrant from New Zealand was first recorded by the Morgans at Suva Point between 26th May and 9th August, 1962. It was first identified positively by the writer on 26th July, 1969, from which time birds in breeding plumage continued to be present until 20th August but had departed before the end of that month. In 1970 returning birds in non-breeding plumage were first seen on the shore at Vatuwanga on 10th March, being identified primarily by call note and leg colour; and had departed from the Rewa sandbank before 29th August. A small number of birds reoccurred in 1971 and two birds were still using the Rewa sandbank on 15th August.

In 1969 and 1970 Vatuwanga beach was used at low tide as a feeding area, but birds were not observed here in 1971. This beach is an area of compact sandy mud which dries out at low tide apart from a number of shallow pools; and there is no coral. The Banded Dotterel is an active bird when feeding, undertaking frequent short runs over the sand.

One bird in breeding plumage was recorded by Templeton 1971 (18) on Ono-i-Lau island in July, 1971; and on the available evidence this species appears to be a regular visitor to Fiji in small numbers outside its breeding season.

3. Mongolian Dotterel *Charadrius mongolus:*

The Morgans recorded this species at the Rewa estuary on 18th February and at Suva Point on 20th May, 1962, but unfortunately gave no details of plumage condition. The writer experienced con-

siderable difficulty for a long time in identifying satisfactorily the small dotterel which were usually present in small numbers at the Rewa sandbank; but eventually concluded that they were mostly this species.

When in breeding plumage the Mongolian Dotterel is quite distinct and it is irritating that so few books give a good description of this plumage which is so striking. One bird at the Rewa sandbank on 21st February, 1971, was in almost complete breeding plumage and, from the description, was a male bird of either the race *mongolus* or *stegmanni:* bright chestnut breast band very broad and extending onto the nape; black around the eye extending forward to the bill and separating the white forehead from the brown crown; white forehead divided longitudinally by a black line; chin and throat plain white, appearing very bright in contrast to the surrounding chestnut and black colouration. The full breeding plumage is also described as having a narrow black line separating the white throat from the chestnut breast band; but Mathews 1913-14 (14) notes that this is not assumed before leaving Australia on spring migration.

Most birds seen were in rather nondescript non-breeding plumage when they were difficult to separate from the Banded Dotterel and the Large Sand Dotterel *Charadrius leschenaulti* in similar plumage. After seeing the Banded Dotterel in breeding plumage, locating their preferred feeding area in the Suva neighbourhood and learning to distinguish their call-note, little difficulty was experienced in distinguishing the Banded Dotterel in non-breeding plumage. The description of field differences between the two species by McGill and Keast 1945 (7) was most helpful.

Descriptions of the Large Sand Dotterel and Mongolian Dotterel by Falla et al. 1967 (5) suggest that the main differences are in size and shape and in leg colour: the Large Sand Dotterel being larger and leggier with a longer and stouter bill and with grey-green or greyish brown in contrast to slate grey legs. Bill sizes given by Witherby et al. 1940 (20) and by Serventy and Whittell 1967 (15) are as follows:—

Pacific Golden Plover	21 - 27 mm
Oriental Dotterel *Charadrius veredus*	22 - 25 mm
Large Sand Dotterel	22 - 27 mm
Mongolian Dotterel	17 - 20 mm
Banded Dotterel	16 - 19 mm

When compared closely with Pacific Golden Plover the Fiji birds were found to have appreciably shorter bills, although difficult to see except at close range. It was concluded that they were Mongolian Dotterel.

Mongolian Dotterel have not been seen by the writer elsewhere than on the Rewa sandbank at high tide and their preferred feeding area has not yet been found. They are present at all times of the year in small numbers, and on available limited evidence appear to be regular visitors. They are silent birds, their trilling call having been heard on only two occasions. At the Rewa sand-

bank they should be looked for along the margin of the area occupied by Pacific Golden Plover or at the top of the beach proper above the mass of small waders.

Small dotterel (*species* ?):

Small dotterel in non-breeding plumage are present throughout the year at the Rewa sandbank but positive identification of them has proved difficult. Most will have been either the Banded Dotterel or the Mongolian Dotterel, although the Large Sand Dotterel is also likely to occur occasionally; but one bird seen on 3rd January, 1970, may have been either a Ringed Plover *Charadrius hiaticula* or a Semipalmated Plover *Charadrius semipalmatus,* more probably the former which has been recorded in Australia, Condon and McGill 1967 (3) and very recently in New Zealand (Notornis 18).

This bird had appreciably shorter legs than other small dotterel present, with which it was directly compared; and the legs appeared to have a yellowish tinge but their colour was not determined satisfactorily. It showed a complete brown breast band, white collar on the hind neck, white wing bar, white sides to rump and tail, and a small white mark behind the eye. There was no white on the forehead and no black in the plumage, and in other respects was similar to the other small dotterel present (presumed to be Mongolian Dotterel) although relative bill size and shape was not noted. This is not considered to be a positive identification although it fits in most respects an immature Ringed Plover.

4. Long-billed Curlew *Numenius madagascariensis:*

This species can be regarded as a regular visitor in very small numbers which occasionally oversummers. The largest number seen together was three at the Rewa sandbank on 4th January, 1970. The birds which frequented the beach at Suva Point in 1969 were almost certainly the same two birds roosting at the Rewa sandbank at high tide, the two places being only 6 miles apart in a direct line.

5. Asiatic Whimbrel *Numenius phaeopus variegatus:*

Around Suva this species is practically confined to the Rewa sandbank area and is seldom seen on the shore at Suva Point, although it can be seen feeding on the exposed reef around Nukulau island at low tide. It is a wary bird which is difficult to observe at close quarters. The narrow white patch on the back of this race is somewhat variable in shade and is not always easy to distinguish unless the birds are seen flying directly away from the observer. However, there is no doubt that this race predominates. This is the latest of the regular migrants to return to Fiji, arriving at the end of September or beginning of October. A few birds over-summer, including four birds reported by Templeton at Ono-i-Lau in 1971.

6. American Whimbrel *Numenius phaeopus hudsonicus:*

A single bird with no trace of white on the back was clearly seen on two occasions at the Rewa sandbank in November, 1969.

7. Bristle-thighed Curlew *Numenius tahitiensis:*

Fiji is on the south-west extremity of the range of this curlew and it appears to be of infrequent occurrence. Stickney 1943 (17) records the collection of one bird at Ngele Levu by the Whitney South Seas Expedition on 28th November (presumably 1924); and Belcher noted that he had taken one in July. The Morgans were unable to find it. One bird was clearly seen and heard calling at the Rewa sandbank no 19th October, 1969, both the call note and the rump and tail pattern being quite distinctive. Although it is possible that two birds were seen at the Rewa sandbank on 22nd November, 1969, careful scrutiny failed to detect this bird on all other occasions.

Note: The reference by Layard 1876 (9) to " the acquisition by my son of the rare little curlew *(Numenius femoralis)* a few days ago at Coconut Point in Sandalwood Bay " (that is Bua Bay, Vanua Levu) is worth noting although the species referred to is not clear.

8. Eastern Bar-tailed Godwit *Limosa lapponica baueri:*

Bar-tailed Godwits are frequently seen on the shore around Suva when their characteristic ' bottoms up ' stance while feeding and white appearance from a distance, make them unmistakeable even without binoculars. They favour pools on the beach left behind by the tide. The beach at both Vatuwanga and Suva Point are favoured localities for feeding near Suva but the largest numbers can be seen roosting on the Rewa sandbank where fifty or more birds over-summered in 1969. Another favoured roosting place is on a sandbank off the north-eastern side of Tomberua island in Bau Waters to the north of the Rewa delta where 250 birds were seen on 7th November, 1970.

Although their numbers increase before the end of August few birds are seen at this time of year with remaining traces of breeding plumage, for instance none of the fifty birds at the Rewa sandbank on 29th August, 1970, showed any red colouration. In contrast, birds in breeding plumage are plentiful in March and April.

9. Wandering Tattler *Tringa incana:*

This is the most abundant wader occurring in Fiji apart from the Pacific Golden Plover, and Fiji must be one of its most important areas outside the breeding season. Its abundance was first commented on by Ramsay 1877 (14) and later by Stickney and Sibson. It is present at all times of the year. Although it seems to be more abundant around Suva and the Rewa delta than elsewhere, it can be seen anywhere along the coast in small numbers, single birds frequently being seen resting on protruding rocks, beacons or fishtraps and it also occurs along rivers inland in small numbers.

At Suva many birds feed on the beach at Suva Point at low tide and follow a regular flight line to roost on barges on the northern side of Suva harbour. Other birds roost on the breakwater at Lauthala Bay.

10. Siberian Tattler *Tringa brevipes:*

This is an uncommon bird in Fiji, not having been recorded previously, and was only identified positively among the large number of Wandering Tattler on a few occasions. It is a difficult species

to pick out among scattered feeding birds where close comparison with Wandering Tattler is hardly possible. Even in April many Wandering Tattler have white undertail coverts and are quite slim in build; and the Siberian Tattler cannot be identified on these characters alone. These characters together with a generally paler grey colouring, prominent clear white eyestripe and underparts and straighter looking bill identified the Fiji birds. The records in the tables are restricted to those occasions when prolonged direct comparison between the two species was possible.

Two were identified at the Rewa sandbank on 29th August, 1970, when a small group of New Zealand ornithologists accompanied the writer. The writer has also seen the Siberian Tattler on the Queensland coast and is in no doubt of the identification.

This species has been heard calling but the writer is not yet able to pick out the call note with certainty from the variety of Wandering Tattler calls, although the normal trilling call note of the latter is quite different.

On the limited evidence available it is probably a regular visitor to Fiji in very small numbers but has not yet been found over-summering.

11. Terek Sandpiper *Xenus cinereus:*

A single bird was seen at the Rewa sandbank on a number of occasions between 24th May, 1969, and 5th April, 1970, and appears to have over-summered in Fiji. It has not been seen again and this species can be regarded as an irregular, rare visitor.

12. Turnstone *Arenaria interpres:*

Turnstone are present in Fiji throughout the year. A few roost on or near the Lauthala Bay breakwater but larger numbers can be found on the Rewa sandbank. Feeding birds are most frequently seen around the edge of small pools or close to the water line on the shore at Suva Point and Vatuwanga. When roosting they squat on the ground in a close-packed huddle and are not easy to count; but the maximum number seen was about 250 birds at the Rewa sandbank on 21st February, 1971. A few of the returning birds at the end of August show traces of chestnut breeding plumage on the upperparts.

13. Sharp-tailed Sandpiper *Calidris acuminata:*

Previously noted by Morris who saw two birds among Pacific Golden Plover and Turnstone on the Vieuto playing fields at Suva Point on 2nd November, 1963.

14. Red-necked Stint *Calidris ruficollis:*

The first stint was seen at the Rewa sandbank on 22nd November, 1969, and the first positive identification of this species was made of a single bird at the same locality on 4th January, 1970. Bill and legs were distinctly black, the back was noticeably vermiculated and its small size was compared directly with a Sanderling with which it associated and to which it was otherwise very similar. A bird seen in the same locality on 27th and 28th March, 1970, was assuming breeding plumage and its tail was noted as having a very dark centre. It was not seen again and can be regarded as an irregular and uncommon visitor.

15. Sanderling *Calidris alba:*

Sanderling were seen at the Rewa sandbank on most occasions and four birds over-summered in 1969. The maximum number seen was seven on 14th March, 1970. They were usually to be seen resting quietly on the sandbank among Wandering Tattler and Turnstone but occasionally they could be seen at the water's edge running up and down in typical action. Their feeding area was not found. A single bird was also seen near Tomberua island on 26th December, 1970, and three on the shore near Navua on 28th February, 1971. Although not recorded before this evidence suggests that it is a regular visitor in small numbers.

The writer has made only a sporadic search for fresh water and inland areas frequented by waders, inspecting flooded rice fields around Navua, in the Rewa valley and elsewhere, a small fresh water lake near Nandi and some brackish pools near Lomawai, all on Viti Levu island, and has only found Pacific Golden Plover and a few Wandering Tattler in these places. Practically all the writer's observations have been made on the shore, particularly around Suva, where careful scrutiny of each bird in a wader flock will occasionally reveal an uncommon species. Reference has already been made to reports of large numbers of shore birds occurring on Ono and Ono-i-Lau islands; and it is expected that all river deltas anywhere in Fiji with sandbanks or other isolated potential roosting places near their mouths would well repay investigation. The wader list is still a short one and there are several species which occur in Australia and New Zealand which can be expected to occur in Fiji occasionally.

The account of the January, 1971, field study course by Edgar 1971 (4) contains a list of waders recorded at that time for the whole of Parengarenga harbour, New Zealand, and provides the opportunity of comparison with the list for one high tide roost on the Rewa estuary, Fiji, on 21st February, 1971. Parengarenga is some 1,100 miles to the South of Suva and 5½° further to the West. The two lists are given in Table IV.

Of the more abundant species, Fiji has the Wandering Tattler which has not occurred at Parengarenga, more Asiatic Whimbrel and rather more Pacific Golden Plover (although it was stated to be a poor season for this species in the far North of New Zealand); while Parengarenga has Knot which have not occurred in Fiji, and considerably more Bar-tailed Godwit and Turnstone. Of the less common species, Fiji has the Mongolian Dotterel which has not occurred at Parengarenga; whereas Parengarenga has more Red-necked Stint and has recorded six Asiatic and two American species which have not yet been recorded in Fiji.

The four common species in New Zealand all have a more northerly distribution in their breeding grounds than the other species which reach New Zealand, and in all cases their breeding distribution spreads across the Bering Straits from Eastern Siberia into Western or North-Western Alaska. The species which are more common in Fiji do not extend so far to the north in their breeding grounds as the common New Zealand species; and have a generally more eastern distribution in Siberia than those species from Asia which

TABLE 1 — LIST OF WADERS RECORDED IN FIJI

Species	Recorded Previously	New Record
1. Pacific Golden Plover *Pluvialis dominica fulva*	(x)	
2. Banded Dotterel *Charadrius bicinctus*	x	
3. Mongolian Dotterel *Charadrius mongolus*	x	( )
4. Long-billed Curlew *Numenius madagascariensis*	x	( )
5. Asiatic Whimbrel *Numenius phaeopus variegatus*	x	( )
6. American Whimbrel *Numenius phaeopus hudsonicus*		x
7. Bristle-thighed Curlew *Numenius tahitiensis*	x	
8. Eastern Bar-tailed Godwit *Limosa lapponica baueri*	(x)	
9. Wandering Tattler *Tringa incana*	(x)	
10. Siberian Tattler *Tringa brevipes*		x
11. Terek Sandpiper *Xenus cinereus*		(x)
12. Turnstone *Arenaria interpres*	x	( )
13. Sharp-tailed Sandpiper *Calidris acuminata*	x	
14. Red-necked Stint *Calidris ruficollis*		x
15. Sanderling *Calidris alba*		(x)

NOTES: 1. Nomenclature follows the Annotated Checklist of the birds of New Zealand.

2. Notation: x indicates a record.

( ) indicates a species which has been recorded as staying in Fiji over the Northern summer (referred to later as ' over-summering ') between May and July.

TABLE II: COUNTS OF WADERS AT SUVA POINT AND LAUCALA BAY, 1969-1970

YEAR	1969																														1970		
DATE	Jan. 26	Feb. 2	Feb. 17	Mar. 21	Mar. 26	Mar. 27	Apr. 10	May 8	May 19	May 23	Jun. 6	Jun. 17	Jul. 2	Jul. 6	Jul. 16	Jul. 19	Jul. 20	Jul. 24	Jul. 31	Aug. 9	Aug. 14	Aug. 30	Sep. 4	Sep. 18	Oct. 2	Oct. 17	Nov. 22	Dec. 5	Dec. 6	Jan. 23	Mar. 19	Jun. 16
TIME OF DAY		Falling 1100					1700		1700	1700	1730		1715	1730	1700	1200	1600	1700		1700	1700	1130	1700	1730	1730	1730	1130	1730	1730		1330	
STATE OF TIDE									Rising	Low	Low	Rising	Low	Low		Falling	Low		Rising	Low	Rising	Falling	Low	Falling	Falling	Low	Low	High	High	Rising	Rising	
PACIFIC GOLDEN PLOVER	50	–	120	*	*	*	*	–	2	4	4	–	–	–	1	–	3	3	–	4	3	7	1	34	36	41	39	107	176	32	140	49
LONG-BILLED CURLEW	1	1	1	–	2	2	–	–	–	2	–	–	–	2	–	2	–	2	2	–	2	–	–	–	–	–	1	–	–	–	–	–
ASIATIC WHIMBREL	–	2	1	1	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–
EASTERN BAR-TAILED GODWIT	*	*	40	*	*	*	*	22	8	6	4	–	–	–	–	–	4	1	–	9	13	9	17	11	32	25	22	30	22	–	30	1
WANDERING TATTLER	*	100	220	*	*	*	*	73	56	40	18	–	25	57	27	11	62	22	25	120	167	162	200	134	199	194	155	180	232	100	190	75
SIBERIAN TATTLER	–	3	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	–	–
TURNSTONE	*	*	20	*	*	*	*	–	–	1	1	–	–	–	–	–	1	–	–	1	4	3	2	5	9	4	17	60	55	10	40	24

NOTES: 1. All figures are for Suva Point alone, except: December 5 and 6 which are combined totals for Suva Point and Laucala Bay; and January 23 which are for Laucala Bay alone.
2. Notation: See Footnote to Table III.

TABLE III: COUNTS OF WADERS AT REWA SANDBANK 1969-1971

YEAR	1969												1970												1971					
DATE	May 24	May 31	Jun. 8	Jun. 22	Jul. 5	Jul. 26	Aug. 9	Aug. 31	Sep. 20	Oct. 19	Nov. 22	Nov. 30	Jan. 3	Jan. 4	Jan. 25	Mar. 14	Mar. 27	Jul. 11	Aug. 29	Sep. 27	Oct. 12	Nov. 22	Jan. 3	Feb. 21	Mar. 6	May 30	Aug. 15	Aug. 29			
TIME OF DAY					1330	1530	1600	0900	1400	1500	1600	1100	1430	1500		1200	A.M.	1300	1600				1130	1430	1400	1100	1300	1130			
PACIFIC GOLDEN PLOVER	50	40	50	10	–	64	37	39+	340	200	*	176	*	*	350	*	*	52	70	283	*	*	242	400	400	40	50	100			
BANDED DOTTEREL	–	–	–	–	–	10	6	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	3	–			
MONGOLIAN DOTTEREL	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	7	8	8	–	–	–			
SMALL DOTTEREL (SPECIES?)	2	10	2	2	2	1	–	2	2	7	7	2	11	5	9	5	1	1	6	3	2	9	–	–	–	–	–	–			
LONG-BILLED CURLEW	–	1	2	2	–	2	2	2	2	2	–	2	2	3	1	1	–	–	1	1	1	1	1	1	1	–	–	–			
ASIATIC WHIMBREL	2	5	10	7	–	15	11	14	16	50	70 to 100	40	*	*	30	*	*	–	26	75	40	100	*	80	70	10	13	2			
AMERICAN WHIMBREL	–	–	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–			
BRISTLE-THIGHED CURLEW	–	–	–	–	–	–	–	–	–	1	2?	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–			
EASTERN BAR-TAILED GODWIT	50	15	70	60	–	110	121	133	170	200	*	101	*	*	200	*	*	24	50	202	*	*	*	250	*	40	14	15			
WANDERING TATTLER	50	20	40	70	7	159	151	140+	300	200	*	188	*	*	250	*	*	2	150	203	*	*	*	250	*	60	150	150			
SIBERIAN TATTLER	–	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–	1	–	2	3	1	1	1	–	1	–	1	–			
TEREK SANDPIPER	–	1	–	–	–	1	1	1	–	–	–	–	1	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–			
TURNSTONE	20	10	10	15	–	9	17	13+	100	70	*	52	*	*	50	*	150	43	50	173	*	*	*	250	*	25	50	30			
RED-NECKED STINT	–	–	–	–	–	–	–	–	–	–	1	–	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–			
SANDERLING	4	4	3	3	4	4	4	4	4	2	–	3	4	4	5	7	4	2	–	1	2	3	3	5	5	4	4	4			

NOTES: 1. About 2000 birds present on 22nd November.
2. All counts were made at high tide except on 31st May on a falling tide.
3. Notation: – = no birds seen.
* = birds present but not counted.
\+ = incomplete count.
? = not a positive identification.

TABLE IV: Comparison of wader counts made in January, 1971, at Parengarenga Harbour, New Zealand, and in February, 1971, at Rewa Sandbank, Fiji.

Location	Parengarenga Harbour, New Zealand	Rewa Sandbank, Fiji
Date of Count	11 to 18.1.71	21.2.71
Species	Numbers	
Pacific Golden Plover	c 100	c 400
Mongolian Dotterel	x	8
Oriental Dotterel Charadrius veredus	-	x
Long-billed Curlew	4	1
Asiatic Whimbrel	-	c 80
American Whimbrel	-	-
Bristle-thighed Curlew	x	-
Little Whimbrel Numenius minutus	-	x
Asiatic Black-tailed Godwit Limosa limosa	-	x
American Black-tailed Godwit Limosa haemastica	-	x
Eastern Bar-tailed Godwit	c 1500	c 250
Greenshank Tringa nebularia	-	x
Wandering Tattler	x	c 250
Siberian Tattler	4	-
Terek Sandpiper	1	-
Turnstone	c 800	c 250
Knot Calidris canutus	c 100	x
Sharp-tailed Sandpiper	10	-
Curlew Sandpiper Calidris ferruginea	7	x
White-rumped Sandpiper Calidris fuscicollis	-	x
Red-necked Stint	24	-
Sanderling	-	5
Broad-billed Sandpiper Limicola falcinellus	-	x
Total number of birds counted	2550	1244
Number of species counted	10	8
Total number of species ever recorded at site	20	14

Origin of Species	Common to both Countries	Confined to N.Z.	Confined to Fiji	Total
Nearctic	1	2	1	4
Palaearctic	6	6	1	13
Holarctic	4	1	1	6
Total	11	9	3	23

Notation: – indicates not recorded on the date of the count although it has occurred at the site.

x indicates never recorded at the site.

have not yet been recorded in Fiji. The obvious exceptions to this statement are the Knot* and the Pectoral Sandpiper *Calidris melanotus* which are possibly the most likely species to be added to the Fiji list.

Apart from the Sanderling which is a great wanderer outside the breeding season, speculation suggests that Fiji's waders originate largely from that part of the centre of East Siberia lying to the north-east of the Kamtschatka Peninsula, with a few birds originating from Western Alaska.

Grateful acknowledgement is made of the encouragement and assistance given to the writer on numerous occasions by R. B. Sibson.

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*[The first Fijian Knots have now been recorded. In a letter posted on 14/10/71, J.B.S. writes: " 27 Knots at the Rewa estuary sandbank on 10th October, with Bar-tailed Godwits." Ed.]

THE BROWN TEAL IN THE AUCKLAND PROVINCE

By H. R. McKENZIE

The Brown Teal, or Brown Duck *Anas aucklandica chlorotis,* has obviously been an inhabitant of New Zealand from early times, many millenia before the advent of man. Oliver, 1955, records that the Brown Duck (Brown Teal) was collected about 1840 by P. Earl, who sent specimens to the British Museum, and that Potts found the first recorded nest in Canterbury in 1870. Oliver describes the species fully.

This fine little duck, plentiful throughout the lower country in the nineteenth century (E. G. Turbott, 1967) has, like so many other species, suffered severely through European settlement so that it is now represented only on Great Barrier Island in fairly good numbers, on Little Barrier Island by a few birds, in Northland by scattered small flocks and small parties, in the Waikato and perhaps the Bay of Plenty by odd pairs and by a few in South Fiordland and on Stewart Island.

HABITS AND HABITAT

Seldom would this bird be found in streams where the flow was rapid, or even steady. Bends in creeks and the lagoons formed in old watercourses were favoured. Ponds, lakes and open water in swamps were used if they had loafing stands and cover about them.

In winter and spring, in my experience of 1902 to 1915 at Clevedon, South of Auckland, and at Wayby, near Wellsford, north of Auckland, dusk would bring them flying down from the rough gully-heads and small swamps of the hills to land on any small body of water and walk out onto the grass to feed. At this time of year many of these would be breeding. G. K. McKenzie (pers. comm.) spent the years between 1919 and 1935 mostly on the high country about Waipu, latterly farming along the top of the Brynderwyn Range, up to c.1300 feet, on the south side of the Waipu basin. On all of the high country the Brown Teal occupied the gully-heads right to the tops, one of his sheepdogs often catching them there. These birds probably flew down to the grassed flats of Waipu at evening. This habit seems to have died away, most likely because the small numbers latterly had not so much pressure on the nesting sites and could breed about the several creeks. Wildlife rangers with well trained dogs, have, in recent years, not found any in the high gullies.

The Brown Teal is very innocent and prefers not to fly. When encompassed by watchers it will disappear under overhanging cover and crawl onto land under rank growth for several yards, where it will remain motionless. This has been experienced more than once when someone has stepped inadvertently on the bird.

FEEDING

The Brown Teal is a dabbling duck so is fond of shallow, still, or slow-flowing water with aquatic vegetation and swampy growth. Its fondness for feeding over grass paddocks is of course an adaptation following the clearing of the bush. The late Maurice E. Fitzgerald, who studied this bird exhaustively, held that it was well worth encouraging for the good work it would do in taking large quantities of harmful insects and their larvae on the pastures. It feeds at night when the pests are abroad. In my sixty-nine years of knowledge of the Brown Teal I cannot recollect seeing it feed in daylight, but A. T. Edgar (pers. comm.) has noted aquatic feeding occasionally. In the pre-European settlement days it must have been quite restricted in its feeding range, except in the larger swamps. Where swamps were scarce it could well have depended considerably on the tidal flats. I have a record of seven in a party on 15/2/46 at 10.30 p.m., seen in moonlight and heard calling, from the footbridge over the Ruakaka estuary, feeding on the exposed mudflat. It possibly fed also to some extent on the floor of the native forest where is used to occur on landslip dams in creeks many miles from open country.

The Auckland Island sub-species *Anas aucklandica aucklandica* and the Campbell Island sub-species *Anas aucklandica nesiotis* feed on the seashore and in the kelp as well as inland and in fresh water.

FLOCKING

Flocking is a habit important to this duck, perhaps almost vital to it. After the extended breeding season it used to be common to see flocks of 300 or more in creeks and rivers at the tidal limit and on lakes, lagoons, ponds and sluggish streams. The flocking period was from part way through November to April and into May. When the great decline happened in the early 1900s the flocks nearly all melted away to small groups or nothing at all. Where the species did not completely disappear the birds of the small parties left seemed to lose the social comfort of the flock and become lost as to locality. In recent years single birds and a very few small lots of up to six have turned up in places not inhabited for many years. This has been particularly noted in North Auckland, Auckland and Waikato. Instances have been: (a) North Auckland, at Kaiwaka and Port Albert (see Recording Scheme); (b) at the sewage ponds at Mangere six were found on 28/12/64. They soon dwindled, the last one staying for some time, but not seen after 11/1/67; (c) in the Waikato district no flock or party is now known, but odd ones keep turning up, usually shot in error or in ignorance; (d) the small surviving remnants about the upper Coromandel Peninsula seem to provide an example of such dispersal. D. V. Merton (pers. comm.). Besides the pitifully thinly scattered birds of the upper peninsula odd ones have turned up further down the coast but have not permanently established.

In no case have small lots and odd wanderers been known to become established and to have increased. Larger parties (in Northland) can appear in new places as a result of a change in locality to more favourable conditions. Increase by breeding can result only where there is suitable environment and strict protection. A clear instance of this is provided by the appearance on new dams on the property of A. T. Edgar (pers. comm. and Recording Scheme)

at Kerikeri of 9 birds on 12/2/62, then on to 20 up to 1963 and 29 in February, 1970. The rise was not steady, numbers fluctuating throughout the period from 0 to 29, indicating the unfortunate habit of moving away from protected areas. Had they stayed altogether on these protected dams the natural increase could well have been considerable. Even so the result is good, the numbers having been more than maintained over a period of eight years. It is to be noted however that this initially was a transfer in number. To think that odd birds appearing in odd places indicates an increase and spread of population is quite unjustified.

THE GREAT DECREASE

Old records tell little of the numbers present when the Europeans came to New Zealand, but it is known that almost all of the lower country was occupied. The clearing of the land, prior to the large-scale draining of the swamps, must have increased the food supply and consequently the population for the time being, say up to the late 1880s. Trouble then came from the increase in introduced vermin, closer settlement, wholesale draining of swamps and a great increase in shooting, so that in the early 1900s their numbers were under pressure.

Then came the disastrous step downward. It may well be that in addition to the above causes an introduced poultry disease struck the Brown Teal at the same time as some such fatal factor struck the Weka. This was somewhere in the period 1916 to 1921. In the case of both birds there appeared to be a spread of trouble from the centre outwards, leaving free, or comparatively so, a large area north of Wellsford and Port Albert. For the Teal Great Brarier Island was not affected, while a few were left at and about the top of the Coromandel Peninsula, with very small lots elsewhere. The Weka faded right out from Waipu to Gisborne. The great Teal populations of North Auckland, Auckland, Waikato, Coromandel area, Bay of Plenty, Gisborne and Wairoa simply vanished. It would seem that a virulent virus behaved in the same way as did the "Great Flu" (influenza epidemic) of 1918, which in its case started violently at a centre (Auckland) and eased as it spread out. The few Teal left in the affected areas seemed to lack the necessary vigour to stage a recovery.

The Northland population may have suffered too to some extent from the same cause at this time, but was nevertheless quite well maintained. Then it was hit by the second step downward for the species. This was irregular as to locality and lasted over a lengthy period, from about 1930 to about 1965.

Mrs. Madge Hows, of Awanui (pers. comm.), writes to the effect that at Takou and Otoroa in the Mangonui area and at Parua Bay, near Whangarei, the Brown Teal were in their hundreds about the late 1920s and 1930s. At Parua Bay they used to fly down from the bush to the bay after dark and ducks and ducklings would wander about the home garden, also after dark. Very soon they decreased and were quite scarce. The Weka was plentiful there also but about 1937-38 it failed. A neighbour, of "Stony Mountain," found dead ones under boulders and other cover. This could indicate that a common disease had hit both the Weka and the Teal in this district.

C. W. Kokich, of Kokopu, near Whangarei (pers. comm.), states that about 1925 to about 1930, when he was a youth, a stretch of about a third of a mile upstream from the Mangere Falls, on the Mangere River, carried about 500 Teal and oldtimers said there had been more. Other flocks were scattered along this small river, right up to its source in the Western Hills, just west of Whangarei. The crash came from about 1930 to 1935 or so and they faded right out, except for small lots visiting at times, but not staying. The Kokich property and some others were closed to shooting, but not those on each side of the Mangere Falls area and some of those further upstream. The Pukeko was then so rare as to be not a destructive factor. Mr. Kokich has made extensive studies of duck rearing in the wild on his farm.

In 1958 I carried out a survey in an arc up to about 20 miles from Whangarei, including Mangapai, Maungakaramea, Tangihua, Titoki, Parakao, Aponga and Purua. Every informant said he used to have plenty in his creek or on his farm but none seen for two, four, six or eight years now. In 1934 there were still about six in a small creek near Onerahi and three were seen in the Otaika River, but these soon disappeared.

Kaeo, Northland, is a well known haunt which in its river had in the 1950s a flock of up to 200. No doubt the flock would have been 500 or so in the early days. On 4/2/55 R. B. Sibson and V. M. Rutherford had c.120 (Notornis 6, 199). In August 1955, a winter count, T. M. Roberts (pers. comm.) had 39. On 31/3/56 J. and A. Prickett, 60 and on 20/4/57, 184. On 15/1/58, R. B. Sibson, 90. Early 1958, W. M. Garner, 80+. A. T. Edgar (pers. comm. and Recording Scheme), records of several visits each year from 1961 to 1970 showed the maximum counts to decrease from 62 in 1961 and 1962 to 30 in 1970.

At Helena Bay, at Teale's farm, about 1955, with J. and A. Prickett, I saw a flock of 17 and in April, 1965, D. V. Merton (official Wildlife Report) 32. I have heard that it was shot out by campers.

The whole of Auckland is covered in a comprehensive official report, 19/5/64, by D. V. Merton, now Chief Conservation Officer of the Internal Affairs Department. Numerous localities are treated and information has been painstakingly gathered. He concluded that the decline has been extensive and is continuing in peripheral areas. The subspecies must therefore be regarded as endangered even though some remnant colonies elsewhere appear to be relatively stable.

For Whitianga. D. V. Merton (pers. comm.) reports, 10/3/65, "None heard of for many years now. Numbers decreased 35 years ago" (W. McLeod). In the late summer of 1909 I saw a flock of c.75 at the tidal limit of the Kaimarama River. I heard of other flocks in the streams running into the Whitianga estuary.

At Katikati, Bay of Plenty, G. Henry (pers. comm.) remembers the species to have been plentiful in the many creeks leading quickly down from the hills to the sea, each with its slack water estuary. Only the long-standing residents can now remember it.

At Te Araroa, near East Cape, in 1952, I met Mr. O. J. McLachlan, an old settler there of early days, who told me that the Brown Teal was once plentiful but now long absent.

Evidence that this Teal was once plentiful about Auckland is supplied by labelled skins of the 1880s in the Auckland War Memorial Museum from Ellerslie, Remuera and St. John's Lake. There are also two purporting to have come from Mayor Island in 1931.

In addition to the known causes of decrease there is much speculation as to the part played in this respect by the Pukeko *Porphyrio melanotus*. C. W. Kokich (pers. comm.) has told of Pukeko eating the cast eggs of Mallard about his farm steading, whereas at one of the dams back up the farm they did not touch the eggs in a prepared nest in their view. He also states that when the Kokopu flock in the Mangere River near his home dwindled to nothing from c.500 there was hardly a Pukeko to be seen. Mrs. A. Sundstedt wrote, in response to my letter in the "Northern Advocate," "I noticed in yesterday's 'Advocate' a piece relating to the disappearance of the native Brown Duck, so thought this might interest you. Most of my life I lived on a little farm at Umawera where we had a small creek running through it. Well, years ago there were numerous specimens of this duck, but of late years they became less and less. Several times during spring I used to hear cries of distress amongst these duck, so investigated the cause and found that Pukekos were killing and eating the little ducklings and we even had our three-quarter grown Indian Runner ducks killed by these birds. This no doubt accounts for one reason why the birds are disappearing." The Pukeko is evidently variable in its predatory habits.

There is some evidence that disease caused trouble in Northland but it was certainly not general. Relentless pressure from clearing and draining of habitat, predators and intensive shooting were no doubt the principal factors in this second decline, which left patches here and there, some fairly substantial, but now worn down to a dangerous level.

INQUIRIES AT WAIPU

When it was realised that the Brown Teal had gone completely from about Auckland, Waipu became quite a "Mecca" for the local ornithologists, it having the nearest approachable Brown Teal habitat. By this time numbers were becoming low and concern was felt for the future. The Internal Affairs Department made the lower five miles or so of the Waihoihoi Stream a "Closed Game Area" to stop shooting. Its Wildlife Branch officers started counting the teal on it from 28/8/50.

Counts were 28/8/50, 23; 23/1/52, 65; 9/9/53, 45; 14/1/55, 52; 22/2/56, 40; 30/10/56, 52. It is to be noted that the winter and spring counts are lower, the species being an early breeder and therefore scattered. Flocking after breeding accounts for the higher summer counts.

I strongly suspected that these counts of the lower Waihoihoi did not indicate the populations of the unprotected creeks in the Waipu watershed and that the total population could be alarmingly low. In 1958 I conceived the idea of taking a full census of the district to test this. I approached G. K. McKenzie of Clevedon, formerly of the Waipu area and fully acquainted with its people and the terrain. With a busy time on the telephone at long range

he arranged billets and permission to cross farm properties, at the same time gathering much up-to-date information. I called for ornithological volunteers and arranged transport and the teams to work the several creeks. I invited the Controller of Wildlife to have staff join us and this was accepted. I cannot speak too highly of the gracious hospitality and co-operation of the people of Waipu, both for this 1958 census and that of 1963.

This census of 18-19/7/58 gave a count of 19 for the 5 miles or so of the Waihoihoi Closed Game Area and 58 for the other 60 or so miles of creeks. Wildlife Waihoihoi counts following this were 26/8/59, 18; 2/2/61, 9; 10/8/61, 6.

The second census of 30-31/5/63 produced 13 for Waihoihoi and 35 for the rest of the area. Further Waihoihoi Wildlife counts were 8/7/64, 2; 9/10/64, 2; 3/3/65, 4; 21/7/65,0; 1/9/65, 5. This shows the futility of counting rare species and doing nothing else.

The 1958 census, as pointed out by Logan C. Bell (pers. comm.), was in the early part of the breeding season so not entirely satisfactory since if it had been taken earlier higher numbers would have shown the decline to the 1963 count to have been more severe.

PUBLICITY

On 13/1/53, after I had made the survey around inland from Whangarei, I wrote to the Whangarei Native Forest and Bird Protection Society, urging attention to the loss of the bird in so much of the area and suggesting publicity. Nothing resulted from this and further correspondence. Mrs. O. Cullen, of Whangarei, took the matter up earnestly and her death was a loss to the cause. Mrs. A. Sundstedt contributed useful information, as did C. W. Kokich.

On 16/1/53 the newspaper " The Northern Advocate " printed for me the following letter:

" VANISHING DUCK. The Teal Duck, now known as the Brown Duck *Elasmonetta chlorotis*, appears to be in grave danger of becoming extiinct. Numerous throughout the country about 30 years ago, it suddenly disappeared, except for remnants in Northland, the south-west Sounds of the South Island and Stewart Island. Now, though protected by law, it seems to be fading again in Northland.

A recent partial survey by the writer of the farming districts about Whangarei, from Mangapai to Pipiwai, makes a sad story. The invariable response to enquiries was that the teal had been plentiful a few years ago but had not been seen now for two, four or six years. It is still present at Waipu and Ruakaka, where strict protection has been practised.

It is hoped that any farmers finding this bird on their property will get their neighbours to co-operate in saving it, preventing illegal shooting and warning legal sportsmen of its presence. To keep this harmless and engaging little native duck from dying out should be worth considerable effort.

H. R. McKenzie, Clevedon."

This letter was of course too late, as the teal had already practically died out in the Whangarei area, but more could have been done about Waipu and Ruakaka; also further north.

THE FUTURE

The provision of protection is the only hope for the species. C. W. Kokich, Kokopu, Whangarei, with his set of dams, has amply proved that Grey Duck and Mallard can, without other help, withstand the pressure from natural enemies if given suitable habitat and safety from shooting. No doubt the same would apply to the Brown Teal. In its case one of the chief obstacles is its habit of moving from one area to another so that a very large range is required. Ordinarily this can be provided only by having a group of large farms, with suitable water and cover, closed to shooting. Some Teal would of course wander over the boundary and be shot, but there would still be a nucleus at least.

Absolute protection is the answer to the near-miracle of the presence of this bird on Little Barrier Island, where there is no open water, swamp or mudflat. A detailed account of its residence and breeding is given by R. H. Blanshard (Notornis 11, 49-51).

The position at Great Barrier Island is good at present, with only moderate shooting, but danger lies ahead in the form of the development which is sure to come.

The dams on A. T. Edgar's farm at Kerikeri have not enough neighbouring closed country to ensure much increase, but as long as he owns the property there will be a nucleus. Properties changing hands is a menace to the group-of-farms scheme, which nevertheless is the right policy to be pursued. We have no sanctuaries large enough or suitable for the species. Wildlife has raised some Brown Teal at its Mt. Bruce establishment and a few have been put on Kapiti Island, where at least one brood has since been observed. The aim is to have the species breed under protection there and then to spread naturally to the chain of lakes, lagoons and swamps along near the west coast of the Wellington Province. The plan is good but the heavy shooting over that area may well defeat it.

Breeding by farmers and others, under permit, on closed groups of farms should be preferable to transfers of adult birds. Ducklings hatched and reared by a domestic duck may feel the place to be their home base, even if they move away at first. A. T. Edgar (pers. comm.) has had the experience with Brown Teal breeding on his dams of the young, when full grown, leaving the area sooner than the parent. It is not of course known whether the same ones return later. Experiment is urgently necessary. Private persons, if advised of the unhappy prospects for the Brown Teal, would surely be glad to give a helping hand if they had permission and encouragement.

ACKNOWLEDGEMENTS

I am grateful to Mr. R. B. Sibson for needed attention to the text and to all those mentioned in it for their help with information.

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NOTES ON THE BIRDS OF GREAT ISLAND, THREE KINGS ISLANDS

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Birds of the Three Kings Islands have been discussed by Turbott and Buddle (1948) and Turbott (1951). Major changes have occurred in the vegetation of Great Island, following the extermination of 393 goats in 1946, and it appears that there have been some changes in the bird fauna during this period, probably largely as a result of vegetation and soil changes. The following observations were made during the D.S.I.R. Entomology Division Expedition on Great Island (6-30 November 1970).

The vegetation of Great Island as it was in 1946 when goats were destroyed has been described by Baylis (1948), and the effect of goats on the vegetation (and incidentally on other animal life) was discussed by Turbott (1948). Incipient forest regeneration observed in 1951 was described by Baylis (1951). The trends noted then have continued, i.e. tree and shrub species palatable to goats are spreading, while previously open areas have been colonised, chiefly by kanuka *(Leptospermum ericoides)* and to a lesser extent by manuka *(Leptospermum scoparium)*. Kanuka remains the only canopy tree over most of the island, but in some places other species, especially puka *(Meryta sinclairii)*, mangaeo *(Litsea calicaris)*, *Brachyglottis arborescens* and *Cordyline kaspar* are now reaching, and in a few places forming, the canopy. Most of the mature trees of pohutukawa *(Metrosideros excelsa)*, mangaeo, puriri *(Vitex lucens)* and other broad-leafed species which survived the goat era, remain. There is usually a dense understory, especially of *Coprosma rhamnoides*, but frequently including also *C. macrocarpa*, hangehange *(Geniostoma ligustrifolium)* and mahoe *(Melicytus ramiflora)*, with some other species locally. Little open grassland remains, but in some places a dense growth of grasses and sedges still occurs under the kanuka canopy.

The Three Kings Bellbird *Anthornis melanura obscura* is the only bird population on the Three Kings which is sufficiently distinct from its mainland relatives to receive formal nomenclatural recognition as a subspecies. This contrasts with plants, of which there are several endemic species, and particularly with flightless and weakly flying terrestrial invertebrates, in which endemism at the specific level seems to be the rule rather than the exception. For the less dispersible biota, the Three Kings have apparently been isolated long and effectively.

Red-billed Gulls *Larus novaehollandiae scopulinus* are abundant, and have numerous colonies around the coast amongst *Disphyma australe*, *Cyperus ustulatus* and other maritime plants. Nests with eggs (usually two), and at the end of our visit, young chicks, were noted. At least two birds were seen with a peculiar slender, ventral movable red outgrowth from the base of the lower mandible. This appeared to be part of the bill, and seemed not to incapacitate the birds. Turbott (1951) has recorded the vital part played by gulls in carrying seeds of *Meryta* from the smaller islands to Great Island (where for many years it was extinct because of goats).

Petrel and shearwater burrows are very numerous on a number of seaward-facing slopes. The Fluttering Shearwater *Puffinus gavia* was by far the most abundant burrower seen (and heard!) ashore at night. Less frequent were Diving Petrels *Pelecanoides u. urinatrix*, and a few Grey-faced Petrels *Pterodroma macroptera* were seen. Well-grown chicks of the Diving Petrel and Grey-faced Petrel, and young chicks of the Fluttering Shearwater, were present.

At sea large flocks of Red-billed Gulls and Fluttering Shearwaters were seen working near the island, and Diving Petrels were present in smaller numbers, together with a few Grey-faced Petrels and Sooty Shearwaters *Puffinus griseus*. Terns, almost certainly the White-fronted Tern *Sterna striata* and Gannets *Sula serrator* were seen out to sea several times.

A shag, probably the Pied Shag *Phalacrocorax varius* was seen on the rocks at the landing beach and then fishing offshore in Northwest Bay, until it was mobbed and driven off by aggressive Red-billed Gulls which pursued it as far as the eye could see. Gulls were also observed mobbing a Gannet. This aggressive behaviour by Red-billed Gulls probably explains why they are the only seabirds nesting on the shores of Great Island.

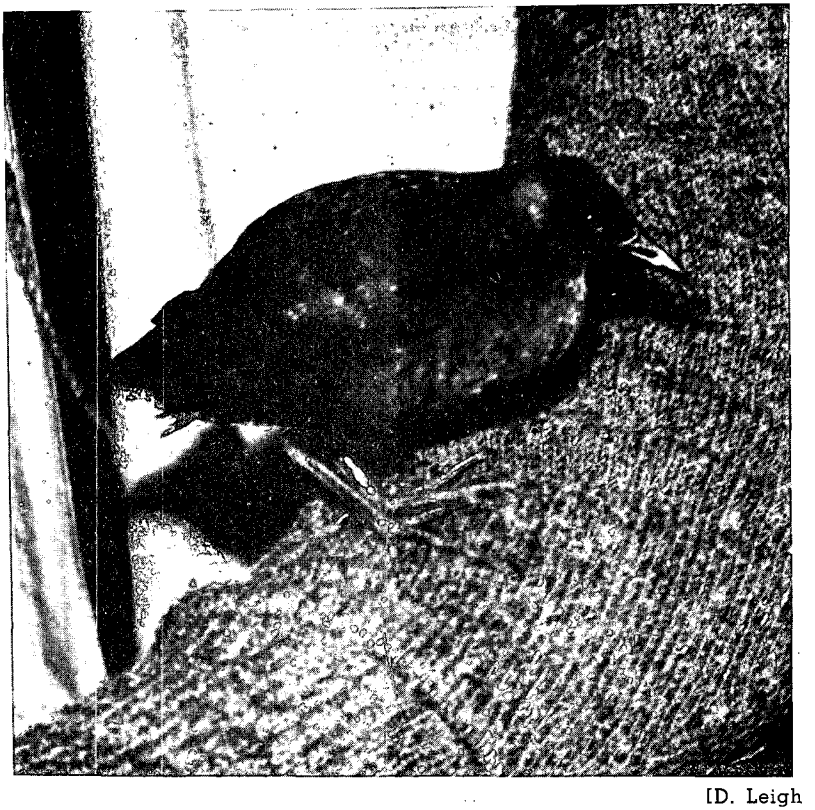
Among land birds, Bellbirds and Red-crowned Parakeets *Cyanoramphus novaezelandiae* are abundant and generally distributed over Great Island. The glorious evening chorus of Bellbirds, gradually fading to isolated bell notes, added to the pleasure of our visit. Three fledgling Bellbirds were noted being fed by their parents near the Castaway Depot. Adults were seen feeding on insects, but not on nectar.

Parakeets were seen on several occasions feeding on berries of *Meryta*, and have no doubt been instrumental in spreading this plant on Great Island. The dense growth of puka beneath some old pohutukawas may be due to parakeets perching and voiding in such places. A nest of a parakeet was found, hollowed out in an almost horizontal rotten kanuka trunk in Tasman Valley, and contained six eggs.

Brown Quail *Synoicus ypsilophorus* were encountered frequently, especially in the clearing near the beacon, on the saddle, and in areas with a high kanuka canopy and undergrowth predominantly of grass. Fantails *Rhipidura fuliginosa placabilis* were moderately common, and were frequently observed feeding on small flying insects (probably Diptera).

A pair of Banded Rail *Rallus philippensis* were often seen near our camp in Castaway Valley, especially as they became tamer towards the end of our visit. Spotless Crake *Porzana tabuensis plumbea* were heard calling in this area, and one (Fig. 1) was caught at dusk in a mist net. This delightful small bird stood calmly on the arm of one of us for several minutes while it was photographed, and had to be encouraged to leave this perch for release, yet the species is very rarely seen due to its timidty in normal circumstances.

Moreporks *Ninox novaeseelandiae* were often heard and occasionally seen. Two nests were observed in Tasman Valley. One was situated in a vertical bank of the Tasman Stream, and comprised a large internal chamber with an upper and lower entrance



[D. Leigh

FIGURE 1 — *Spotless Crake, Great Island, Three Kings Islands, Nov., 1970.*

opening indirectly to the exterior. This nest contained a single young chick, and the remains of three geckos *(Hoplodactylus pacificus)* and a large centipede (*Cormocephalus* sp.). The other nest was a straight burrow in soil beneath a large boulder, and contained two eggs. The first nest could well have been formed from the enlargement of two adjacent Kingfisher burrows (of which there were several unoccupied nearby).

At least two pairs of Harriers *Circus approximans* were present, and three were seen on the wing simultaneously near Bald Hill. Kingfishers *Halcyon sancta* were frequently heard and occasionally seen, especially in Tasman Valley. A Shining Cuckoo *Chalcites lucidus* was heard several times, and a larger bird which was probably a Long-tailed Cuckoo *Eudynamus taitensis* was seen once fleetingly on the saddle. Pipits *Anthus novaeseelandiae* were frequent in the open areas, which are, however, much less extensive now than they were in 1946.

The Blackbird *Turdus merula* appeared to be the most common adventitious bird, and was seen often on most parts of the island.

Starlings *Sturnus vulgaris* were often seen flying, especially about the cliffs, but no flocks were observed. A flock of at least 10 Indian Mynas *Acridotheres tristis* was seen once in the clearing around the beacon, and smaller numbers of this species were noted elsewhere on other occasions. The Myna has apparently arrived fairly recently on the Three Kings, as it has not been recorded in earlier reports. In view of the known migratory behaviour of this species, it is possible (although unlikely) that the birds observed were not breeding residents on the Three Kings.

The following birds were examined for ectoparasites: Diving Petrel (3), Fluttering Shearwater (4), Grey-faced Petrel (3), Parakeet (1), Spotless Crake (1), Morepork (1), Bellbird (7). Ectoparasites collected included lice, fleas, feather mites and mosquitoes.

Several sea-birds previously recorded from the vicinity of the Three Kings were not seen. The Allied Shearwater *Puffinus assimilis* and the Black-winged Petrel *Pterodroma nigripennis,* which have previously been recorded breeding on Great Island were not observed, probably because we did not visit their reported nesting sites at night.

The following land birds which were recorded by Turbott and Buddle (1948) were not seen or heard by the Entomology Division Expedition: Silvereye *Zosterops lateralis,* Chaffinch *Fringilla coelebs,* Redpoll *Carduelis cabaret,* Goldfinch *Carduelis carduelis,* House Sparrow *Passer domesticus,* Yellowhammer *Emberiza citrinella,* Song Thrush *Turdus philomelos,* and Hedge Sparrow *Prunella modularis.* None of these were observed in more than small numbers by earlier expeditions, and our observations of birds were incidental to other work, so it is possible that some are still present on Great Island but were not seen. However, it would be surprising if the substantial changes in vegetation, and especially reduction in open areas, since the goats were exterminated, had had no effect on the bird fauna. Thus it seems very likely that some of these adventitious land birds no longer occur on the Three Kings.

Great Island now has no mammals at all, and hence it is very important as a rat-free nature sanctuary. The vegetation changes seem to have had little adverse effect on the native birds (except perhaps the Pipit). There is almost certainly a more abundant food supply for forest birds now, i.e. a greater diversity of vegetation (and associated invertebrates) occurs over much of the island which was formerly clothed only in goat-resistant plants.

We wish to record our grateful thanks to the Ministry of Defence, and especially to Lt.-Commander Arnott and the officers and crew of H.M.N.Z.S. Kiama, who provided transport to and from the islands, and assisted with carrying heavy equipment up 300 ft. of steep, crumbling slopes.

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THE BIRDS OF NIUE ISLAND, SOUTH PACIFIC: AN ANNOTATED CHECKLIST

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ABSTRACT

The checklist of the birds in Niue Island, South Pacific (19° S. 169° W.), consists of 19 species (5 sea birds, 3 shore birds, and 11 land birds). Niuean and English vernacular names have been added. Five new bird species are now recorded from Niue Island for the first time. Of the five sea bird species two (Common Noddy and White Tern) are known to breed on the island and a third (White-tailed Tropic Bird) possibly breeds and three species (White-tailed Tropic Bird, Common Noddy and White Tern) are common. All three shore birds species are migrants but only one (Pacific Golden Plover) is common. Among the land birds the presence of the migratory Long-tailed Cuckoo is recorded for the first time and all the remaining ten species are resident and breeding. However, only four species (Banded Rail, White-rumped Swiftlet, Polynesian Triller and Polynesian Starling) are common.

The affinities of this restricted avifauna with those of the neighbouring archipelagos of Samoa, Tonga and the Cook Islands are briefly discussed as are the abundance and the status of the birds breeding on Niue. Finally some research problems and the conservation of species that are at present endangered are briefly presented and some tentative recommendations are made.

Relatively little has been published on the avifauna of Niue Island, and no qualified ornithologist has ever visited Niue for the purpose of studying birds. The two American expeditions — the Whitney South Sea Expedition in the nineteen-thirties and the recent Central Pacific Survey of the Smithsonian Institution both missed Niue Island; and although the excellent manual of King (1967) includes Niiue Island in the area covered by that publication no mention has been made of the sea birds of the island. Since the 1968 hurricane that devastated Niue and the looper caterpillar plague that appeared in its wake there has been an increased interest in the birds of Niue (as shown by a recent issue of stamps) and the part they may play in controlling insect populations.

The present paper briefly reviews information published on the birds of Niue, provides an annotated checklist and concludes with recommendations for further study and bird preservation.

LOCATION, TOPOGRAPHY AND ENVIRONMENT OF NIUE ISLAND

Niue Island (19°S., 169°W.) does not form part of any island group, lying 480 km east of Tonga, 500 km south-east of Samoa and about 1,040 km west of the Southern Cook Islands.

The island (Fig. 1) is an elevated coral outcrop with two terraces: the lower terrace being at about 28 m and the upper terrace at about 69 m above sea level. Apart from the rise from the lower to the upper terrace, there are no hills and there are no streams or surface water. The coastline is broken and precipitous with a fringing coral reef and without good harbours. The island's area is over 295 sq.km (about 100 sq. miles); it is about 21 km long and 18 km wide; the main road which roughly follows the coastline is about 64 km in length.

The climate is oceanic and sub-tropical with a mean annual temperature of 76.4°F and a mean annual rainfall of 80.6 in. with occasional droughts. East-south-east winds prevail though variable winds, particularly during the summer months, from west, north and

FIGURE 1 — Map of Niue Island from a N.Z. Department of Lands and Survey aerial mosiac, 20 chains to 1 inch, compiled from aerial photographs taken in August, 1965. Vegetation from Frost and Berryman, 1966.

north-west may occur. Niue is on the edge of the hurricane belt and winds of high velocity sometimes prevail such as the severe hurricane that struck the island on 9th February, 1968, and had a profound effect on the island's biota.

The vegetation of Niue Island comprises 629 taxa of vascular plants (Sykes, 1970). The main habitats of importance to bird life are (Fig. 1): (i) the remnants of the original tropical rain forest of tall trees with a relatively dense canopy and the coastal forest below the second terrace; (ii) large expanses of secondary forest in various stages of regeneration; (iii) large patches of scrub more modified by man and dominated by *fou (Hibiscus tiliaceus)* and " fernlands " with *Nephrolepis hirsutula,* the dominating fern species, and finally (iv) the three Government farms, the areas with fruit crops and the coconut palm groves with the legume *Seratro,* all form different plant communities.

Among terrestrial insects indigenous and adventive abound: (Eyles, 1965 and 1968, Given, 1968) recorded 376 species of insects belonging to fifteen orders. Several of them such as flies or the moth *Cleora samoana* are of considerable ecological importance together with numerous lizards belonging to four species (Whitaker, 1969). Among mammals of importance to wildlife of Niue the Polynesian rat or *kuma (Rattus exulans),* the roof or ship rat *(R. rattus)* and feral cats should be mentioned (Wodzicki, 1969).

PREVIOUS OBSERVATIONS OF THE BIRDS OF NIUE

Hood (1863) considered that " the natural history of Niue possesses no particular interest " but stated that " doves and pigeons abound." Brenchley (1873) observed: " With the exception of fowls, which are reared everywhere, there are but few birds; among them are pigeons or doves of a green colour, parrots, a pretty little green bird with white feathers under the tail, a small martin or swallow, the tropic bird or the boatswain . . ." Ramsay (1878) describing the collection made by the Rev. Mr Whitmee mentions " a Ptilinopus sp." which he named " *P. whitmeei,* in honour of its discoverer " and " an Aplonis ": presumably the Polynesian Starling or Miti, *Aplonis tabuensis.*

Smith (1902) supplied the most comprehensive list of Niue Island birds with notes on their biology: it includes 13 land and shore birds and 5 species of sea birds. He also notes that the *kiu* plover is known to exist on the island in four varieties: *kiu-ulu-fua, kiu-valuvalu, kiu-hakumani* and *kiu-uta.*

The Earl of Ranfurly, while Governor-General of New Zealand, procured 14 specimens of birds from Niue Island. This collection was deposited at the British Museum (Natural History) and has been identified by Ogilvie-Grant (1905). It contains the following: Sooty Rail *Porzana tabuensis,* Crimson-crowned Fruit Dove *Ptilinopus porphyraceus,* Blue-crowned Lory *Vini australis,* Long-tailed New Zealand Cuckoo *Eudynamis taitensis,* White-rumped Swiftlet *Collocalia spodiopygia,* Polynesian Triller *Lalage maculosa* and Polynesian Starling *Aplonis tabuensis.*

We owe to Loeb (1926) an account of the old methods used for catching birds such as nets, bow and arrow, and snares. However, already in the early twenties, the old men assembled in *fono* " insisted

that the former methods have passed entirely from the recollections of the people." Loeb also recorded the birds that still formed articles of diet during his stay in Niue. They were: *lupe (Ducula pacifica), tuaki (Phaeton lepturus), taketake (Gygis alba), Kulukulu (Ptilinopus perphyraceus), henga (Vini australis), misi (Aplonis tabuensis), kale (Porphyrio porphyrio),* and *ngongo (Anous stolidus).* The following bird species were said never to have been used as food: *lulu (Tyto alba), kalue (Eudynamis taitensis), heahea (Lalage maculosa), peka-peka (Collocalia spodiopygia), kalangi (Puffinus pacificus), kiu (Pluvialis dominica),* and the curlew *(Numenius tahitiensis).* Finally, Loeb gave an account of bird lore of Niue and of various omens connected with certain species.

Mr. Edwin J. Bryan, Manager, Scientific Information Centre, Bishop Museum, Honolulu, Hawaii, kindly provided copies of bird paintings by Niuean school children of the following twelve bird species: *kulukulu, henga, tuaki, misi, heahea, kalue, kiu, motuku, ngongo, lupe, pekapeka* and *kale.* The above species must have been common, if they were well known to children. It is of interest to note that the *veka,* nowadays so common, is not included in the paintings.

Mayr (1945) recorded eight out of ten species of shore and land birds known to Ogilvie-Grant (1905) and others.

A preliminary account of the present survey (Wodzicki, 1969) listed 19 species and a full account of these birds is given below.

MATERIAL AND METHODS

A survey of rodents of Niue Island conducted in November 1968 and July-August 1969 provided an opportunity to carry out bird observations throughout the island. Birds that could be easily seen from a vehicle were noted and Fig. 1 shows the roads on which road counts have been carried out and the localities where some of the less common birds were noted. In addition it has been the writer's privilege to be assisted by Messrs. Luka Tauelima and Samuel Tohilima, Department of Agriculture, Government of Niue, both experienced field naturalists. The observations provided by these two gentlemen have been included into the accounts of the species found on the pages below.

A questionnaire embracing the birds of Niue Island divided into sea and land birds and their present status was distributed in November, 1968, among the thirteen Assemblymen of Niue: it provided important, initial basic information.

Captain J. A. F. Jenkins made a small collection of birds in Niue Island during 1963 which is deposited at the Auckland Institute and Museum. This collection has been examined and details and measurements are itemised in the species synopses, where applicable, in the following order: Auckland Institute and Museum (AM) number, locality, date, sex, bill, tarsus, toe, wing and tail length (mm.) and weight (gm) if available. All measurements were taken from study skins. Four additional study skins from Niue Island, deposited at the Dominion Museum (DM) have also been examined.

The nomenclature and systematic arrangement of the birds listed in the present account follow Kinsky (1970).

The orthography of the Niuean bird names follows the spelling adopted by Mr. J. M. McEwen in his dictionary of the Niuean Language (1970): thus the previous " gogo " is now, as in the Maori language rendered by " ng "; also the " t " in " miti " becomes " misi."

RESULTS

Introductory

The list below shows the scientific and vernacular names (English and Niuean), also information on the status of the birds *(manu-lele)*, the dates of the observations, and information on the specimens collected. The birds listed are broadly classified as sea birds, shore birds and land birds. Subspecific names have been given wherever sufficient taxonomic information is available.

Annotated Checklist

Order Procellariiformes

Family Procellariidae

1. *Puffinus pacificus* (Gmelin, 1789). Wedge-tailed Shearwater. *Kalangi.* Non-resident, uncommon. One specimen in the Jenkins collection, AM 131.17., at sea, —, 40, 46, 60.5, 308, 165 and 425. Another specimen was photographed by Matron H. Gray in February 1971. Known to nest on Tonga, Fiji, Samoa and the Kermadecs (King 1967), very seldom reported and not observed by the author.

Order Pelecaniformes

Family Phaethontidae

2. *Phaethon lepturus* Daudin, 1802. White-tailed Tropic Bird. *Tuaki.* Resident, fairly common. Noted by Brenchley (1873) and Smith (1902). Three specimens in the Jenkins collection: AM 1207.6, Mutalau, 30/11/63, —, 43, 22, 37.5, 275, 483 and 250. AM 1207.8, Hikutavake, (" Fau Etama "), 26/10/63, —, 43, 25, 39, 266, —, and 283.

Frequently seen flying inland towards the central part of the island in November, 1968, and July-August, 1969, where it apparently nests on trees. Brenchley (1873) reported that the " tail feathers are used to make elegant fly-brushes, the handles of which are neatly bound with plaited human hair."

Family Fregatidae

3. *Fregata minor* (Gmelin, 1788). Pacific Man-o'-War or Greater Frigate Bird. *Kota* or *Manu Folau.* Visitor. Uncommon. An immature specimen in the Jenkins Collection: AM 111.23, Tuapa, 4/11/63, 114, 32, 74, 630, 311 and 1930. Not mentioned by previous authors nor seen by the writer in 1968 and 1969.

Order Gruiformes

Family Rallidae

4. *Rallus philippensis* Linnaeus, 1776. Banded Rail, *Veka.* Resident, very common. One specimen in the Jenkins collection: AM 5777, Vaipapahi, 10/10/63, female, 28.5, 50, 60, 141, 61.5 and —. Five specimens were accidentally collected during rat control experiments in coconut groves with *Serato* ground cover on Vaiea experimental farm (Fig. 1). These specimens were deposited at the Dominion Museum and details of their measurements are: DM 16,232, Vaiea Farm, August, 69, male, 32.5, 55.8, 51.5, 138, 60.7 and 232; DM 16,233,

Niue Island, 8/5/69, male, 31.9, 54.7, 52.8, 154.5, 64.6 and 315; DM 15,512, Vaiea Farm, 7/8/69, male, 30.2, 53.8, 51.5, 153.5 and 55.5; DM 16,185, Vaiea Farm, 12/8/69, chick, 85 g and DM 16,184, Vaiea Farm, 12/8/69, chick, 60 g.

The presence of two unfledged chicks of 85 and 60 g respectively would indicate a 1969 nesting season in about mid-winter, shortly after solstice.

The changing status of this species during about three-quarters of a century deserves comment. Smith (1902) reported its status as "extinct." Mr. Barry Good (pers. comm. 1968) has stated that when he first visited Niue in the early nineteen-fifties, few, if any *vekas* could be seen on the roads. About that time a pair of *vekas* were captured in the southern part of the island and later kept as a great rarity and bred at Fenuakula Farm (J. M. McEwen pers. comm. 1969). In 1953 *veka* were still very scarce; when a cat killed a young *veka* at Tapeu, the body was taken to a village to show a bird which to most villagers was at that time only known by its name. However, by 1956 the *veka* was already making a recovery as it was being observed on roads.

In 1968 and 1969 *veka* were very common and widely distributed. They were seen on all roads, singly or in pairs, occasionally in company of *kale*.

At present villagers consider the *veka* as a noxious bird: in five out of six questionnaires the *veka* is referred to as a "bad bird" to crops, particularly kumara.

5. *Porzana tabuensis tabuensis* (Gmelin, 1789). Sooty Rail. *Moho.* Resident, uncommon. An immature specimen was collected on 17 April, 1902, by the Earl of Ranfurly and Ogilvie-Grant (1905) recorded this specimen. Amadon (1942) listed another specimen and Mayr (1945) included Niue together with Fiji and Tonga as islands inhabited by this rail. According to J. M. McEwen (pers. comm. 1969) *moho* were seen in the mid-fifties. It was not observed by the writer in 1968 nor in 1969 but a rail smaller than the *veka* was reported by Niuean observers. It may therefore be still present in the interior of the island and it is being tentatively included in the present check-list.

6. *Porphyrio porphyrio* (Linnaeus, 1758) (ssp. *vitiensis* ?). Purple Swamphen. *Kale.* Reported by Smith (1902). J. M. McEwen stated (pers. comm. 1969) that *kale* was common round 1956 and was at that time considered as a nuisance to crops. It was seen by the writer from time to time in 1968 and 1969 but significantly less frequently than the *veka.*

Order Charadriiformes

Family Charadriidae

7. *Pluvialis dominica fulva* Gmelin, 1789. Pacific Golden Plover. *Kiu.* Non-resident, migrant, very common. Three specimens in the Jenkins Collection: AM 6944, Vaipapahi, 10/10/63, female (winter plumage), 22.5, 44, 31.5, 148, 72, —; AM 6945, Vaipapahi, 11/10/63 (winter plumage), 23.5, 46.5, 34, 162, 75, —; AM 6946, Toi, 1963, female (breeding plumage), 23, 43, 35.5, 160, 76, —.

One of the most common birds seen on roads, gardens and other open spaces. It may be keeping loose territories as similar

numbers of kiu were observed in the gardens of Tapeu, during July and August, 1969. It would also appear that a substantial part of the *kiu* population migrating to Niue remains on Niue during the northern summer (see road counts below).

8. *Numenius tahitiensis* (Gmelin, 1789). Bristle-thighed Curlew. *Motuku.* Non-resident, migrant. Not common. One specimen in Jenkins collection. AM, 334.4, reef, Alofi Bay, 30/11/63, —, 91.5, 60, 52, 130(?), 109 and 360. Not seen by the writer in November, 1968, and July-August, 1969.

9. *Tringa incana* (Gmelin, 1789). Wandering Tattler. *Kiu-tahi.* Non-resident, migrant, uncommon. Two adult specimens collected by the Earl of Ranfurly, one in the summer and one in winter plumage (Ogilvie-Grant, 1905). Another specimen in the Jenkins collection, AM 1208.7, Hikutavake, male, 11/10/63, —, 36, 38.5, 32, 174.5, 88 and —. Not observed by author.

Suborder Lari
Family Sternidae

10. *Anous stolidus* (Linnaeus, 1758) (ssp. *pileatus* ?). Common or Brown Noddy. *Ngongo.* Resident, common. Single birds or pairs flying inland were seen daily and nesting has been reported in the forest of the interior.

11. *Gygis alba* (Sparrman, 1786). White or Fairy Tern. *Taketake.* Resident, common. Reported by Smith (1902). Single birds or pairs flying inland seen daily, particularly in the mornings, and nesting has been reported in the tall forest of the interior.

Order Columbiformes
Family Columbidae

12. *Ptilinopus porphyraceus porphyraceus* (Temminck, 1821). Purple-capped Fruit Dove (sometimes called " Crimson-crowned Fruit Dove "). *Kulukulu.* One specimen in Dominion Museum: DM 15,827, Vaiea, male, May 1970, 12.6, 28.5, 27.0, 131.2 and 90.0. The author following Goodwin (1967) regards this specimen as falling into the nominate race of this species.

This beautiful dove was first recorded from Niue by Ramsay (1878) as *P. whitmeei.* It was known to Smith (1902) and was identified by Ogilvie-Grant (1905) on one adult example collected on 17 June 1902. In those days according to Smith the " sweet 'coo' was constantly heard in the woods " and, its yellow feathers were " much prized for purposes of ornamentation."

The writer has found *kulukulu* common in places but definitely less common than in Smith's days. For instance in the dense but narrow belt of coastal forest between the lower and the higher terraces, behind the Hospital at Alofi, one could often hear two or three *kulukulu* cooing at a time. It is absent from most of the upper terrace land, except localities where either there is still standing tall, primeval forest or the land is in an advanced stage of regeneration.

13. *Ducula pacifica* (Gmelin, 1789). Pacific Pigeon. *Lupe.* Resident, not common. In the Jenkins collection there is an immature specimen: as described by Amadon (1943) it lacks the horny knob, the grey of the hind part of neck is darker and the plumage of the underparts is tinged with brownish and dusky when compared with the clear vinaceous tinge of the adults. Details of this specimen are: AM 2164, Niue Island, 7/1/64, —, 23, 44, 178.5, — and —.

In pre-European days this widely distributed pigeon used to be very common and kept in captivity. It has been also claimed that *lupe* was the only animal domesticated. It was noted by Brenchley (1873). According to Smith (1902) *lupe* were caught by the use of decoy birds and nets and the catching of pigeons was an " amusement of the chiefs, as it was in Samoa." Loeb (1926) described the importance of *lupe* in the diet of Niueans and the use of sling, bow and arrow and bird net for catching pigeons. Prayers to Huanaki, the god of the pigeon, preceded hunting.

The few *lupe* seen on the wing by the author were all in or in the vicinity of the tall forest. It was reported to the author that the hunting pressure is severe and this was confirmed by seeing *lupe* served at the *fia-fia* banquets attended by the writer. This, with the gradual decrease of the primeval forest area on the island, has largely contributed to the present drastic reduction of the pigeon's numbers.

Order Psittaciformes

Family Psittacidae

14. *Vini australis* (Gmelin, 1788). Blue-crowned Lory. *Henga.* Resident, not uncommon. This small lory is also found in Samoa and Fiji (Mayr, 1945). Recorded by Smith (1902) and by Ogilvie-Grant (1905, 2 adult specimens). Three specimens were seen during November 1968: one was observed in the coastal forest between Taumakautoga and Alofi South, another between Tutakolu and Hakupu; and a *henga* was captured at Liatau, near Lakepa. During July and August, 1969, a pair of *henga* was frequently observed near Vaiea on the border of fernlands and second growth forest. Other birds were occasionally seen on the edge of second-growth forest and fernland.

Order Cuculiformes

Family Cuculidae

15. *Eurodynamis taitensis* (Sparrman, 1787). Long-tailed New Zealand Cuckoo. *Kalue.* Migrant, uncommon. Not known to Smith (1902) but an adult bird has been recorded by Ogilvie-Grant (1905). J. M. McEwen (pers. comm. 1969) recalls that during his period of residence at Tapeu (1953-1956) he used to observe *kalue* every March in the Residence gardens. Not seen in July-August, 1969, when *kalue* should be present on Niue. The Assemblymen from Avatele, Liku and Tuapa villages recorded *kalue* as rare or very rare.

Order Strigiformes

Family Strigidae

16. *Tyto alba lulu* (Peale, 1848). Barn Owl. *Lulu.* Resident, not common. Two specimens in the Jenkins collection: AM 687.12, Niue Island, 7/1/63, —, 22.5, 23, 74.5, 26, 280, 123 and —; and AM 687.13, Makefu, 29/10/63, 25.5, 75, 29, 284, 121 and 247.

The only predatory bird on Niue Island. Smith (1902) thought that "this bird is semi-sacred, the natives seem to fear it " and "object to catching it ,though one was brought to me by a boy."

It appears local: one or two owls were seen at night in the vicinity of the Airport Farm in 1968 and 1969; and another owl has been observed hunting in bright daylight on Vaiea Farm.

Order Apodiformes

Family Apodidae

17. *Collocalia spodiopygia* (Peale, 1848). White-rumped Swiftlet. *Peka-peka.* Resident and one of the most common birds of Niue. Recorded by Smith (1902) who rightly thought that this was the same species as the swiftlets found in Tonga and Samoa. It has been recorded in all the major habitats of Niue but is usually seen in small flocks flying along roads, presumably hunting insects disturbed by vehicles. As in Tonga, the *peka-peka* nests in caves. The largest nesting place reported to the writer is in the caves south of Mutalau. According to local residents the *peka-peka* population has been seriously affected by hurricanes which drastically reduce the flocks.

Order Passeriformes

Family Campephagidae

18. *Lalage maculosa whitmeei* (Sharpe, 1879). Polynesian Triller. *Heahea.* Resident, very common. Sixteen subspecies of this cuckoo-shrike have been described and it is found in Tonga, Fiji and adjacent islands. The Niue Island subspecies was described by Sharpe (1879) and this identification has been confirmed by Ogilvie-Grant (1905) on an adult and an immature specimen from Niue. Three specimens in the Jenkins collection: AM 163/65.1, Toi, 11/10/63, male, 13.5, 31.5, 15.99, 78 and —; AM 163/65.2, Vaipapahi, 11/10/63, —, 14.5, 32, 18, 98, 73 and —; AM 163/65.3, Toi, 11/10/63, male, 14, 33, 19, 101, 78 and —.

This arboreal and insectivorous species was found to be very common by Smith (1903) and by the writer in 1968 and 1969. It was conspicuous in tall and second-growth indigenous forest, fernlands, gardens and round homes, usually moving in small parties of three to four birds but sometimes coming down to the ground. In November, 1968, the *heahea* was occasionally seen perched on trees and making its characteristic call upon which its Niuean name is based.

Family Sturnidae.

19. *Aplonis tabuensis brunnescens* (Sharpe 1879)). Polynesian Starling. *Misi.* This small bird with dark grey-brown upperparts and pale grey underparts with whitish streaks is known to exist in seven subspecies in Tonga, Futuna and the entire Fiji Group (Mayr, 1945). The Niuean subspecies has been described by Sharpe (1879). Four adult specimens were recorded by Ogilvie-Grant (1905) and a specimen is in the Jenkins collection: AM 103/63, Amanau, 1963, —, 17.5, 38, 21, 103, 65 and 52. This arboreal species can be seen very commonly feeding on insects and fruit in most Niue Island habitats.

Relative Abundance of Some of the Birds of Niue

Road counts from a Landrover, driven by Luka Tauelima and carried out by the auothor covered 670 miles during daylight in July and August, 1969. A total of 1175 birds were noted in the following decreasing order of abundance: *pekapeka* (916), *heahea* (84), *veka* (77), *misi* (48), *kulukulu* (17), *kiu* (16), *henga* (10), *ngongo* (4), *lupe* (2) and *tuaki* (1). It is proposed to publish a fuller account elsewhere of the road counts in relation to various habitats.

DISCUSSION

The Niue Island Bird List

Although some birds from Niue Island were described nearly a century ago (Ramsay, 1878), no proper bird list was available prior to the present survey. Smith (1902) listed 13 species but his list is of little help because only Niuean names were given and from his description it is sometimes difficult to identify to species level birds that the present author has not seen in the field. Ogilvie-Grant's (1905) list is based on newly collected specimens which he identified to eight species and these eight were included in Mayr's (1945) field guide.

The present list is the most comprehensive as it shows a total of 19 bird species. These 19 species include 5 sea birds, 3 shore birds and 11 land birds. In the present list we find five bird species that have not been previously reported from Niue: three sea birds (*kalangi, kota* and *ngongo*) and two shore birds (*kiu-tahi* and *motuku*). As there are Niuean bird names of other birds, not included in our checklist, it is likely that future investigations will add more sea or shore birds to the list.

Relationships with other islands of the South-east Pacific

The Samoan, Tongan and Cook Islands are the three nearest island groups to the north, west and east respectively of Niue Island that would be expected to share many species of Niue's avifauna. There is, unfortunately little information published on the birds of the southern Cook Islands; but all the 11 species of Niue land birds are found both in Tonga and Samoa (Finsch and Hartlaub, 1867, and Graffe, 1870).

It is of interest to compare the birds of Niue — a raised atoll with those from the Tokelau Islands — true Pacific atolls (Wodzicki and Laird, 1970). Fig. 2 compares the areas and the avifaunas of Niue Island with those of the Tokelau Islands and illustrates the relative wealth of shore and sea birds in the Tokelau atolls; it also shows that Niue with its rocky and precipitous shores is an unfavourable habitat for most waders, except those like *kiu* that can also utilise inland habitats. The relatively small number of sea bird species reported from Niue is perhaps also due to the fact that there are far fewer people sailing round Niue than in the Tokelaus; and it is possible that in future more sea bird species will be added to the Niuean list. The Reef Heron *Egretta sacra* is a notable absentee among the shore birds. Finally, Niue, with a so much larger land area than the Tokelaus, has a relatively poorer land bird fauna than one might expect. As Edwin H. Bryan, Jr., observed (*in litt.* 4 March, 1968) it is hard to believe that "such birds as kingfishers, warblers, honeyeaters or white-eyes are missing from Niue Island."

Abundance of some Bird Species

Road counts are sometimes the only means to assess the abundance, or changes in the course of time in the abundance, of certain bird species provided that certain assumptions such as the conspicuousness of the birds, their habits of using roads as flyways, etc., are taken into account. The order of abundance of Niuean birds arising from road counts given above and led by *pekapeka*

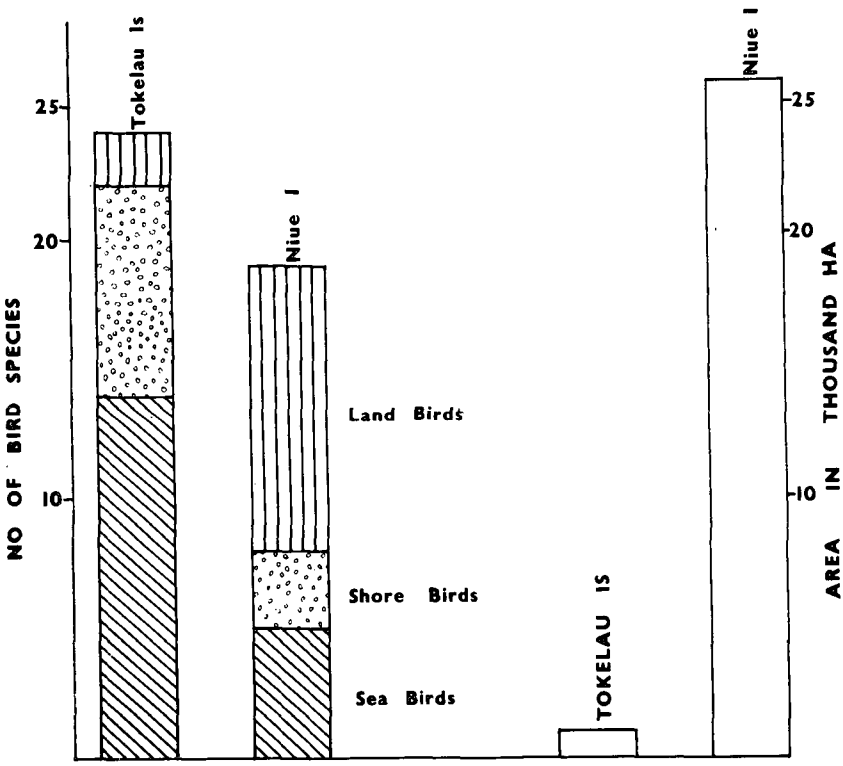

FIGURE 2 — Diagram comparing the areas and avifaunas of the Tokelau Islands and Niue Island.

seems to be generally correct; except that birds prefering other open spaces in preference to roads like *kiu,* or birds not easily observed from a moving vehicle such as *ngongo* or *taketake* may appear less abundant than they actually are. It is proposed to present a detailed analysis of the road counts elsewhere.

Past and Present Status of Birds on Niue Island

A comparison of the past and present status of various birds from Niue is of interest. We note that the first visitors to Niue Island during the last century were impressed with the abundance of *lupe* and *kulukulu* (Hood, 1863, and Brenchley, 1873). This is striking in comparison with the present low numbers of these birds, particularly of *lupe* and the fact that the present population of Niue Island (5,258 as at 1st March, 1968) is not significantly larger than that in the third quarter of the last century.

The changes in status of the three Niue Island rails (*veka, moho* and *kale*) reported above are more difficult to explain, particularly the drop in numbers of the *veka* earlier in this century and its apparent recovery during the last fifteen years.

In the writer's opinion several factors may have contributed to the present precarious status of some land birds, such as *lupe, henga, ngongo* and probably *kulukulu, kale, tuaki* and *taketake.* The introduction of the roof or ship rat *(Rattus rattus)* to Niue during the first quarter of the present century and its successful spread to practically all habitats (Wodzicki, 1969) could have had a profound effect, particularly on all tree-nesting birds. It is very likely that an adjustment between the small bird species and the only other predatory animal, the *lulu,* already exists. The relatively small numbers of the barn owl and the presence of large numbers of an alternative prey in the form of Polynesian rats *(Rattus exulans)* and roof rats would suggest that *lulu's* effect in controlling bird numbers is probably small.

During the last century the shifting system of agriculture with repeated burning of second-growth forest has led to the establishment of large "fern-land areas" (Sykes, 1970) and to a considerable reduction of the primeval, tropical forest that once covered the whole island (Fig. 1). This must have significantly affected all species that solely or partly depend on the fruit or seeds of forest trees or require tall forest community with a high canopy for nesting, such as *tuaki, taketake* or *ngongo.*

Finally, the present policy of granting firearm licences and the weakness of the present regulations regarding wildlife management that are difficult to enforce are among the factors that contribute to the present precarious status of some of the Niuean birds. The writer has been reliably informed by the Administration that anybody over 16 years of age may apply and obtain a shotgun licence. Lines of a dozen or more shooters standing along the roads between the villages and shooting at any bird or flying fox that may fly over are a common sight as are roasted *lupe* or *kulukulu* at official banquets in contravention of the legislation.

While it may be difficult to arrest or slow down the disappearance of the primeval forest it may be possible to have the existing policy of granting firearm licences changed and new ordinances promulgated and adhered to. A bill conservation of natural resources recently introduced in the Assembly of Niue may promise a brighter future for these bird species whose numbers are at present on the decline.

SUGGESTIONS FOR FUTURE RESEARCH

The present survey has merely scratched the surface and, if the avifauna of Niue Island has to be preserved for the enjoyment of future generations of Niueans, some problems require urgent attention.

1. *Taxonomy of Niuean Birds*

We require to know a good deal more about the birds of Niue. The taxonomy of several South-West Pacific bird species also found in Niue has been fairly recently reviewed. This applies for instance to the fruit doves of the *Ptilinopus purpuratus* group (Ripley and Birkhead, 1942, Amadon, 1943, and Goodwin, 1969), the Pacific Pigeon (*Ducula pacifica,* Amadon, 1943), the genus *Aplonis* (Mayr, 1942) and the Polynesian Triller, genus *Lalage* (Mayr and Ripley,

1941). The Jenkins collection in the Auckland Institute and Museum is too small and incomplete for a taxonomic study. It would be of considerable interest to examine a series of examples of the above and other common birds of Niue to see how the birds of this island fit into the geographical variations of these species in the South-West Pacific.

2. *Further Studies into the Ecology of Niuean Birds*

One of the results of the 1968 hurricane in Niue was a population explosion of the moth *Cleora samoana* Butler which defoliated large tracts of the forest and according to beekeepers led to a significant decline in honey production. This in turn led to strong recommendations to the Administration to introduce exotic bird species in order to combat future insect plagues. It should be emphasized that Niue is one of the few islands in the world totally without introduced birds. A further study of the ecology of the Niuean birds is recommended before any liberation of exotic bird species is seriously considered. Such a study would help an understanding of the role played by birds in the Niuean ecosystem, particularly regarding the various insect pests.

ACKNOWLEDGEMENTS

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SEABIRDS FOUND DEAD IN NEW ZEALAND IN 1969

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ABSTRACT

During 1969, 1,665 miles of coast were patrolled by 99 members of O.S.N.Z. and 2,534 dead seabirds were found. No species was exceptionally abundant but there was a high proportion of albatrosses relative to other years. The rarest specimens were an Oriental Cuckoo **Cuculus saturatus horsfieldi** and an Arctic Tern **Sterna paradisaea.**

This paper reports on the results obtained in the O.S.N.Z.'s Beach Patrol Scheme during 1969. The coastline of New Zealand has been divided into 15 zones (see Figure 1 in Imber and Boeson 1969) and cards were received from 12 of these. During the year 99 members or friends were recorded as having taken part in patrols; 316 beach patrol cards and 58 specimen record cards have been filed. There was a high level of patrolling on all western coasts of the North Island, which are consistently rewarding. However, Auckland East and Bay of Plenty, which usually give moderate returns, were almost ignored. There was very little patrolling on South Island coasts which mostly give average to poor results but the level of patrolling there has been much higher in the past.

RESULTS AND DISCUSSION

Western coasts of the North Island were patrolled most regularly throughout the year and yielded the greatest numbers of birds (Table 1). Excluding zones where less than 10 miles were covered, Wellington West had the highest density of specimens. The overall density in terms of birds per mile travelled (1.5) is the lowest recorded since regular reports began in 1960 (but 1965-7 results are not yet available). Miles travelled are the total distances patrolled; miles covered are the lengths of coast inspected monthly. Thus if a mile of beach is patrolled three times in one month, 3 miles have been travelled but only 1 mile covered. The monthly mortality pattern exhibited in Table 1 is a typical one, low initially but increasing towards the end of the year.

Seabirds found in few numbers during the year are listed in Table 2. Several Blue Petrels *Halobaena caerulea* were found on western beaches in October, as also happened in 1968. Rarer specimens were the Wilson's Storm-petrel *Oceanites oceanicus* and the Arctic Tern *Sterna paradisaea,* both from Southland. It was also very pleasing to have 4 specimens of the relatively rare Black Petrel *Procellaria parkinsoni* reported. A dead petrel found on a beach normally indicates many thousands alive at sea, particularly with the highly pelagic *Pterodroma* and *Procellaria* species. For instance, the Grey-faced Petrel *Pterodroma macroptera* populations breeding around the North Island north of 39°S probably number a few millions, yet note the few found dead in 1969 (Table 2) or in any previous year (1960-2, 1961-5, 1962-6, 1963-19, 1964-7, 1968-3).

However, the rarest bird found was not a seabird but a migratory land bird: an Oriental Cuckoo *Cuculus saturatus horsfieldi.* This was found on Muriwai beach, Auckland West on 21 December 1969 by the Auckland party, led by Mrs. S. M. Reed, which regularly patrols that coast.

The commoner species found in 1969 are tabulated according to coast (Table 3) and month (Table 4) of discovery. As is often the case, the Fairy Prion *Pachyptila turtur* was the most abundant. Of the three prion species that occur in winter and spring, the Narrow-billed *Pachyptila belcheri* was found most.

But the albatrosses *Diomedea* stand out as having been especially abundant in 1969. Of previous years for which data are available only 1968 recorded more albatrosses and that was because of the April cyclone (Kinsky 1968). For 1960-1964 and 1968 (excluding the cyclone mortality), albatrosses numbered 16 to 67 per year and represented 0.9 to 1.7 percent (mean 1.25) of all seabirds found. In 1969 the 175 albatrosses formed 6.9 percent of all seabirds recorded. Most mortality occurred in June on Wellington West and Auckland West coasts. The 93 seabirds collected from 61 miles of Wellington West coast on 21 June included 31 albatrosses. No species appears to have been more abundant than any other relative to numbers recorded in previous years. One Grey-headed Albatross *D. chrysostoma* banded on Bird Island, South Georgia, in 1963 was recovered on Wellington South coast in August (G. Woodward, pers. comm.). It is probable that others found about that time came from the same region.

Among the shearwaters there was again, but to a lesser extent than in 1968, a relatively high number of Short-tailed *P. tenuirostris*. Fluttering Shearwaters *P. gavia* were more abundant than in the previous year; most of them were found in winter when Hutton's Shearwater *P. huttoni* was absent.

In addition to seabirds, 76 land or freshwater birds were found: 7 Black Swans, 3 Grey Duck, 6 Mallard, 6 Harriers, 4 Pheasants, 1 Pukeko, 2 S.I. Pied Oystercatchers, 1 Banded Dotterel, 1 Bar-tailed Godwit, 2 N.Z. Pigeons, 5 Rock Pigeons, 1 Oriental Cuckoo, 1 Morepork, 3 N.Z. Kingfishers, 1 Skylark, 2 Song Thrushes, 3 Blackbirds, 1 Tui, 2 Starlings, 1 Black-backed Magpie and 23 White-backed Magpies.

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TABLE 1 — Numbers of dead seabirds recorded and miles patrolled on each coast in 1969*

COAST	CODE		MONTH JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS		BIRDS/MI/MO
Auckland West	AW	Miles	11	4	26	53	108	81	50	27	28	28	27	31	474		
		Birds	4	0	23	33	59	60	214	100	26	86	97	112		814	1.7
Taranaki	T	Miles	1	8	6	13	7	9	9	14	10	8	10	4	99		
		Birds	2	8	7	20	9	11	13	12	9	10	14	5		120	1.2
Wellington West	WW	Miles	1	-	42	33	26	61	28	42	18	32	29	4	316		
		Birds	1	-	73	42	56	122	59	194	89	343	283	33		1295	4.1
Westland	WD	Miles	-	-	4	-	3	-	3	4	3	-	5	-	22		
		Birds	-	-	2	-	0	-	2	1	0	-	3	-		8	0.4
Bay of Plenty	BP	Miles	-	3	1	-	1	4	-	6	-	-	3	3	21		
		Birds	-	3	0	-	3	10	-	1	-	-	4	50		71	3.4
East Coast North Island	EC	Miles	-	-	-	-	-	-	-	-	-	-	1	-	1		
		Birds	-	-	-	-	-	-	-	-	-	-	9	-		9	9.0
Wairarapa	WA	Miles	-	1	-	-	-	-	-	-	-	-	-	-	1		
		Birds	-	1	-	-	-	-	-	-	-	-	-	-		1	1.0
Canterbury North	CN	Miles	4	-	-	-	-	-	-	-	1	-	1	2	8		
		Birds	6	-	-	-	-	-	-	-	1	-	12	19		38	4.8
Canterbury South	CS	Miles	-	3	4	-	3	3	3	3	-	1	-	5	25		
		Birds	-	3	8	-	4	1	0	0	-	1	-	4		21	0.8
Otago	O	Miles	1	2	-	-	-	1	-	1	-	-	-	-	5		
		Birds	2	0	-	-	-	4	-	1	-	-	-	-		7	1.4
Southland	S	Miles	6	2	2	2	2	2	2	-	-	2	2	-	22		
		Birds	17	5	5	5	3	0	4	-	-	7	10	-		56	2.5
Wellington South	WS	Miles	-	1	-	-	22	5	9	4	8	11	4	5	69		
		Birds	-	2	-	-	35	12	12	8	3	5	2	15		94	1.4
Total Miles Travelled (not listed)			43	39	156	159	219	227	153	150	110	149	162	98	(1665)		
Total Miles Covered			24	24	85	101	172	166	104	101	68	82	82	54	1063		
Total Birds Recorded			32	22	118	100	169	220	304	317	128	452	434	238		2534	
Birds/Mile Covered/Month			1.3	0.9	1.4	1.0	1.0	1.3	2.9	3.1	1.9	5.5	5.3	4.4			2.4

* No patrols were reported from Fiordland, Auckland East, or North Coast South Island.

TABLE 2 — Seabirds of which 1 to 5 specimens were found dead in 1969. Coast and month of discovery given.

SPECIES OR SUBSPECIES	NUMBER FOUND	COAST(S)	MONTH(S)
Eudyptula albosignata	1	CS	2
Eudyptes p. pachyrhynchus	1	WD	11
Phoebetria palpebrata	3	AW	6,6,11
Pterodroma macroptera	4	AW,T,BP	9,10;2;11
inexpectata	4	AW,WW,S	3,12;3;2
pycrofti	1	AW	12
Halocaena caerulea	5	AW,WW	10,11;10[3]
Procellaria cinerea	2	BP,CN	12;11
parkinsoni	4	AW	5,10,10,11
westlandica	2	AW,WS	11;7
aequinoctialis	1	AW	4
Puffinus carneipes	3	AW,WW	12,12;6
Oceanites oceanicus	1	S	4
Garrodia nereis	2	WW,WD	11;7
Phalacrocorax varius	2	AW	5
sulcirostris	1	AW	5
melanoleucos	2	CN,S	11;1
Leucocarbo carunculatus chalcorotus	1	O	8
Stictocarbo punctatus	5	AW,CS,S	5,7,9;3;3
Stercorarius parasiticus	1	WW	3
Hydroprogne caspia	2	AW	12
Sterna paradisaea	1	S	1
TOTAL	49		

TABLE 3 — Coastal distribution of the more common seabirds found dead in 1969.

SPECIES OR SUBSPECIES	COAST												TOTAL BIRDS
	AW	T	WW	WD	BP	EC	WA	CN	CS	O	S	WS	
Eudyptula minor	48	20	35	-	-	-	-	3	1	-	-	2	109
Diomedea spp.*	3	-	14	-	-	-	-	-	-	-	1	-	18
exulans	4	-	5	-	1	-	-	1	1	-	-	1	13
epomophora	6	-	1	-	-	-	-	3	-	-	-	6	16
melanophris	3	1	12	-	-	-	-	-	-	-	1	1	18
chrysostoma	15	-	31	-	-	-	-	-	-	-	-	3	49
bulleri	4	-	5	-	-	-	-	-	-	-	1	-	11
cauta cauta	13	1	13	-	-	-	-	-	-	1	-	1	29
cauta salvini	2	-	1	-	2	-	-	-	-	-	-	1	6
cauta subsp.	2	-	10	-	-	-	-	-	-	-	-	-	12
Macronectes giganteus	10	1	8	1	-	-	-	-	-	-	-	5	25
Daption capensis	18	3	26	-	1	-	-	-	-	1	-	3	52
Pterodroma lessoni	18	-	4	-	-	-	-	-	-	-	-	-	22
Pachyptila spp.*	26	5	376	-	-	-	-	-	-	-	5	1	413
vittata	7	1	12	-	-	-	-	-	-	1	7	1	29
salvini	17	-	1	-	-	-	-	-	-	-	1	-	19
desolata	6	-	-	-	-	-	-	-	-	-	-	1	7
belcheri	27	1	35	-	-	-	-	-	-	-	-	-	63
turtur	221	6	291	-	3	-	-	1	-	-	5	4	531
Puffinus spp.*	-	1	2	-	-	-	-	-	-	-	3	-	6
bulleri	8	-	11	-	4	-	1	-	-	-	-	3	27
griseus	106	7	74	-	31	9	-	20	2	-	13	19	281
tenuirostris	29	4	62	-	1	-	-	-	1	-	2	1	100
gavia gavia	103	12	74	-	5	-	-	-	-	-	-	4	198
huttoni	7	-	28	-	-	-	-	4	3	-	-	-	42
gavia/huttoni*	9	-	5	-	-	-	-	1	-	-	-	-	15
assimilis	6	-	2	-	-	-	-	-	-	-	-	-	8
Pelagodroma marina	2	-	-	-	6	-	-	-	-	-	-	-	8
Pelecanoides urinatrix	12	2	74	1	13	-	-	-	-	-	2	2	106
Sula bassana serrator	30	1	7	-	1	-	-	-	-	-	-	-	39
Phalacrocorax carbo	2	1	5	1	-	-	-	-	1	-	-	1	11
Larus dominicanus	20	13	52	2	-	-	-	1	6	2	2	27	125
novaehollandiae	4	33	5	-	1	-	-	1	-	-	4	6	54
bulleri	-	-	3	-	-	-	-	-	2	-	2	-	7
Sterna striata	-	6	4	1	-	-	-	1	2	-	2	-	16
TOTALS	788	119	1288	6	69	9	1	36	19	6	51	93	2485

Species not identified.

TABLE 4 — Monthly distribution of the more common seabirds found dead in 1969.

SPECIES OR SUBSPECIES	MONTH 1	2	3	4	5	6	7	8	9	10	11	12	TOTAL BIRDS
Eudyptula minor	2	5	20	7	6	13	9	14	11	7	10	5	109
Diomedea spp.*	1	-	-	-	1	-	3	3	1	5	4	-	18
exulans	-	-	2	2	2	2	-	1	1	1	1	1	13
epomophora	3	-	1	1	5	1	-	-	-	-	4	1	16
melanophris	1	-	-	1	2	12	1	-	1	-	-	-	18
chrysostoma	-	-	1	-	2	27	6	10	1	2	-	-	49
bulleri	-	-	1	-	1	3	2	2	1	1	-	-	11
cauta cauta	1	-	4	6	6	1	2	1	1	3	3	1	29
cauta salvini	-	-	-	-	1	2	-	1	-	1	-	1	6
cauta subsp.	-	-	3	-	-	1	-	-	1	3	3	1	12
Macronectes giganteus	1	-	-	-	2	4	5	4	3	4	2	-	25
Daption capensis	1	-	-	-	-	12	6	10	2	12	6	3	52
Pterodroma lessoni	-	-	-	4	-	3	-	5	-	4	3	3	22
Pachyptila spp.*	-	-	19	7	1	5	8	56	7	136	157	17	413
vittata	4	-	-	1	-	2	5	3	1	8	4	1	29
salvini	-	-	-	-	-	2	11	2	-	3	1	-	19
desolata	-	-	-	-	-	-	5	1	-	1	-	-	7
belcheri	-	-	-	-	-	2	22	35	3	1	-	-	63
turtur	2	-	4	13	7	20	115	61	61	146	73	29	531
Puffinus spp.*	-	2	-	-	-	2	-	1	-	-	1	-	6
bulleri	-	2	2	2	3	2	-	-	-	4	6	6	27
griseus	6	2	10	7	63	18	3	1	-	14	62	95	281
tenuirostris	2	3	8	1	6	-	1	2	-	31	34	12	100
gavia gavia	-	-	5	8	6	19	74	56	8	8	7	7	198
huttoni	-	-	4	-	1	6	-	-	3	19	7	2	42
gavia/huttoni*	1	-	-	1	-	7	2	-	-	1	3	-	15
assimilis	1	-	-	1	1	1	-	-	-	2	1	1	8
Pelagodroma marina	-	-	-	-	-	-	-	-	1	1	-	6	8
Pelecanoides urinatrix	-	-	-	7	4	21	10	34	3	7	7	13	106
Sula bassana serrator	-	2	4	5	7	2	1	3	3	3	3	6	39
Phalacrocorax carbo	-	-	1	2	-	1	-	1	-	-	5	1	11
Larus dominicanus	2	1	17	8	26	22	5	6	8	10	8	12	125
novaehollandiae	1	1	2	10	5	4	4	3	4	6	8	6	54
bulleri	-	-	2	-	1	-	1	-	-	-	3	-	7
Sterna striata	1	1	3	4	5	-	-	-	-	1	-	1	16
TOTALS	30	19	113	98	164	217	301	316	125	445	426	231	2485

* Species not identified.

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HORUHORU REVISITED
Longevity of the Australian Gannet

By PETER STEIN

EVIDENCE OF THE LONGEVITY OF THE AUSTRALIAN GANNET

On 31 December 1970 an adult gannet was trapped on Horuhoru close to where it had been banded on 20 February 1954. It had been hatched on 19 December 1953, and was therefore slightly over 17 years and one week old.

Here we describe the work undertaken in banding chicks on the islands in the Hauraki Gulf, to find where they go while developing from juvenile to adult plumage, and when and where they return to breed.

In the Hauraki Gulf there are four main areas in which Gannets *Sula bassana serrator* breed. In the far north is Mahuki, a small island off the west coast of the Great Barrier, just over four miles to the south of Wellington Head. The 1946 Gannet Census figures was 325 breeding pairs, but in six visits in the peak of the season, we have twice counted over a thousand and only once less than 900.

Off the Coromandel Coast there are two large groups, one at Motu Karamarama (Bush Island) about three miles to the west of Amodeo Bay, and another one mile further west at Motu Takupu. We think that this is the oldest of all the rookeries in the Gulf. A mile to the north is a tiny colony at the western end of Motuwi Stack (Double Island). On two visits in the middle fifties, we found 24 nests in a confined space with no room for expansion, but when passing on a visit in 1968, we found they had started to build along the south coast too. In the 1949 Census the figure for Motu Karamarama is given as 1513 and Motu Takupu 288. In 1954 we found 2500 at the former and 650 at the latter. Two years later we counted 960 at Motu Takupu.

Last, off the north-east point on Waiheke we have Horuhoru. The Census figure was 1228: on 5/11/49 there were 1503 and on 22/11/58 there were 1573 pairs breeding.

From very early times ornithologists in New Zealand have known that there were gannets on Horuhoru, but up to 1930 they had not been studied in any detail. Although I knew of the rookery earlier, I did not land there until 1919, and another four years went by before I made even a rough estimate of the number of nests on the Terraces, and arrived at some conclusions that later proved to be inaccurate. In the course of the 1946-1947 Gannet Census* several parties counted the nests occupied by egg or chick, but their figures for different dates were so conflicting (1228 in October dwindled to 157 in December) that Dr. Wodzicki at Cape Kidnappers and I in the Hauraki Gulf were asked to make regular visits over a period, and to obtain accurate figures on each trip.

HORUHORU DESCRIBED

When we started our study, the gannets were in six distinct groups separated by rocky outcrops and patches of taupata. At the northern end there is a reef terminating in a mass of bare rock called North Stack. The gannets here are quite close to the sea, and suffer

* Contributors to the Gannet Census visited Horuhoru on seven occasions; in 1946 Oct 2nd Fleming, Dec 1st Cunningham, 29th Clark & Roberts, 1947 Clark & Roberts again, 1948 May 6th Johnson, Dec 12th McKenzie, and 1949 Jan 21st Stein. (See Notornis 2.5: 109-113; 2.7: 152 & 153; 3.2: 42; 3.6: 159 & 3.7: 238.)

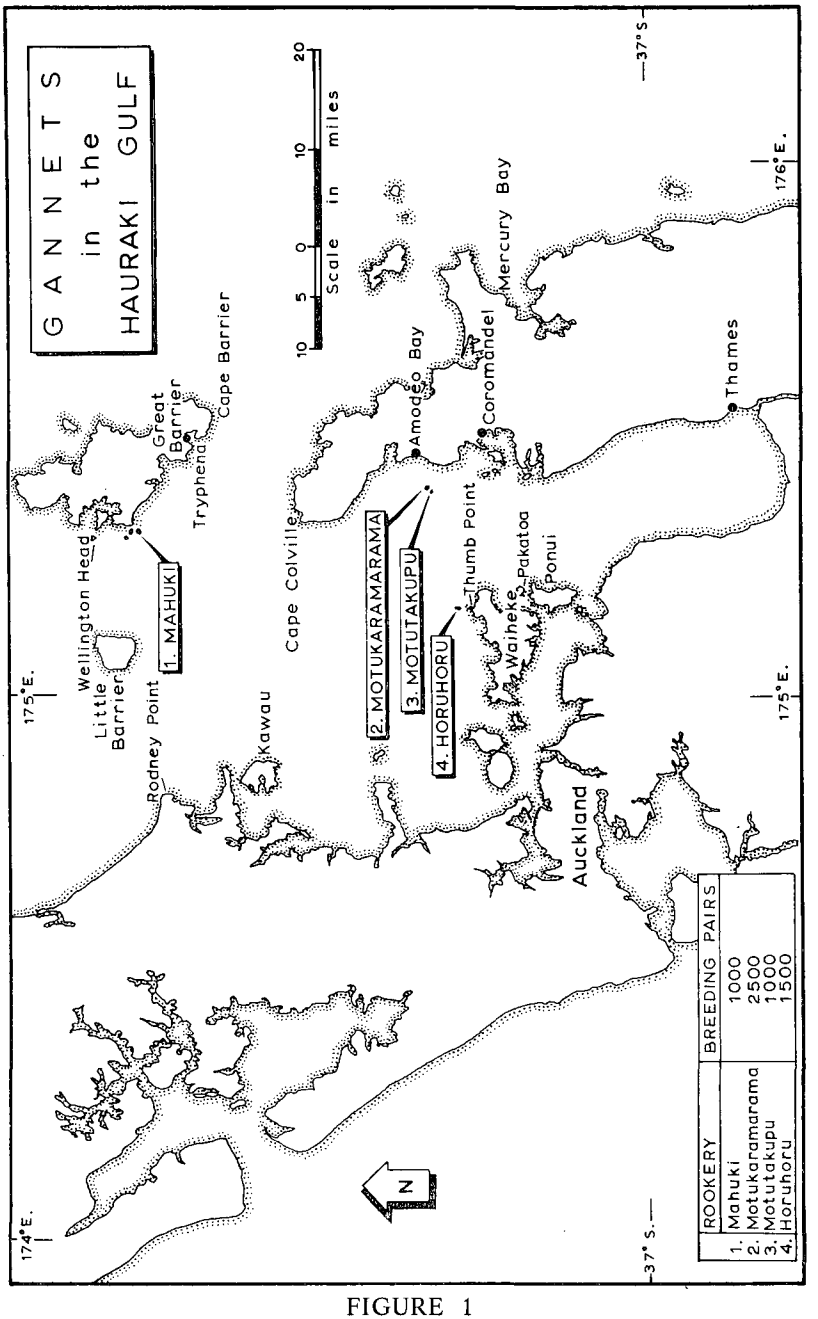

GANNETS
in the
HAURAKI GULF
Scale in miles
10 5 0 10 20
1. MAHUKI
2. MOTUKARAMARAMA
3. MOTUTAKUPU
4. HORUHORU
Great Barrier
Cape Barrier
Tryphena
Wellington Head
Little Barrier
Rodney Point
Kawau
Cape Colville
Amodeo Bay
Coromandel
Mercury Bay
Thames
Thumb Point
Waiheke
Pakatoa
Ponui
Auckland
174°E.
175°E.
176°E.
37° S.
N
ROOKERY | BREEDING PAIRS
1. Mahuki | 1000
2. Motukaramarama | 2500
3. Motutakupu | 1000
4. Horuhoru | 1500

FIGURE 1

from spray in the frequent north-east gales. The remainder of the island is a long narrow ridge rising to a height of about 25 metres. In all but one short section sheer cliffs fall to sea level. Two vigorous growths of taupata divide the summit into three main areas. The two outer divisions are called North Ridge and South Ridge. The middle one is the most extensive. Its eastern side falls straight down to the sea, but on the west there are many shelves and ledges, which dscend gradually to a wave platform where we have an extensive landing place. We call this part of the rookery The Terraces. They contain over 700 nests and by climbing up through them, we have comparatively easy access to the summit of the ridge. To reach the areas lying north and south, we must scramble through the two stands of taupata. The northern stretch is only shoulder high, but the one to the south contains many old gnarled trees up to two metres high. North Stack has 300 nests, and North Ridge and South Ridge have 200 each. North Ridge has a fairly level section on which we have done our best work. On its northern boundary there is another patch of taupata, some of which is only breast high. In it are two small clearings at cliff edge. They, too, have been very important in our study. Between them they have over fifty nests so that in all, we have on Horuhoru fifteen hundred pairs of breeding gannets.

DIVIDED INTO SECTIONS

For his count Fleming had divided the six groups of Gannets into 16 sections, in some cases lettering them (from A to L), and in all but one, he had less than seventy nests. On the Terraces, however, because of the lack of prominent outcrops of rock or ledges, he had 400 nests in his section F. This made accurate counting almost impossible, and forced him to make estimates there. In an attempt to make our maximum 60 or 70 we decided to use the whole alphabet. Starting at the landing place below the Terraces as he had done, we moved up in steps through his first three sections A, B and C until we came to an abrupt drop of ten metres down to sea level again. Turning inland to the east, we climbed up through three more shelves to reach section G at the summit. The rest of the Terraces now lay to the south of us.

We used two faint ridges running north and south to make eight more areas from H to O. On 5th November, when there were over 700 nests here, we found this very difficult, so that on the next visit three weeks later, we came prepared with several long lengths of thin rope. To each end of these we tied a fair sized rock weighing about ten Kg. We lowered these over the cliffs to east and west, so that the lengths of rope were tight and close to the ground. We used these divisions for another four counts, but returning on 14th January after a dry spell, we found that the ropes had become so loose that two chicks had become hopelessly tangled up; we removed the ropes and from then on had to count IJK and MNO together. At the southern end of the Terraces there is a narrow space, and the remaining nests run up into the taupata. This is our area P and Fleming's G. It has many flat rocks under which there is a colony of geckos *(Haplodactylus pacificus)* and many of the earwigs *(Anisolates littorea)* mentioned by Dayton Stoner in the account of the Fiji - New Zealand Expedition.*

* Iowa University Studies in Natural History Vol. X, No. 5, p. 279.

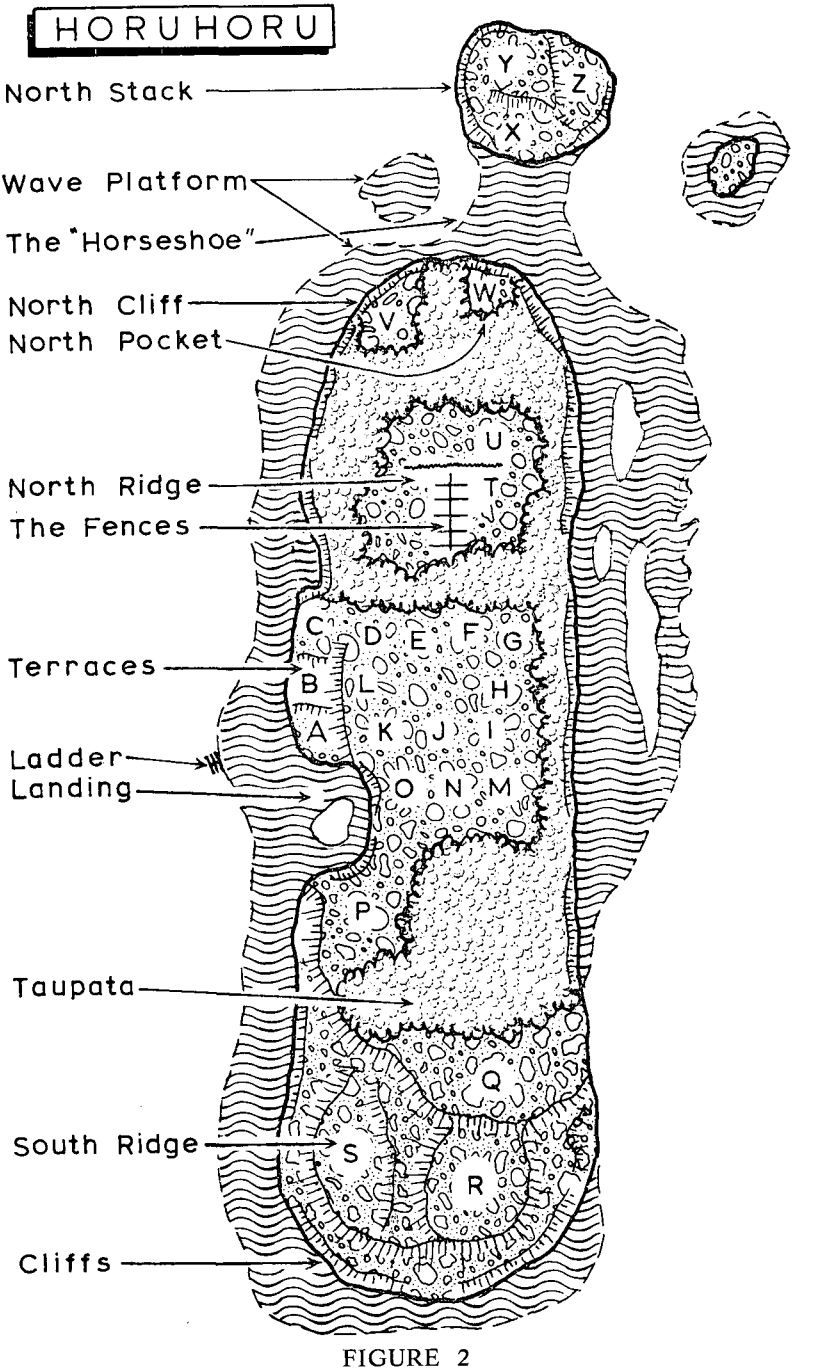

HORUHORU
North Stack
Wave Platform
The "Horseshoe"
North Cliff
North Pocket
North Ridge
The Fences
Terraces
Ladder
Landing
Taupata
South Ridge
Cliffs
Y
Z
X
W
V
U
T
C
D
E
F
G
B
L
H
A
K
J
I
O
N
M
P
Q
S
R

FIGURE 2

[R. F. Attwell

FIGURE 3 — Horuhoru: Gannets on South Ridge

From P we climbed up through the extensive grove of taupata again to the summit, and then south until we could see the whole of South Ridge with areas Q, R and S. Q is a triangular section with its base against the taupata. It slopes down to its apex where it meets the final rocky spine R. There is a small ledge below it on the east, and a much more extensive one S to the west. A sudden drop of over two metres, gives this western area great protection from all the easterly gales which are so frequent in the spring. The whole

of this area is shown in Fig. 3. When R. F. Attwell took the photograph, he was standing on the rocky knob at the southern end of Horuhoru. In the background the extensive grove of taupata to the south of the Terraces is shown forming an effective shield for the whole of Q, sheltering it from the north-east gales which sweep down from Cape Colville seen in the right distance. As I make my way back to the Terraces, I am facing Area Q. The gannet above me, preparing to land, and those close to my feet, are going about their usual duties without taking any notice of my passage.

The group behind me is R on the exposed part of the Ridge, and the nests here are buffeted by both north-east and south-east gales. These were the areas H and I in Fleming's count. Down to the left in complete safety is our area S, sheltered from all easterly weather by the sudden drop of over two metres. This area is ideal for detailed observation, and it was by working here that we first arrived at the "Gannet Rule for Tail Feather Growth." It will be mentioned again when mortality it discussed. Throughout the past twenty years, the nests here have varied from 28 to 32; there were 31 in Fleming's area K and on 25/9/71 there were 29.

We had now to retrace our steps through the taupata, and along the summit of the Terraces to area G. From there we had only a short distance to go, before the whole extent of North Ridge lay before us. First came a fairly level section, and then a slight slope down to the final patch of taupata. So far our areas had contained not more than 70 nests. But here there was a group of over 200, without any marked features to divide it up. There were many loose rocks lying about, so we collected these and made a low wall from east to west, to divide the level area from the slope; the southern part was T and the northern U.

Area T was the highest and most level on the island, so that in 1951, when we started to ring the chicks, we chose it for the work, and sub-divided it by using 6 x 1 timber on edge. Wherever possible we dug shallow trenches and half-buried the boards, so that the little "fences" formed would stand up to the trampling of the gannets, *without upsetting their nesting to any great extent.* As it turned out, we found the birds welcomed the fences for they built close alongside, getting a little shelter from them.

Area T is about 20 metres from north to south and some eight metres wide. We ran a dividing fence down the middle, and then several from east to west, so that we finished up with five pairs of compartments about three metres square. The most southerly pair we called Ta, then came Tb, Tc, Td and Te followed by the wall and beyond it the open area U. We made some small fences there, too. Later on, when we were tracing the movements of pairs of birds from year to year, we defined the position of a particular nest by using co-ordinates. A nest in the right hand compartment of Tc, three feet to the east and then four feet north would be Tc 3.4. and in the left hand compartment, five to the west and then six north would be Tc –5.6.

At the northern boundary of U there was a very light growth of taupata, containing the two small clearings which became V and W. V overhanging the sea at the north-west tip we called North Cliff, and W just above North Stack, became North Pocket. Twenty metres below was the reef running out to North Stack with areas

X, Y and Z. These were on the large size; 300 nests in all. Very soon we learned to refer to any area without chance of misunderstanding.

MORTALITY 1949 - 1950

In the 1949 - 1950 season we made sixteen visits to Horuhoru: on June 4, Aug 4 & 27, Nov 5 & 19, Dec 10, 14 and 31, Jan 7, 14, 18, 21 &29, Feb 18, Mar 25 and on April 8th. From 5 Nov onward we recorded adults, nests, eggs, and chicks in each of the sections A to Z. Table I gives a summary of the totals, but the individual records for each lettered section, have been filed for reference should they be required.

At the left of the table is the number of adults present on each occasion, and before the eggs began to arrive, the number of empty nests is given. These are of interest to the reader, but they were not needed for our main problem: Mortality.

Before the November gales, the percentage dying per week was nearly 5. Then up to the first week in December it doubled

TABLE I

			1 + 2 = 3			4	5	6	7
Adults	Empty nests	Date	Nests with egg	Nests with chick	Breeding pairs	X by 2	Percentage remaining	Percentage decrease	Weekly decrease
8		Jun 4							
1079	808	Aug 4	5		813				
929	706	27	174		880				
1444	6	Nov 5	657	840	1503	3000	100		
1363	2	19	350	1002	1354	2708	90.3	9.7 in 2	4.9
1274		Dec 10	91	822	913	1826	60.9	29.4 in 3	9.8
758		24	18	718	736	1472	49.1	11.8 in 2	5.9
469		31	10	668	678	1356	45.2	3.9	3.9
535		Jan 7	8	658	666	1332	44.4	.8	.8
675		14	1	626	627	1254	41.8	2.6	2.6*
259		18	2	589	591	1182			
68		21	1	572	573	1146	38.2	3.6	3.6*
24		29		499	499	998	33.3	4.9	4.9*
232	5	Feb 18	1	295	301	602	20.1	13.2 in 3	4.4*
138		Mar 25		6	6	12	.4		
14		Apr 8		4	4	8	.3	* Birds departing	

Col 1 + 2 = 3

Col 4 is double 3

To get Col 5 divide Col 4 by 30. This is the percentage of chicks on the island taking 5th November's figure as 100%

To get the percentage decrease between visits in column 6, subtract the number in Col 5 from the one immediately above it. For Nov 19th "9.7 in 2" means 9.7% decrease in the 2 weeks between visits

Divide the decrease in column 6 by the No. of weeks between visits to get Col 7 the "Weekly Decrease."

falling back then to 5.9 before Christmas, and finishing the year at 3.9. The first week in January was beautifully fine and only 12 birds disappeared. In spite of this good weather in the next week it increased again to 2.6%, i.e. 39 birds disappeared in the week.

On 14/1/50 two observers on North Ridge* heard a sudden beat of wings behind them, and a juvenile gannet on its first flight went by, flying unsteadily at about 20 metres above the waves. As it sank towards the water, it beat its wings more frantically and rose a little. And so it went on towards the north-west, until it finally disappeared. The decrease in population on the island was no longer caused by death alone. Some of the full-grown young had started to fly away. We did not know where they were flying to until the next year. During the weeks that followed, more flew away until nearly 5% were going each week. Over 4% a week continued until the middle of February when 300 remained. In another five weeks, all but 12 had gone. Something like 600 flew away in the 12 weeks since their start in January. Nearly all we observed flew towards the north-west; we saw only four that did not. Most of them crash-landed on the water well within a mile of Horuhoru, and failed to rise again. They paddled and flapped along until they were out of sight. We observed this same direction at other rookeries. A case at Motu Takupu is given in Appendix K.

This high mortality rate convinced us that we had experienced a bad season. We had much to learn however. The next two seasons were much worse. Table II will show that about 250 in 1950 - 1951 matured enough to depart, and in Tables III and IV we shall see that only 208 lived to depart and that we were able to band 198 of them.

INCUBATION OF THE EGG

Our main object in the second season was to determine the incubation period for gannet eggs. In Table II columns 1 + 2 are used again to give the number of pairs breeding, but most of the righthand space explains the progress of the egg project. In the 1949 - 1950 season we had seen that the eggs took something over six weeks to incubate. We chose dates in the August Holidays, Aug 24, 25, 26, 31 and Sept 1 and planned to return on October 7 and 14. The first three dates would give periods of 44, 43, and 42 days to Oct 7 and the final two, 44 and 43 to Oct 14.

Our method was to paint a vivid band of gentian violet right round all the eggs one afternoon, and returning early the following morning, we numbered carefully and recorded the positions of all the unmarked eggs, as having been laid overnight. We had been told that the stain would not injure the chicks, and the number of blue eggshells found later beside perfect chicks, reassured us on this point.

By examining Table II we see that after a rough day in June we landed successfully in July, and first saw eggs on 12/8/50. From our visits during the August holidays, we found and marked 9 eggs whose laying dates we knew, and a week later another 9. By 16/9/50 we knew that we must land to transfer our egg-marks to

* Notornis 5.2: p. 42

TABLE II

	1	+ 2	= 3	
1950	Eggs	Chicks	Adult pairs	
June 30				Too rough to land
Jul 22				Adults 126 Empty nests 113
Aug 12	6		560	515 554
24	38			
25	40			2 eggs laid overnight were marked
26	47			7 eggs laid overnight: 9 marked now
31	107			During this 5 days 62 eggs were laid and 2 broken 47 + 62 = 109 - 2 = 107
Sep 1	116			9 more laid overnight: 18 eggs now marked
16	365			Very rough: one hour required to moor ship and land *
Oct 7	899	21	920	Eggs of Aug 24th hatched: 25th some hatching
14	933	52	985	9 six-day-old chicks: eggs from 31st hatching
21	844	102	946	
22	840	105	945	one lost overnight
1951				November - December awful!
Jan 16	0	255	255	Started banding a few for practice
28		208	208	Good weather: 47 departed in 12 days
Mar 28		1	1	Only one lone chick remained. A very poor season.

* Marks had to be transferred from eggs to sites as eggs would be broken in hatching.

nest-marks, for when the eggs hatched, we would lose the numbers marked on the shell. We arranged October landings on the 7th and 14th so that the intervals between our finding the egg's laying date, and our seeing it hatch, varied (as we saw before) from 42 to 44 days. Our findings were that an egg took 43 days or a little more, not 44, to hatch. Eggs that had not hatched by the 44th day were infertile or contained a perfect chick that failed to cut a ring round its shell sufficiently deep to allow it to force its way out.

We also ringed a few chicks to see how best to catch them and fix the rings. It was not until the third year that we made a catcher that gave us complete satisfaction. We started with a crooked stick which we placed round the bird's neck, and forced it down firmly to the ground without hurting it, until another operator picked it up. Holding a bird was easy once you cornered it. A gloved hand holding the beak, and the other hand one wing, kept the chick absolutely still. The wings move in unison, up and down together; when one is held firmly the other remains free but motionless.

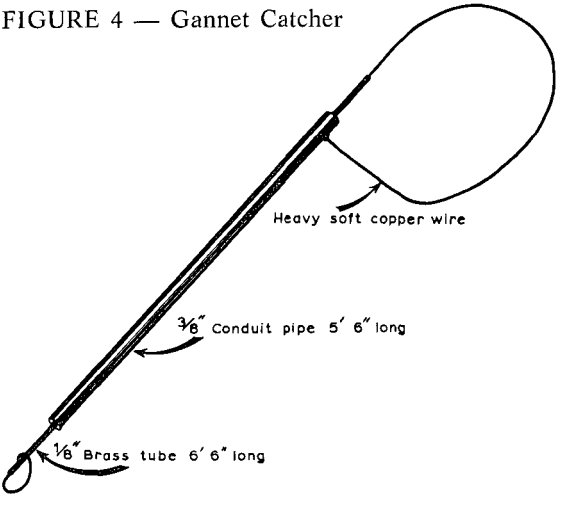
After the crook came a fixed look of wire at the end of a pole. Sometimes it worked, but if a bird was a bit thin and put its two feet on the wire, it swung like a parrot on its swing.

Finally we made a loop that could be made bigger or smaller by running a thick soft copper wire up a tube, fixing it at one end, and having a free end at the other. As the free end was pushed into the tube, the loop at the other end became larger. As it was

pulled out again, the loop became smaller. If the loose loop was put over the gannet's head, down its neck, and back along its body until it came against its legs, tightening the wire pulled the wings together, close to the body, and it was held firmly but without pain.

After a few pushings in and out, the wire tended to buckle in the tube, and its efficiency was much reduced. Finally we ran a No. 7 copper wire through a $\frac{1}{8}$" brass tube, and placed the sheathed wire in a piece of conduit pipe. The wire was fastened at one end of the stiff steel pipe, which was held firmly in one hand. The other hand grasped the brass tube, with the wire inside. Pushing the hands together made the loop bigger, and pulling one away from the other tightened the loop.

FIGURE 4 — Gannet Catcher



This worked very well. Sometimes the loop broke where it met the tube, but we had supplied at the free end, more wire than was required there for the loop. When the loop broke, we pushed through the $\frac{1}{8}$" brass tube some of this extra wire, and we then tied again to the conduit, the wire that came through.

BANDING COMMENCES

In the 1951-1952 season, conditions were even worse. We started on 31/8/51 with 545 nests; 35 of them already had an egg. After this the spring gales kept us from landing for four months, so that on 30/12/51 we found that only 259 pairs remained. We determined to band as many chicks as we could, as they became big enough to retain the rings on their legs. On the left in Table III, we have the usual eggs plus chicks record; while in Table IV on the right, we have tried to relate our banding operations, to the number of chicks departing.

We seem then, to have ringed 198 of the 208 juveniles that departed.

TABLE III

1 + 2 = 3

Date 1951	Eggs	Chicks	Pairs
Aug 31	35		540
Sep			
Oct			
Nov			
Dec 30	7	252	259
1952			
Jan 5	1	249	250
18		239	239
23			
Feb 1		218	218
23		157	157
Mar 8		71	71
Apr 11		1	1

TABLE IV

Date 1951				
Aug 31	515 empty nests			
Sep	Heavy gales			
Oct				
Nov				
Dec 30				
1952	Chicks banded on day	Total to date	Chicks departing between dates	Chicks departing Total to date
Jan 5	22	22	0?	
18	46	68	1	1
23	81	149	2?	22
Feb 1	24	173	50?	72
23			70?	142
Mar 8	25	198	65?	207
Apr 11			1?	208

In 1952, from 5 Jan to 11 April, we made seven visits. We banded 22 on the first day, 46 on the second, 81 on the third and 24 on 1/2/52, many of which have been found in Australia or have been recovered alive at Horuhoru later. On 23/2/52 only 157 remained, and as most of the oldest ones seemed to have been banded already, we did no further banding. On 8/3/52 we made our last March landing, and found 71 remaining of which we banded another 25. One of these, 16-342 banded on the right leg in T, was caught again in T on 30/8/57 when it was rebanded 35-408 on the left leg. It was 5 yrs and 6 mths old and was standing in an empty nest. On 26/12/64 it was caught again in T. This time it had a 4-day-old chick. As 16-342 was wearing a little, it was removed and replaced by M 4309.

When we visited Horuhoru again on 11/4/52 only one chick remained. This was our fortieth trip; we had made twelve trips of 20 miles while holidaying at Waiheke, and 28 of 70 miles (when we had to travel from Auckland). *Waitangi* steamed over 2000 miles to accomplish this.

In the 1952-1953 season we managed to band 260. Then came four good years in which we banded 634, 758, 900 and 742 from the 900 to 1000 chicks that survived each season. Our highest count on Horuhoru, on 22/11/58 was 1573 eggs plus chicks.

PLUMAGE CHANGES

In recording their number of chicks, some contributors to the Gannet Census classified them as small chicks and large, or in first or second plumage. We set out with the idea of finding out something that might prove useful in determining a chick's age by its appearance. From 5th November onwards we counted the chicks in every area by arranging them in age groups according to their

feathering, and then adding the subtotals. We selected names that developed naturally from the appearance of the birds. They would have to be short and distinctive names, names that could be heard easily above the din arising from the calls of the birds, the sound of the breaking waves and the noise of the wind. First of course we had the EGG, and when it hatched the naked chick with its dark skin was obviously BLACK; this stage lasted for about a fortnight. Then as the quills appeared, still sheathed tightly in their *calamus* they covered its nakedness but were not an ample protection until in three or four weeks time it appeared WHITE. Until this stage, the adults on their nests usually succeeded in covering the chicks, so that we had to lift the parents to see what they were hiding underneath, EGG, BLACK or WHITE.

We found this was best done with an oar. The flat blade could be pushed under the adult without disturbing it much, then, when we rotated the oar handle through 90°, the parent was raised two or three inches, enough for us to see what was underneath.

The chick continued to grow without change in colour, until the sheath suddenly burst freeing the downy end of the feather so that, overnight the down fluffed out converting the small white chick to a large white " powder-puff ": we called these FLUFFIES.

So far we had been dealing with the *neossoptyle* plumage. Just over a week later, on the 43rd day, three or four brown dots appeared in the tail and at the tips of the wings. These heralded the change to " second plumage," the *first teleoptyle* in which the chick would finally fly away. These birds we called TRACE. The brown feathers, with a white spot at the end of each, continued to grow and spread until, when the back between the wings was brownish grey, the second plumage had developed enough to term this stage ADVANCED. Although the down had disappeared from most of their bodies, each chick still had a deep muff of white down extending from the head right down the neck, so that it looked as if it were wrapped up because of a sore throat. This down disappeared from the shoulders upwards until in the twelfth week only a prominent tuft remained on top of the head; these birds we called TUFTED. The tuft required a week to disappear entirely and then the chick, nearly as big as its parents, appeared smooth and sleek: its *first teleoptyle* plumage was COMPLETE. These names, egg, black, white, fluffy, trace, advanced, tufted and complete, were used in every count from 5th November onwards. By the end of the year, by looking at a chick we could nominate its age in weeks, with some degree of confidence.

We soon had a dozen or so chicks which we had seen hatching. These were visited every landing from 10th December until 20th Feb. and the state of their plumage was noted. Some of these nests were in North Pocket, and their record is shown in Table V. There were six nests built during the course of the experiment. Nos. 1 to 4 were first seen on 27/8/49 and the first egg was seen in No. 1 on 18/9/49, and those in 2, 3, and 4 followed on 23rd and 30th and 5/10/49.

After the eggs hatched, the age of the chick in days is noted alongside the type of its plumage.

TABLE V

Date	Nest 1	Nest 2	Nest 3	Nest 4	Nest 5	Nest 6
1949						
27 Aug	nest there	nest there	nest	nest there		
18 Sep	egg laid					
23		egg laid				
30			egg laid			
5 Oct				egg laid	nest appeared	
24					egg laid	
1 Nov	hatched					nest
7		hatched				
13			hatched			egg
18				hatched		
6 Dec					hatched	
10	Fluffy (39)	Fluffy (33)	White (27)	White (22)	Black (4)	Lost
24	Trace (53)	Trace (47)	Lost	Fluffy (36)	Lost	
31	Advcd (60)	Trace (54)		Fluffy (43)		
1950						
7 Jan	Advcd (67)	Trace (61)		Trace (50)		
14	Advcd (74)	Advcd (68)		Trace (57)		
18	Advcd (78)	Advcd (72)		Trace (61)		
21	Advcd (81)	Advcd (75)		Advcd (64)		
29	Tufted (89)	Tufted (83)		Advcd (72)		
20 Feb	Complt (110)	Complt (104)		Complt (94)		

When we consider the difficulty of deciding just when a Trace becomes an Advanced, the close agreement in these figures is remarkable. Combined with the results from five birds in other parts of the island, we had a scale that was very accurate. The age in weeks at which each stage ended is shown in Table VI.

TABLE VI

Field name	Variation of age in days	Final age in weeks
Black	0 - 14	2
White	22 - 27	4½
Fluffy	33 - 43	6
Trace	47 - 61	9
Advanced	60 - 81	11
Tufted	83 - 89	12
Complete	94 - 110	15½

SUMMARY

During the first three months at their rookery, gannet chicks develop two types of plumage; a downy stage comes first: the *neossoptyle* plumage, which is white. After 43 days this whiteness is sullied by dark dots which appear first in the tail and wingtips. These herald the change to the second type of plumage (the *first teleoptyle*), the dark spotted plumage in which the bird will first fly. Dr. C. A. Fleming came north from Wellington to join

the party which landed at Horuhoru on 14/1/50. After that we sent him a copy of the weekly reports which our Recorder, H. Ross McKenzie, was filing at Clevedon. Dr. Fleming expressed concern lest the Field Names which we found so convenient at Horuhoru would not be acceptable to ornithologists in England and America. Consequently he consulted Dr. R. A. Falla and Dr. K. A. Wodzicki, and together we developed the more scientific names which appear in Appendix A. There you will find that the names during the development of the *neossoptyle* plumage contain the noun "down" with a qualifying adjective, and the *first teleoptyle* names mention "fledgling" or "feathered."

AGE OF EGGS

For some of the work it has been necessary to know the chick's age exactly. There is no problem when the egg is seen hatching. We hoped to learn more by considering eggs that had been hatched in the past three or four days. For years we have kept records of the eggs in North Pocket (six breeding pairs increased slowly to ten) and in area S seen in Fig. 3 where the 28 to 32 nests are easily identified, and the chicks cannot wander away into other areas. We have marked dozens of eggs, and nominated when they would hatch, mainly for fun. A young gannet laying for the first time often leaves large streaks of blood on the shell. Some find it so difficult that they are completely exhausted and lie for some minutes with their legs stiff and still and their necks and head along the ground on the other side of the nest. Streaks of blood on the shell can be a great help. By experiment we established the following points:—

(1) If the shell has distinct streaks of blood.
   (a) the blood is quite fluid up to 2 hours.
   (b) a wet finger will smear the blood up to 4 hours.
   (c) after 6 to 8 hours the smear dries before the wet finger spreads it more than 5 mm.
   (d) some blood keeps very red up to 6 to 8 hours. Most blood is brown after 10 hours and certainly after a day.

(2) If there is a lot of very thick blood on the egg it appears almost black at the end of 2 days.

(3) If there is no blood. The egg has a faint blue tinge and it seems translucent and "alive." This "living" quality disappears in the second day and the egg becomes opaque even if it is still quite clean.

(4) If the egg is stained with footmarks. The amount of staining depends on the surface of the ground and the state of the weather. It varies from place to place and from day to day. There is however a limit to the amount of discolouration, and in a muddy area it may be reached in a week. Eggs a week old differ little from those that are four weeks old. It may be possible to arrange the eggs in the correct order of age, without being able to say if they are one or four weeks old.

These observations are from over a hundred eggs, marked in different seasons. One may say with confidence "that egg was laid yesterday" or "last night," or "this morning" knowing that one

will prove correct when the egg hatches. Eggs that I have nominated as being laid two days before or three before may be a day out. I have been right with some four day eggs but only in fine weather. Anything older than that is beyond me, and although I can name sixteen eggs in the correct order, I will be a week or so out with the older eggs. Here is the result when I estimated the age of sixteen eggs in area S when there were 20 nests, and then examined them 44 days later.

My estimate	10, 9, 9, 8, 6, 4, 4, 3, 2, 2, 1, 1, 1, 0, 0, 0.
Age as shown by the chicks after they had hatched	21, 16, 15, 10, 5, 4, 3, 2, 2, 2, 1, 1, 1, 0, 0, 0.

A rather different experiment was carried out in 1954. On 9/9/54 we selected twenty-one eggs in different parts of the island. I was fairly confident that these had been laid between 7th and 9th. We marked each egg and recorded its position with reference to some well recognised landmark. The record was kept in seven columns. First there was the egg's number, the section in which it had been laid, and the time it had been laid expressed thus:— 7 meant some time on the 7th. L8E9 meant between mid-day on 8th and mid-day on 9th, while 8-9 meant I was uncertain. (By the evidence given by the appearance of the egg I was not prepared to state which.) We returned on 23/10/54, 44 days later. It was wild and stormy; the parents were snuggled hard down on their egg or chick. Before my son Peter raised each adult, I nominated what we would find underneath. Egg I was hatching and the egg-tooth could be seen through a ½" hole. Egg II was addled. In III the chick had opened its shell ¾ way around, but Egg IV had a four-day-old chick. We continued with V, VI and VII: then my son ceased making critical remarks, and acknowledged that I was making the grade. With Egg IV I was quite wrong, two eggs were addled, one that I expected to be a day old had died in the shell just before hatching; the embryo was quite fresh, perfect, but dead. Two eggs disappeared, the nests were empty and neglected. One nest had two eggs, one of them recently laid compared with the other (which was old but not addled). When we returned on 4/12/54 there was a 16-day white chick in this nest, but no chick from the earlier egg. Of the remaining fourteen eggs, 8 were hatching and 5 contained chicks of the age I had predicted; thus we had 15 out of 16 correct.

A copy of the page from my Field Book will be found in Appendix B. In defining the position of the egg we have referred to a well known mark or another numbered egg and stated the number of feet from it and the compass bearing to the egg. The final (seventh) column shows what we found there.

GROWTH OF TAIL FEATHERS

Our main project for 1954 was to find if there existed a clear relationship between the length of a juvenile gannet's tail and its age. Area S was again chosen for the main experiment. On 9/9/54 there were 29 nests and these were mapped out and numbered from east to west in rows arranged from north to south. At the north there was a trianguar group of ten nests arranged —

FIGURES 5, 6, 7 — Area S nests in September, October and December

1
2 5
3 6 8
4 7 9 10

The southern group of 19 was arranged in 6 rows of from two to five thus:—

17
11 18 22
14
12 19 23 25
15 28
13 20 24 26
16 29
21 27

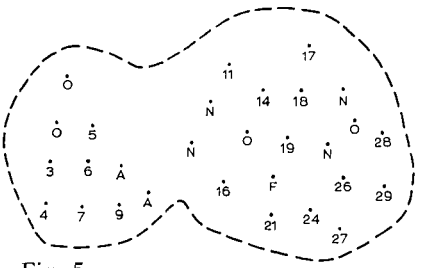


Fig. 5

Fig. 5 — On 9/9/54 there were —

	Marked Nests	Nos.
4 old eggs	(O)	1, 2, 15, 25
4 new eggs	(N)	12, 13, 22, 23
1 fresh egg	(F)	in 20
2 late afternoon eggs	(A)	in 8 & 10

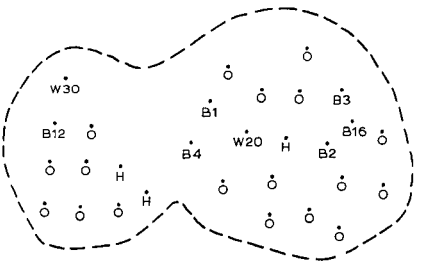


Fig. 6

Fig. 6 — On 23/10/54 all nine eggs had hatched, giving —

	Nests
2 Whites W30, W20 from	1, 15
6 Blacks B12, B16	2, 25
B4, B3, B2, B1 from	13, 22, 23, 12
3 hatching H H H in	8, 10 20

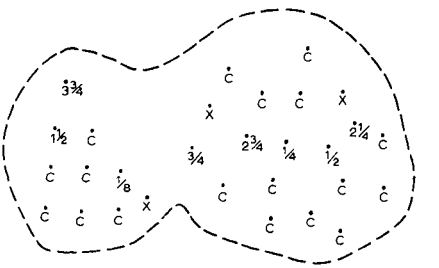


Fig. 7

Fig. 7 — On 4/12/54

By Dec 4th H1, B1 & B3 in 10, 12, 22 had disappeared.

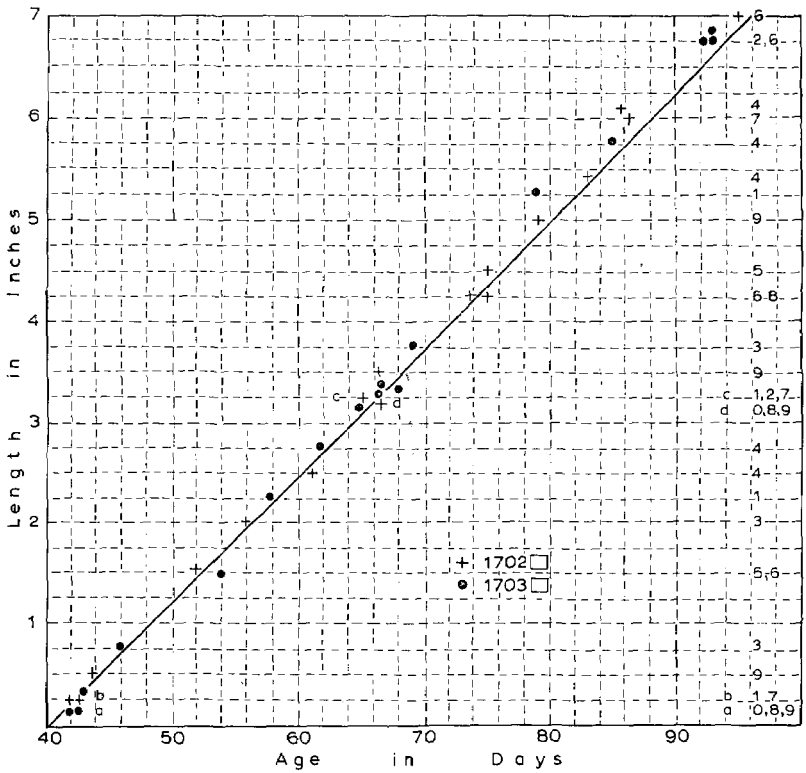
The other 8 chicks were now 1 Advanced and 7 Traces.

Seven were banded, see Table VII. The other 18 eggs had hatched giving 10Wh & 8 Fluffies.

TABLE VII

Nest number	Band number	Age of chick in days	Length of tail in inches
1	17032	72	3¾
2	17036	54	1½
8	17035	42	⅛
13	17033	46	¾
15	17034	62	2¾
20	17030	42	¼
23	17029	44	½
25	17031	58	2¼

FIGURE 8 — Age of Gannet Chicks from length of tail feathers.



Throughout the season we continued to measure these tails and all others banded from 17021 to 17039. During the course of the experiment birds numbered 17035 and 17037 were lost. The readings obtained from the others will be found in the Graph, Fig. 8. (The length of tail in inches is plotted vertically against horizontally the age in days.) All points plotted + are for birds with band numbers 17020 to 17029 and those marked • for bands 17030 to 17039. The units figure is shown in a column on the right. The readings marked a, b, c & d are multiple plottings. The straight line drawn from 0″ at 40 days to 6″ at 88 days gives the readings for a bird whose tail grew $\frac{1}{8}$″ per day. From this we may state the "*Gannet Rule of T F G.*"* If D be a juvenile gannet's age in days and t be the number of inches in the tail: D = 8t + 40.†

From 1955 onwards when banding we recorded the length of the bird's tail and entered the corresponding age in the Banding Schedules on return to Auckland.

* Tail Feather Growth.

† In the metric system if m be the tail length in mm; D = 1/3m + 40. This would be accurate if $\frac{1}{8}$″ = 3mm. A better relation is $\frac{1}{8}$″ = 3.175 mm. There is therefore an error to allow for which we should add 1 day at 60 days old and 2 days at 80 days old.

CHANCE OF SURVIVAL

We have seen that a young gannet's chance of living through the spring gales until the flying-away stage is reached, is often a very slim one. Even if the egg is laid by mid-August (and that is very early), and the parents keep their chick alive to mid-January, there would be no time to raise a second chick even if they wanted to. Sometimes the first egg is lost before it hatches. If this happens early in the season, a second egg may be laid. In one case we found "Gertie" (area G), who laid an egg early in August, and in September I saw her make a clumsy landing and she smashed it. There was yellow on her chest for over a day. The pair did not desert the nest, and in October I found her sitting on a second egg. But in early November the nest was again empty. She laid a third egg before the end of the month, and it hatched in January. Although it grew steadily for some weeks, we lost sight of it in March. This pair laid three eggs in the season, without raising a single chick.

In most cases the first egg laid does hatch. In our experiment in area S, all 29 eggs were fertile. In another experiment extending over two months and involving 1350 eggs, we found that 98% hatched. In the spring the easterly storms come often twice a month, and decimate the population. Fifteen hundred pairs in early November rarely produce a thousand surviving chicks and eggs at Christmas: by the time they start to fly off in mid-January, 700 to 800 is a good tally. Then too, a great many must fail to make the Tasman crossing. (They find little to eat on the way and arrive thin and weak, and are easily killed in the surf if they try to land on Australian beaches.) And then, after developing for a year or two they have the perilous crossing back to New Zealand. From the eggs laid in one spring on Horuhoru, it would not be surprising if we found that less than five percent had returned to the rookery from which they originally came, to start raising families of their own.

ADULT MISHAPS

Some pairs seem to have a long run of misfortune. In area P there is a stump with two surface roots running back up the slope. The hollow between them is an ideal place to have a nest. The same pair used it for some years. On 14/1/54 I banded the adult 19860 and her chick 19861. On our next visit (19/1/54) the adult on the nest had no ring, so I banded it 20002. On the 24th it was again 19860. Between them they raised the chick to the flying-away stage. In the 1954-1955 season, these two birds had another chick in the same nest, but it died before it was large enough to band, and they did not lay again. In 1955-1956 they did not appear, and no other birds used the nest. In 1956-1957 19860 sat on an egg in the nest for over three months, and when I opened it I found that no chick had developed.

On 30/8/57 I caught 19860 near the site, but no nest had been started. On 27/10/57 there was a bird without a ring on the nest; it was nervous of me and flew off leaving the egg. On 29/12/57 I caught 19860 on the nest (seventh time of catching). She was on an egg, so they must have lost the first and laid another. They succeeded in hatching this second egg, but the chick died within a few weeks. In the 1958-1959 season they succeeded in raising a

chick. In the spring of 1959 the nest site was vacant on each visit, and on 15/1/60 19860 was found sick on a beach near Warkworth which is 40 miles north-west of Horuhoru: she died next day. She must have been well over twelve years old and in the seven seasons in which we observed her, with the help of two husbands, she managed to raise only two chicks.

ADULT BANDING 1957 - 1958

In the spring of 1957 we made four landing on 30 Aug, 3 Sept, 21 Oct and 23 Nov, and we caught 21 adults (5 + 5 + 4 + 7 = 21). These were banded 35-407 to 35-427. Of these, twelve had been ringed as chicks and nine as adults. The chicks had been aged to the nearest week and grouped by months were, one 4 yrs and 10 mths, five as 5 yrs, two 5 yrs 1 mth, two 5 yrs 9 mths, one 5 yrs 9½ mths and the oldest was 5 yrs and 10 mths. Three of the adults three years before the present season,one 3 yrs, one 4 yrs and four 5 yrs before the latest months in 1957. The 4/10 bird was alongside an empty nest. The rest were all nesting and had an egg or chick. Some were therefore in their fifth year and some in their sixth. (We thought that it would be safe to assume that the birds ringed as adults were all at least five years of age at that date. Their ages on being banded in 1957 therefore, ranged from four over 7 to four over 10 years old.) In later years we found several birds building in their fifth year, many in their sixth, a few in their seventh and two in their eighth year after hatching. Later still we were to find that although many were nearly six, many more were seven years old and a fair number were eight. The average was 1 yr and 4 mths. We finally moved the 5+ for an adult when first caught, up to 6+.

CATCHING ADULTS

Catching these ringed birds took a lot of time. If you set out to catch only ringed birds, you found that a gannet rarely stands so that you can see both legs at the same time. After examining a bird from a distance and seeing no ring, you had to creep round in a circle without making a fuss, so that you could see the other leg without alarming the bird. If the bird you select is sitting, you have to lift it to see if it has been already banded. The time wasted was considerable. Determined to get some benefit from our efforts, we marked out an area on North Ridge, and starting from one end, we worked along systematically banding every bird that allowed us to catch it.

During the remainder of the 1957-1958 season, we made four more visits to Horuhoru, on 29 Dec, 7 and 30 Jan and 5th April 1958. On these days we banded 35, 83, 15 and 31 chicks, 164 in all. Fifty-nine were banded near the landing on the Terraces and 105 on the top in the North Ridge area. On the first three days we banded 12, 27 and 13 adults as well, eight on the way up, and 44 on North Ridge. Only five of these had been banded before, two as adults and three as chicks. All three had been hatched in 1952 and were known to be, 5 yrs and 3 mths old, 5/3 and 5/2½. The adults, both caught on 7/1/58, were more interesting.

In October 1957, an apparently sick gannet had been taken from the water in the Waitemata, and brought to me in Ponsonby. After banding it 28836, I released it again in the Ponsonby Boatharbour.

If an adult gannet is caught on its nest and banded alongside, even if it has been handled with great care, when it feels itself released, it spreads its wings and beats them on the ground, so that it can get as far away as possible. Before it gets airborne, it knocks eggs and small chicks out of their nests, and causes a lot of damage. To avoid this, when we have finished the banding process, we use two hands to keep the bird's wings close to its body, and then with a mighty swing, we launch it upwards as high as possible. All birds immediately spread their wings, and within seconds are safely airborne and instinctively glide out over the sea. After a very small circle, they come in to land close to us again. They have been surprised to be caught, but they are not resentful. Standing on the Westhaven Jetty, about 3 metres above the surface of the water, I managed to hoist the gannet 28836 upwards about six metres. But it had forgotten that it could fly. Keeping its wings folded, it fell into the sea with a mighty splash. It did not sink. It just sat on the water. After a few minutes it decided to leave us; it paddled away a little and then managed to get airborne.

As it staggered away I remember saying, "Well, we won't be seeing you again," but we did. Three months later on 7/1/58 we found it again, on the best nest-site in square Tc, sitting proudly on a three-day-old chick. We gave it a second ring; 35444.

Quite close to 28836/35444 was the oldest bird of which we could guarantee the age (16-244). On a new egg in square Tc was a bird which we had banded as an adult in Tc six years before on 5/1/52: it must now be well over 11 years old.

AGE OF CHICKS AT DEPARTURE

On our final visit to the Rock in the Autumn of 1958, besides banding another 31 chicks, we found that seven banded on 30th Jan were still on North Ridge. Their numbers were 36746, 47, 48, 50, 52 and 36758. By adding 65 days to their ages we found that they were now 100, 95, 97, 103, 105, 107 and 95 days old. Over the years we have found that chicks fly away on their 107th, 108th or 109th day.* Only two have been found to be older. One year a chick apparently 120 days old, was the last remaining on the island. its parents were still in attendance, and there were only three other adults over the whole of Horuhoru. We caught this chick quite easily, and found that it had a bad injury to one foot.

Another season when only 16 remained, we found that we had banded 15 of them, and knew that their ages lay between 95 and 108 days. While we were working on the Rock, two chicks aged 107 and 108 days flew off. Later we carried a 102 day chick from high up on the Terraces down to the landing, and putting it in the dinghy, we rowed it some fifty yards out to the north-west and let it go. We rowed well away and watched to see what would happen. After two or three minutes it paddled back to the Rock, was washed up on a swell and tried to climb back up to the top. Although it was only a week under age, it had no wish to leave.

* In Appendix J comparison is made with departure of Shetland Island chicks.

SEASON 1958 - 1959

In the spring of 1958 we made a first visit on August 23rd. It was too early to band any adults. After nearly three months of blustery weather, we landed again on 22/11/58 and used 80 rings, Nos. 37003 to 37082. We caught 87 adults, of which 21 already had one ring, and nine had two. The two "ringers" had been banded in 1957, and on one other occasion before that. One of them was 35406/19860 which I was catching for the eighth and last time. She was something over 11 years old. Another was "Gertie," who laid the three-eggs-in-one-season. Her two rings were 35427/28793. The older was becoming too thin, so we replaced it with 37006. She had now been caught over twelve times quite willingly, and was over eight years old. Three of the others were over seven years and three over six. Among the 21 one-ringers, there were two that had been ringed as adults in January. Each now had a chick, 18 and 26 days old. They themselves were something well over six years old. The other 19 had been ringed as chicks so that their ages were known. The youngest had been ringed in January 1955 so that their ages could be given in days:— four years and eight days, four years and 24 days. The elder was definitely roosting. The younger was alongside a nest containing a banded adult; it was not clear that it was the other parent. Of the remaining one-ringers, two were now 5 yrs 1 mth, one 5/11, two 6/1, three 6/2, three 6/3, two 7/0 and the last one, hatched about 20/8/51, was 8 years and 1 month old.

In another landing on 30/12/58, 21 adults were caught and banded from 45001 to 45020. Of these, seven had been ringed before and were given a second ring, the other with two rings did not require another. Of the seven, two had been ringed as adults in the preceding January. They were now well over six years old and had chicks 12 and 24 days old. The other five had been banded as chicks, four of them from 1952 to 1954. Their ages were 5/1½, 6/2, 6/3, and 7/3. The final bird was the only four-year gannet we have ever found breeding. It had been hatched on 13/10/54, banded on 8/1/55 aged 87 days, and now sitting on a black chick it was 4 yrs and 78 d old.

The two-ringer was the most interesting of all, a really old friend. Hatched about 2/12/53, it had been banded 20007 on 19/1/54 and then caught on North Ridge when it was almost three years old. It was then banded 35403. Now just over two years later, it was on a nest very near the same spot. It had a 5-week-old chick in its nest. As ring 20007 was badly worn we replaced in with 37061.

On 3/1/59 we banded 200 more chicks on North Ridge. At the same time we banded another 12 adults (45021 to 45032), three of them originally banded as adults and four as chicks. These latter had an egg or 8 to 10 day old chick and themselves were 5/2, 5/2½, 5/3 and 6/2. Two of the adults banded in 1956 were 8+ years old. The other had been banded on 22/11/58.

OTHER ROOKERIES

While all this had been going on, we still had been taking an interest in Mahuki, and the Coromandel rookeries. Only a few hundred chicks had been banded there, but they had been following

the same courses to Australia as our Horuhoru birds, and taking the same times to make the Tasman crossing. None of them was returning to Horuhoru instead of to its own rookery. At Mahuki on 17/1/59 28101 was guarding a 68 day old chick, within two metres of where it had been banded as an adult on 26/11/55. There was no sign that any of the 99 chicks banded with it three years before, had returned to Mahuki. On 1/1/60 however, three were found unemployed on the northern boundary of the rookery, and in 1961 several of them were found nesting.

SEASON 1959 - 1960

In the 1959-1960 season Horuhoru was visited only four times. On 26/8/59 we circled the rock with the Ecological Society Expedition, and counted well over a thousand adults ashore as we went slowly past, but there was no chance of landing. On 3/9/59 we made a quick run across the Gulf to all the Coromandel rookeries. Nesting was in full swing, and there seemed to be the usual number of pairs (up to 2500), but it was too rough to land anywhere, although we could get close in to all the nesting places. On 5/9/59 we managed to get back to the Great Barrier, and spent most of the afternoon of the sixth in examining Mahuki with great care. We had the highest count there to date:— Census Estimate 325; nests with egg or chick on 6/9/59 1032, and there were several other nests still being built. No. 28,101 was seen again, but he has not been seen since.

The most interesting sight was a 12-day-old chick, which must have come from an egg laid on 12/7/59. This would have been weeks earlier than we have ever seen before.

HORUHORU ADULTS BANDED

And when we got back to Waiheke, Horuhoru made up for all the previous disappointments. We landed on 12/9/59 and again on 13/9/59 and managed to catch 109 adults of which 38 had been ringed before. Of these 23 had been ringed as adults in the two preceding years. We had recorded the position of their nests on North Ridge using the co-ordinates method, so that we could now state the position of their nests of the year before, to the nearest foot. We learned a great deal about their movements from year to year. The ages of those originally banded as adults are given on the 5+ system in Table VIII. The week-end weather until the end of the year was frightful, so that we did not get ashore again until 5/1/60 when another four adults were banded and added to the record in Table VIII.

TABLE VIII

Landings	Number caught	Dates when first banded as adults				as chicks		Ages of adults			
		1953	1956	57/58	58/59	1952-55	Total	6+	7+	9+	11+
12/9/59	103	1		4	19	9	33	19	3	1	1
13/9/59	6					5	5				
5/1/60	4		1			3	4				
	113	1	1	4	19	17	42				

Once again the ages of the birds that had been first ringed as chicks, could be given accurately. They may be of little use here, but they are included as an item of interest. In our Field Books the ages were worked out at the date of ringing, but to give a more accurate comparison, the ages in Table IX are all given as on 12/9/59.

TABLE IX

Ages of ADULTS originally banded as CHICKS

Years	Months/Days						Nearly
4	10/19	10/20	11/ 4	11/12			5 years
5	9/24	10/15	11/ 5				6 years
6	9/21	10/ 0	10/17	10/24	11/11	11/30	7 years
7	9/ 4	9/12	9/15	10/ 3			8 years

AGE OF BREEDING

In Table IX there is something remarkable about the age of birds first banded as chicks, and now caught breeding for the first time. Four are four years old but nearly five; they will be five before they rear their first chick. Three are nearly six, six nearly seven and four nearly eight. In 17 birds there are 10 over six years old, average age is 6 yrs 5 mths. Since 1951 we have caught few adults that were under five years old. There was a three-year-old obviously unemployed, a few fours, one near a nest in which another adult was brooding a chick (was it the other parent?). Only one four year has been found incubating an egg. There have been some nearly five, a lot nearly six, more nearly seven, and a few nearly eight years old. We cannot guarantee that they were breeding for the *first* time. To do that we would have to catch two birds a nest over a long period, and still there would be no conclusive proof. Up to the present, we have been recording adults of unknown age caught breeding for the first time as 5+. From now on they will be 6+.

NEST BUILDING

During the course of years, we have often wondered as we see adults carrying seaweed about, and dumping it near the nest site they have chosen, "how much energy and time goes into the building of your nest?" The effort required must be terrific. The adults in the second nest in area A have always been easy to catch, and I have wondered if they would remain so co-operative, if they realised the great disservice I once did them. One August holidays we had as a guest Dr. Vivienne Cassie, noted authority on seaweed and algae. It occurred to me when she was with us on Horuhoru, that this would be a splendid time to find out what work went into collecting the weed and building the nest.

Their nest had just been completed; it was spotless. I had in Waitangi a very clean sack that had been used to deliver ti-tree blocks. Just before we left on the return trip to Arran Bay, I slipped ashore again to pack the nest into the sack. It was a tight squeeze, but we managed to get it in without much damage. Then we fled. What happened after the pair of gannets returned I cannot imagine. I am sorry that I could not get out again to see if they built another nest.

Next morning we sat on the sand in the sun, and as I took it to pieces bit by bit, the Doctor named and recorded each part of the nest. There were 542 items in all: from the three most common Carpophyllum 376, from other things with more than 10 examples 117, from others with less than 10, 49. This means over 250 trips per bird. At six trips an hour, this would require from each of the pair, forty hours of travel. The most interesting specimens were on two pieces of seaweed. One was an alga not previously known in New Zealand. The other a protozoon whose nearest known habitat was in South America. On a later visit, Dr. Cassie found the alga growing in profusion in the pool shown in our Map of Horuhoru, at the Landing. Fresh seawater gets into it only at high water when there is a south-west gale. The protozoon was not identified until it was sent to Cambridge University. Our gannets must be wonderful collectors. The individual items in the nest are set out in Appendix D.

BANDING ADULTS

When we are preparing to band adult gannets, we take a thick piece of Whakatane Board, and rule it up in lines and columns. The left hand column has a numerical list of the numbers on the rings we propose to use. Then come two columns headed Left leg Right. If the bird has already been ringed we write the band's number in the correct column, and the new number in the other. If there is no ring, we place the new one on the bird's left leg. If it already has two rings, the older is removed and replaced by a new one. Then comes the exact location of the nest, followed by its status (i.e. egg, or 10 dc = 10 day chick). Finally there is a column headed "Tail."

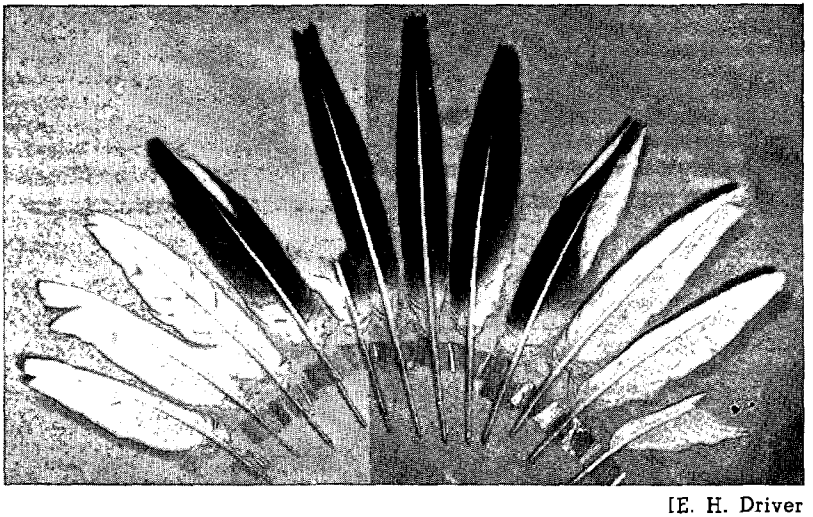
This has a cryptic set of figures we call the bird's "tail code." It gives the distribution from left to right of the white feathers which are on each side of the tail, and the dark brown or black feathers in the middle. Sometimes there is between the white and dark feathers a dark one with white diagonal stripes indicated by the letter "v."

It all arose from another theory that did not work out. After a storm up north, an observant youth found a gannet washed up dead, and found it had a band on one leg. He promptly forwarded the ring to Wellington and I was informed the same day. The young man was only fifty miles away, so I rang him to find if he had noticed anything about the bird's plumage. We had been getting news from Australia, of young birds that had been killed in landing in too high a surf. This bird was four years old, and obviously on its way home to Horuhoru. The finder said he had pulled the corpse well up above high water, so it might still be there. It was only eighty miles away, so he went for it on his motor-cycle the same evening. He sealed it up in a tin, and posted it to me. Its tail feathers had been damaged, but I managed to arrange them in order, and they may be seen in Fig. 9. We always read the feathers from the bird's left to right. Here then, you must look from right to left. First we have a smashed white and two whole ones, then a variegated one, three whole and one broken black or dark brown (at times it is hard to say which), another variegated one and three whites. This bird's feather code would be (taking no notice of the broken feathers), 3+1v+4+1v+3. The tail of the text book*, 444 is seldom

* Oliver: N.Z.Birds, p. 236, Tail of 12 feathers; p. 238, four central feathers black, remainder white.

found. Other examples may be seen in Appendix C, which gives five examples of Recoveries and Repeats from the 1959-1960 Season. The ½ which is seen in (2), Bird 37 007 (left leg), means that on 22/11/58 it was moulting, and three small feathers were showing among nine fully grown ones.

Ever since this bird was found, the tail of each adult has been recorded. I thought for a while, that we had discovered a way of telling that a bird was a sub-adult, but it was not to be. A bird may have 12 feathers one year, and 10 the next, and after an interval return to 12. We have photographed all types of tail, one with ten coloured feathers between two whites; the only constant feature has been, that every bird so far, has at least one white feather on each side of its tail. Mr. E. H. Driver made me a colour-slide of these feathers, and I have used it frequently.



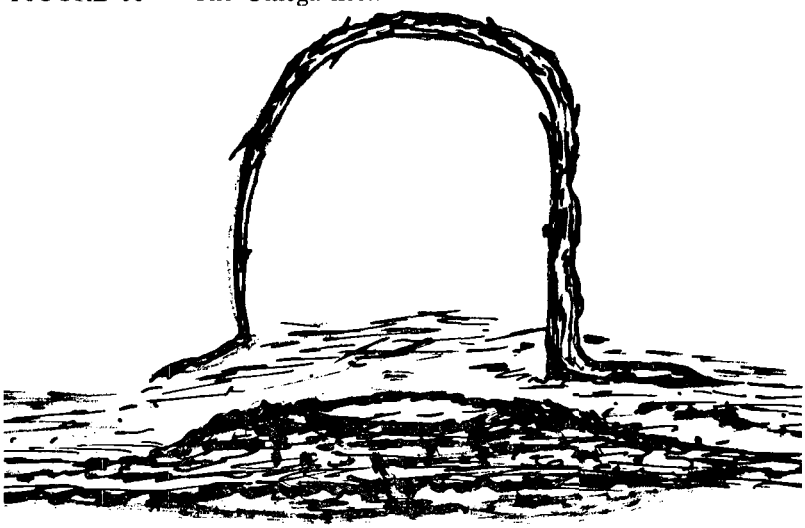
[E. H. Driver

FIGURE 9 — Gannet Tail Feathers: from a sub-adult aged four years, returning from Australia.

Returning to Appendix C, in (6) mention is made of the Omega Nest. This shows how something noticeable may give rise to a "nickname" that persists. In Tc at position 3.9, there was a long stalk, that in times past had been a small taupata. The strong west gales across North Ridge had bent it over until the top nearly touched the ground. When it died because of the gannets, in passing they slowly snapped off the branches, until only one remained at right angles to the trunk. On the far side, a surface root still showed above the ground, and the whole looked like a Greek capital Omega. The nest alongside was called the Omega Nest, and it will be seen when we come to Fig. 15. A bird had just laid an egg in it on 3/9/53, and was banded 15787 on its right leg; when lifted, the bird was still noticeably damp from the laying process. There is no mention of its "tail feather code," because it did not exist then. On 23/11/57 it was caught again. This time it had just laid an egg, but the nest was nearly a metre to the NW of the Omega Nest, which was occupied by another bird. Another ring 35426 was placed on its left leg. It flew off, and ten minutes later

another bird alighted by the nest, and covered the egg. It was banded 35425. The rings had been rather out of order, and this was later found to be very confusing. If 35426 had been 6+ in 1953 it was now 10+. When it was caught in 1953, its egg was found to have hatched on 17/10/53, and to make it easily recognisable, on 2/1/54 it was banded 15793 on its left leg, and 15792 on the right; it was then 76 days old. A week later it was recorded as "tufted" (12 weeks old): exact age was 83 days. That unfortunately was the last we saw of it. It disappeared.

FIGURE 10 — The Omega nest.



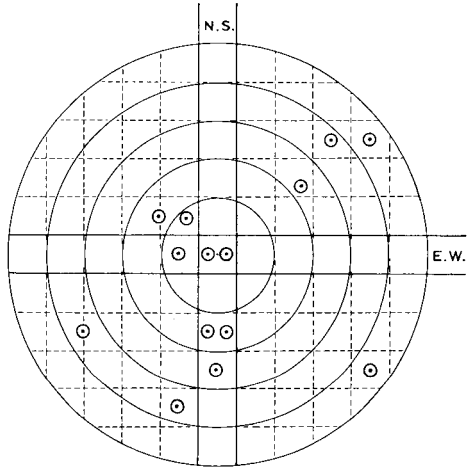
The next season there was a ringed bird on the Omega Nest, and another standing by. When I approached, one flew off, and then the other. I tried again half an hour later with the same result. On our next visit, I put the gannet catcher down near the nest and went away on other business. When both birds had returned, I wandered across not looking at them, but when I stooped to pick up the catcher they were off again. In all, I tried eight times in the season. But on 12/9/59 I caught the bird on Tc 3.9 and found it was 35425/15787. On 23/11/57 its tail code had been 3+6+3, on 12/9/59 it was 3+2+3, it had an egg, and it was over 12 years old. From records such as these, we were able to trace the movements of some of the birds from one year to another.

SLIGHT MOVEMENT IN NESTING SITES

In the 1958-1959 and 1959-1960 seasons there were 23 gannets whose nest positions in Ta, Tb, Tc, and Td were recorded each season (there were more in Te but no more room on the graph paper). The two positions of their nests are joined in Fig. 15, and will be discussed in detail later. In another area we caught 14 birds in similar circumstances. Twelve had made slight movements, but two had not moved at all. This is generally due to some formation of the ground which prevents even a slight displacement. Gertie's nest,

for example, was on a slight projection from the western edge of area G, and any movement to the north, south or west, would have caused the nest to drop into space. In some cases the nest is between the roots of a tree, or near one, as in the case of the Omega Nest. Twelve pairs had made a slight movement, but two had not moved at all.

FIGURE 11 — Movement of nests in one year.



In Figure 11 these short moves are shown in a series of concentric circles, varying in radius by one foot, which are drawn on a one-foot grid. Two pairs of vertical and horizontal lines a foot apart, cross at the centres of all the circles, and in the square so formed there are the two nests that had not moved at all. The centre of each nest is indicated by a dot within a small circle. Movement to the east and west is shown horizontally, and north and south vertically. The 1958 position of each nest is the centre of the concentric circles. We have then three nests which showed no lateral movement, but moved to the south, two of them by two feet, and the third by three feet. If the middle of a somewhat wobbly row of nests running north and south were shown by the heavy vertical line to the left of N.S., these eight nests would all be in it, as would be the ninth, that has moved one to the west and four to the south. The other five could be included in two other rows running north and south, but 30″ to the east, and 30″ to the west. The two most distant nests, by using right-angled triangles of the 3-4-5 shape, would both be under five feet away from their 1958 positions. In most cases then, the movement of pairs within an area, is comparatively small.

GANNETS NESTING IN GROUPS

In the Hauraki Gulf gannets have been banded on Horuhoru, Mahuki, Motu Karamarama, Motu Takupu, in the Bay of Plenty on White Island and in Hawke Bay at Cape Kidnappers, yet it all our recoveries on Horuhoru, we have not yet found a single bird that had originally been banded on any of these other rookeries. Among our recoveries of sub-adults on Horuhoru over 95% have been birds that spent their original 15½ weeks in the area in which they were found breeding for the first time. In that area too, many of

those that were neighbours when first banded, are found quite close together when they begin building nests. It has been suggested that they are homing on some prominent landmark. This is indubitably true so far as the whole " area " is concerned, but within it, the most prominent marks are our little " fences." It may be that some material purpose is involved: there may be some pairs who provide too much food for their own chick, and are generous in giving away the surplus. I find it much easier to believe that they enjoy the company of their group. Cases like that set out in Figures 12 to 14 illustrate this:—

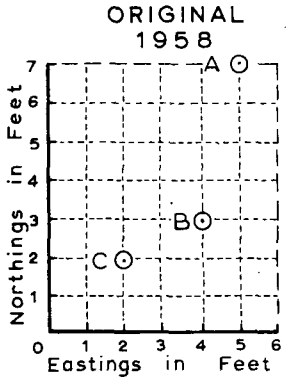


FIGURE 12

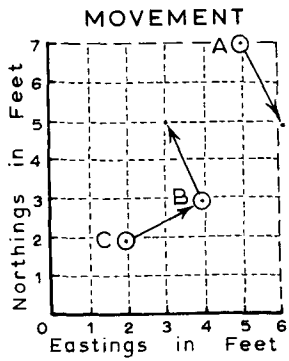


FIGURE 13

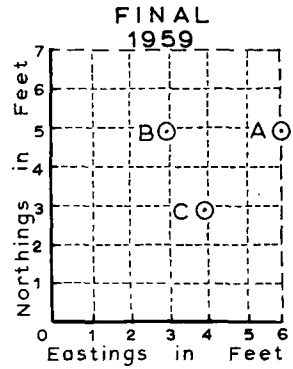


FIGURE 14

In Fig. 12, taking O as the origin, A = 5.7, B= 4.3, C = 2.2 were the positions of three nests in 1958.

When they started building in 1959 A moved 1′ to E and 2′ to S, B moved 1′ to W and 2′ to N, C moved 2′ to E and 1′ to N, see Fig. 13.

Their final positions in 1959 were A = 6.5, B = 3.5 and C = 4.3, so that from a boomerang formation reading clockwise ABC, they have changed to a cosier triangular formation, reading clockwise ACB. There is of course no proof that this means anything.

Small movements in any direction do not seem to be resented by gannets who find other pairs in the nesting space they had in the year before. There does not seem to be anything of " defending territory " among gannets.

A DISAPPOINTING SEASON, 1960 - 1961

After our increasing success 1958-1959-1960 we looked forward hoping that 1960-1961 would reveal even more. Everything went wrong. Gales for most week-ends in the spring; a few fine week-ends came when there was insufficient manpower to make a good sweep. To do a sweep across North Ridge at least five, preferably six workers are required. The first uses the catcher and two take care of the birds as they are caught, a fourth prepares the rings and gives them to the bander in their correct order, calling out the number as he does so. The fifth man, who bands the birds, has a lot to do. He first calls out the number on the ring, and states which leg he is putting it on, at the same time the catcher

who has used his long instrument to measure the exact location of the nest, calls this to the recorder too, with the status of the bird. He then moves on with No. 3 to catch another bird which No. 3 will hold. Meanwhile No. 2 is holding his bird by the head with his gloved hand and by one wing with the other. Suppose the bander has named the left leg as the one to receive the new ring, he then says " Right leg ring No. 15 623 " giving the number of the ring already on that leg and finally " Tail code 3+4+3." The recorder, who has entered all this data in the lined and columned Whakatane Board, which we have mentioned before, now calls back to Nos. 1, 4 and 5, the new ring used, where the nest was, what was on the other leg, and what the tail-feather-code was. No. 2 then takes his bird some distance to the rear, and as he releases it, tosses it high up into the air, where it becomes airborne without damaging any chicks in the neighbourhood. At this stage No. 3 brings forward the bird the catcher has secured to be banded, No. 2 follows No. 1 to the third bird, and so on to exhaustion point.

CHICKS BANDED JANUARY 1961

The first day on which we had fine weather and sufficient workers was 21/1/61. On landing we found that the chicks were so far advanced, that their parents considered they needed no more protection, and were themselves not eager to be caught. Such a thing as a good sweep was out of the question, so we banded on T 100 chicks using 0 601 to 0 700. Three of these were heard of quite soon. Departing on 25/1/61, 0 656 was found dead on a beach near Woolongong on 1/3/61, after 35 days' absence. Leaving a week later, 0 607 was found dead on a beach in South Tasmania, on 11/3/61. More interesting was 0 673, which on being banded and placed back on the ground, decided to depart. It made a particularly poor start, falling into the water quite close to Horuhoru and, tail awash, paddling and flapping along towards Kawau, but in the next 27 days it covered 2400 miles, nearly reaching Adelaide. Very high waves on Surfers Beach, three miles south of Port Elliot in South Australia, battered it to death on 17/2/61.

Only one adult was banded on 21/6/61, 36760. It was singled out because it was attending a 10 day old chick in area P. This was a very late laying, about 27/11/60. (It hatched on 10/1/61.)

On 25/2/61, we went out to see how it was progressing. We did not manage to get in sight of him. So steep were the breakers at both south and north ends of Horuhoru, that after creeping up to the north-west in its shelter, we came close in to the Rock, but failed to reach the western side, and were forced to turn back. On the next morning we tried again, and although we managed to sail round the island, we could not land. We saw 36371 (36370's chick) still in P, a well-developed " trace.' There were still six other chicks on Horuhoru, none on either North Stack or South Ridge.

On 1/4/61, we made a final attempt to visit him, but after getting through the inner passage at Kauri Point, we ran into the full force of a north-west gale, and could not proceed with safety. So ended a very disappointing season. But our next landing on 30/8/61, made up for it all.

SEASON 1961 - 1962

There were enough helpers to make a full-scale sweep across North Ridge. We made a good landing on the wave platform at the foot of the Terraces, and immediately spotted a ringed bird in Area A. It had been banded first on 28/1/52; the ring was in a fair condition, so we left it in position and rebanded this gannet on the left leg, 36301. Completing the climb up to G, we approached the " fenced " rectangles that fill area T.

We started our " sweep," and succeeded in catching another sixty-one birds. Of these 23 had been banded once before, 10 twice and one three times. Six had been banded in 1952, 1 in 1953 and of the thirty-seven banded in the past three successful seasons, 3 had been banded in 1957, 16 in 1958 and 18 in 1959. We used only 52 rings from 36 301 to 36 352; all nine of the double-ringers did not need any fresh bands.

As our decision to assume that adults breeding for the first time are probably at least six years old, seems to be fully justified, we shall now continue to class these as six-year-olds. Among those which have been caught as adults at least once before, there were 25 over eight years old, namely; 8 eights, 10 nines, and 7 ten-year-olds. The remaining eight birds had been banded as chicks and their ages in years/months/days were: 4/11/8, 8/11/7, 8/11/7, 8/11/7, 8/11/8, 8/11/29, 9/10/25 and 9/11/11, which gives an average of 8 years and 8 months. We had hoped to make a sweep in August 1960, and it is conceivable but not likely that seven of these eight birds might all have been caught then. In that case the average would have been reduced to 7 years and 8 months. Conceding this point, it is still clear that many, perhaps most of the gannets that return to Horuhoru, may delay breeding until they are six or seven years old.

NESTING CHANGES

We now have to examine again the slight changes that some pairs make from year to year, in their nesting sites. In the 1958-1959-1960 sweeps across North Ridge, we found over twenty pairs in Ta, Tb, Tc, and Td had moves from one to five feet. The moves are indicated in Fig. 15. We have here the " fences " bounding these four sub-areas. There were more in Te and in U, some of which are mentioned in Table X, but there was not enough room to get them on the graph. The positions occupied by the nest in 1958 is shown by a cross, and an arrow shows the movement to the 1959 position shown by the large dot. Opposite the crosses in the margin are the numbers of the 0 300 series of bands used in 1959, and Table X shows the number of the band found on one of the pair in 1958.

In banding throughout area T, we do not follow an absolutely fixed course. We start in Ta and move north through Tb, Tc . . . and in each fenced rectangle we move from east to west. The rings are used in strict numerical order, to make them easy to check, and to help the recorder, who has them already written up on his WhakaBoard. Neighbouring nests therefore tend to get numbers in numerical order. Years later in banding recoveries, we adopt the same procedure using a new thousand group each year. Thousands up to 20,000 were used in 1951 to 1954, 35 thousand in 1957, 37 in 1958 and 45 in January 1959. Later came Os and finally Ms.

FIGURE 15 — Fenced Sections in Area T.

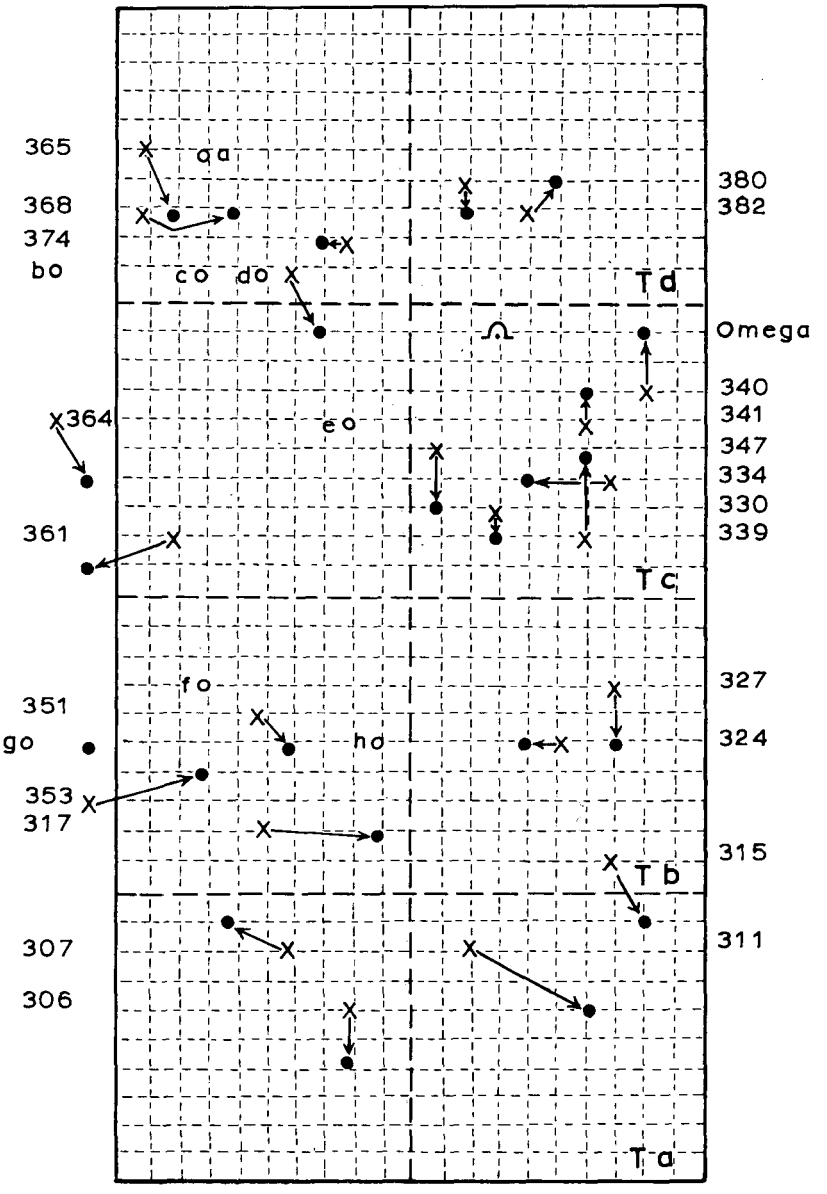


TABLE X

Band Recovered	New Band "O" series
35 428	301
37 007	302
37 010	306
37 014	307
37 011	311
35 425	312
37 032	315
19 104	317
35 461	318
37 031	314
37 036	327
37 040	330
37 043	334
37 050	339
37 051	340
37 049	341
37 041	347
37 020	351
15 544	353
15 567	361
16 060	364
16 044	365
37 065	368
16 348	369
37 056	380
45 026	382
35 471	385
35 449	399
45 003	400
15 621	401
19 965	403
19 137	404
16 174	405
15 686	406
16 330	407
15 908	409
16 070	411
28 535	416
35 107	16 129

here followed the other two-ringers

TABLE XI

	Band number	Used in	"O" series number	Co-ordinates of nest
a	16 348	1952	369	Td - 7.5
b	16 060	1954	364	Td -12.1
c	16 044	1954	365	Td - 7.1
d	16 208	1951	359	Td - 5.1
e	15 567	1952	361	Tc - 2.6
f	15 632	1952	418	Tb - 7.7
g	15 644	1952	353	Tb -13.5
h	19 104	1954	317	Tb - 1.5

TABLE XII

Band	Hatched	Age Yr	Mth	Status
35 407	1951	8		On nest
16 169	1951	7	10	Egg
16 348	1951	7	9½	10-day chick
16 174	1951	7	9	Nest
15 632	1952	7		7-day chick
15 635	1952	7		Egg
15 686	1952	7		Egg
15 621	1952	7		Nest
15 637	1952	7		Building
15 631	1952	6	10	Egg
15 622	1952	6	10	Egg
19 104	1953	5	11	Egg
19 137	1953	5	11	Egg
19 965	1953	5	10	Egg
19 956	1953	5	10	New nest
16 060	1954	5		New nest
16 044	1954	4	11	Egg

Notice the long runs of the 37 thousands, and the shorter 35 thousands, and the two substantial groups from the early fifties. Another point to remember is that there were two gannets to a nest, so that some of the 37 thousands of 1958 would be away fishing in 1959. The numbers missing from the "O" series were put on birds that had no other band. Notice the eight open dots lettered from a to h. These birds were banded as chicks somewhere in T, but their exact co-ordinates then are not on record. Whatever else we know about them is given in Table XI.

Besides the two points already mentioned, (1) Gannets show some form of memory in returning to the area in which they spent

their first three months and (2), having settled there they show some form of associating with certain members of a group, we found (3) sites where nests appear early one year are first to be occupied the next, but (4) if birds find that their usual site is occupied by another pair, they do not seem to mind moving a short distance. (5) Younger birds seem to settle on the outer edges of the area, sometimes right outside the "fences," but when opportunity occurs they move in. (6) Some pairs do not build every year.

There is no need to try to explain any of these points, but we seem to be better pleased if we can see a reason for what happens. Suppose the older birds took first pick, and the younger used what remained, then when one of the older pairs decided to take a year off, a younger might take their place. To see if there were anything in this, I took 17 birds of which we knew the ages and arranged them in order, eldest first, and finally added their status in 1959. The result is seen in Table XII. Unfortunately nine of them are stated to be "on egg," so for a period of six weeks we can make no differentiation, and in the remaining cases there is nothing remarkable; only the 3rd and 5th have chicks, and the oldest still has not laid an egg; the pair may have lost their first one of course.

To get anything worthwhile, we would have to make a sweep when all the nests held chicks; the adults would be much harded to catch. In any case this would be more an ingenious exercise than a quest after useful knowledge.

STEALING NEST MATERIAL

The only unfriendly aspect in the whole nesting process, is the stealing which so frequently takes places. There is no unpleasantness, because the theft is made while the owners of a heap of nesting material are away collecting more. A bird from a nest some distance away, will hurry over when the birds depart, and pick out from their store a piece that suits him. He will exert considerable energy in pulling it out of the heap. He immediately takes it over to his own nest and has it worked in securely before its rightful owners return.

Some strange things happen during nesting. One year when area V had about six rows of 8 or 9 heaps of nesting material, I examined it to see how many would be there. About a week later, when I had a second look, the whole area had been trampled over and individual nests were hard to trace. A fortnight later still I came a third time, and found six rows of 10 or more, nearly completed nests. This area is particularly restricted: on three sides there are overhanging edges of steep cliffs, and on the fourth there is a steep slope up to a thick hedge of taupata; there is no room for expansion. Room had been made for several additional nests. I was so surprised that I noted it in my diary; I wonder what the real explanation was.

Another incident surprised me even more. There was a stiff breeze from the SE: the wind met the incoming tide at the south tip of Horuhoru, raising endless close rows of steep-sided thin-tipped waves. As I watched, a gannet flew by holding a huge piece of seaweed by a long thin but strong stalk. It trailed out nearly two

metres beyond his tail. He had taken off to the SE against the wind, and when he was up three metres he wheeled to the east, then north, to approach North Stack from the north. Gaining height slowly, he cleared North Stack, but would hit the cliff below North Pocket about half way up. He banked away to the east again, and settling softly on the water, had a little rest.

Then he set out again. This time he flew about a metre above the waves, weaving up and down so that his trailing weed smacked loudly against the tip of every fourth or fifth wave. As he passed Waitangi, I could see a shower of drops pour off at each slap. He covered a good two hundred metres before he circled round east, and then north, and this time he was well to the north of North Stack as he commenced his approach. He cleared it easily, but just skimmed over the taupata behind North Pocket, to land somewhere in area V. How many nesting adults were buried when he came to ground level, I do not know. There must have been some angry cries as they freed themselves, and he would have to chop it up, before he could use the seaweed in his nest. How many trips he saved himself by this endeavour I do not know — I cannot bring myself to believe he planned that part of the operation, but I did see him shake off the excess of water, before completing his second attempt to get the weed up to North Ridge.

We made another trip to Horuhoru on 11/11/61, but the wind got up and it became so cold that we had to clear out after banding only nine adults in area T. This was not the end of operations for the season. A fortnight later we were able to get to Mahuki again, and there we banded 300 chicks.

TO MAHUKI WITH THE NAVY

In the early sixties, the Navy had moored in Westhaven, a 65 foot Harbour Defence Launch, which with three officers and a Chief Petty Officer as engineer, was used at week-ends to carry out training. We had once before been taken over to Motu Karamarama in this vessel in appalling weather, to visit the rookeries there, and now we learned they were organising a week-end exercise at the Great Barrier.

In the Hauraki Gulf an operation involving a few ships from the Australian Navy, and some from ours, had been hunting a British submarine. At the same time, a battalion of our troops had been engaged in an exercise which took them through the wilder wastes of the Barrier. We were to be near Port Fitzroy at dawn on 25/11/61, to pick them up and ferry them out to the Royalist, in which they were to return to Auckland.

We left Auckland very late on the night of Friday the 24th, so that we could make our way through Governors Pass in daylight, deliver the Commodore's mail, and do our ferrying. The trip across was interesting and exciting, the ferrying hilarious, but we finished early, and I was allowed to act as Pilot through the archipelago of islets to the south of Wellington Head, and into the Boat Passage to the north of Mahuki, where we moored ship and prepared for a welcome mid-day meal.

In the afternoon the Captain and several of the crew came ashore with us, and climbing over the intervening hills, arrived at

West Promontory, where we have the cleanest and tidiest rookery in New Zealand. I proceeded to catch 299 chicks, while R. F. Attwell assisted by his team of sailors wearing heavy gloves, banded them from M 4502 to 4800. This brought our Mahuki tally up to 399.

With the help of Douglas Guthrie's crew of the Isle of Arran, we had banded 1 adult and 99 chicks on 26/11/55. On 2/1/60 we had visited them again, and saw 28 101 with a chick on exactly the same spot, where he had been ringed as an adult in 1955. There was no sign among the breeding adults of any of the chicks which had been ringed with him in 1955, but two were standing unemployed on the bank to the north.

We were able to make a careful count. (The figures in parentheses were obtained at the "Terraces" on Horuhoru a week later.) 351 Complete (H 406), 46 Tufted (48), 23 Advanced (16), 18 Trace (30), 27 Fluffies (43), 7 White (4), 4 Black (6), and 10 eggs (3) a total of 486 (H 556). In early November the Horuhoru total had been 1063. A total of 900 in early November would thus be reasonable for Mahuki.

Some of the birds were ready to fly off — this begins in mid-January at Horuhoru. Twice with the help of Isle of Arran, I have managed to cross to Mahuki a day after counting the birds on Horuhoru. On most occasions the number of birds and their distribution, have been almost the same as on the Terraces at Horuhoru, but twice there have been over 1000 eggs plus chicks. On all occasions the development at Mahuki has been a little more advanced than at Horuhoru. Mahuki is the only rookery I have visited in New Zealand, where the stage of development at that time, has been slightly ahead of what we had found at Horuhoru. If we take Horuhoru as the standard, I would place the Colville rookeries as a week later, the Sugarloaf to the north of the Hen and Chickens as a fortnight later, and the one at Oaia a fortnight to three weeks. From talks with Dr. Wodzicki, I think that Kidnappers is from a month to five weeks behind.

On 7/11/64, 28 101 was not on his former nest, and we have not seen him since. One ringed bird flew round and round our heads for over twenty minutes. The gannets build on a slope that extends from a cliff running from east to west along the northern side of the promontory. The western end drops down to the sea, but at the eastern end, the land widens out to the south east and the north east and rises up on an open grassy slope. The prevailing breeze from the south west meets the cliffs to the south of the rookery, and rising, makes a beautiful up-draft in which the gannets play for hours. They come along from Anvil Island which is out to the south east, glide over the saddle at the eastern end of the rookery and along the cliffs there. An abrupt break in these cliffs, opens into a small inlet with a pebbly beach, on which it is most convenient to land when the S.W. wind is not too strong. The birds pass this gap and disappear into the Boat Passage as they swing away to the north east. Three or four minutes later, they come back over the saddle from the other direction, and disappear out towards Anvil Island, which strange to say, looks like an anvil. It rises straight up out of water forty metres deep, to a height of fifty metres, leaving a passage thirty metres wide between it and Mahuki. While I lay

on my back in soft long grass on the slope above the saddle, a long string of from two to three hundred gannets passed over me, perhaps twenty metres up, and twice in every five minutes, for upwards of half-an-hour one passed showing a leg below its feathers, so that I could see that it had a ring on that leg. It is no wonder that the gannets of Mahuki seem cleaner than they are elsewhere: the green stripes on their feet are a brighter colour too. Later while I walked slowly through the rows of nesting birds, they made no movement except to turn their heads. Alongside the nests there were four birds with rings. If I had had my thick gloves I could have caught them. I did manage to hold one by his beak to read his number, 28 156. He had been hatched about 10/10/55 and on 26/11/55 when we banded him, his brown tail feathers were just over ½" long. Now he was 9 years and 1 month old, and had a 30-day-chick in his nest.

There was no sign of any of the 1961 birds. Several from both groups have been reported from Australia. They all seem to be following the same programme as the Horuhoru birds; one of them had crossed to New South Wales in six days. We have recently had news of three of them in New Zealand. On 30/7/68 M 4741 was found dead near Whangarei Heads, and on 27/10/68 M 4595 was found dead in Te Kouma Harbour, 20 miles to the east of Horuhoru. The latest one M 4580 can be seen in the 1971 recoveries. On 21/1/71 it was found dead on Muriwai Beach by our Auckland Regional Representative. It was then 9 years and 5 months old. What it was doing on the West Coast, two miles from Oaia, and over 400 by sea from Mahuki, is hard to imagine.

In 1963 we decided to stop banding juveniles. We had over ten years results from our operations, and further results seemed to be repetitions of what we had learned before. Assistance was not always available as the younger members of our band were accepting more responsibilities of their own. We felt that the manpower available should be concentrated on finding out more about the adults that had returned to Horuhoru.

We would not be giving up all work with young birds. Every time we went to Horuhoru, we passed close to the Frenchman and, without slowing down, we could see exactly what was going on among the fifty to sixty Blackbacks established there, with their developing young of two or three seasons. The Reef Herons, too, and an occasional Caspian Tern, would show up. It remained a yearly institution, to take the young folk from Arran Bay to do the banding sometime between Christmas and the New Year.

On 17/1/63 then, we banded the 70 chicks still growing up in area T, using 0 501 to 0 571. This brought the total we had banded on T to over 700, of the 1200 odd that had departed from it since 1951. (More about this will be given later in connection with Appendix G.)

MORE NEWS OF ADULTS

There were still reports coming through from Australia, and our visits to Horuhoru still continuing, gave us more up to date news of the great number of birds we had ringed there. On each visit we caught a few birds. Most were quite friendly and did not mind being caught. There was no need to use the catcher all the time.

Often I went round wearing one glove and holding out my thumb for one to bite. Many refused to peck me, and my invitation, " come along, bite it," would have sounded strange to anyone passing, but if the bird stood up to take my thumb, I simply closed my hand round its head and beak, and taking advantage of its spring upwards, I continued its movement and there it was under my left arm, with its two wings pressed in close to my side. I held it there until one of the others took hold of its left leg, to attach a new band if it needed one, and to read out the other ring's number, to the recorder.

SEASON 1964 - 1965

After our trip to Mahuki in November 1964, we again visited Horuhoru on Boxing Day. The weather was lovely. As we passed the Frenchman we could see that we had better get on with the Blackback banding, as some of the chicks were in the water. We anchored off Horuhoru, and climbed up the Terraces to North Ridge. What we found there is outlined in Table XIII. We used bands M4301 to 4310. The first three birds ringed had not been banded before, but the other seven were " repeats." M 4301 and 4302 were in T and 4303 in U. The next three repeats in U, had all been banded as chicks in some other area. M 4304 had been banded 28 559 in area M on 7/1/56 a 76-day-chick; it was therefore 9 yrs 2 mths old. It was not on a nest. The other two had been banded 0 170 and 0 186 as 100-day-chicks on 3/1/59, so they were 6yrs 3 mths old. One was on an egg, the other had a 35-day-chick.

The next one was most interesting. On 7/1/58 it had been trying to hatch an egg in Ta. This was very late, but on 30/1/58 it was still trying. It was banded 35 441 on the left leg.

Ten months later and still in area Ta, it had had more success, for there was an 18-day-chick in the nest; we banded it 37 013, and opposite the date 22/11/58, recorded it as being 7+. Another six years had passed when we found it still on Ta, but this time without an interest in any nest. At 13+ it seemed to be taking a year off. It was then banded M 4307.

When we came opposite the higher taupata to the east of area V, we found a dead gannet hanging down among the branches. It had a ring 0 103. Hatched in U on 25/10/58 it had been banded on 3/1/59. Now at the age of six years it was back at Horuhoru. It had been away on some business and when it was shot, had not enough strength to get home.

Two more were caught in T on the way back to the Terraces. M 4308 had been hatched in T on 25/9/58 and banded as a 70-day-chick on January 3rd 1959. Now at the age of 6 yrs 3 mths it was building on the extreme western edge of Tb, and had a 100-day-chick in its nest. The final one in area T had been there a long time. It was one of our first chicks to be banded on 8/3/52 No. 16 342 on its right leg. It had been a recovery on 30/8/57, when caught near an empty nest. It had been banded on the left leg 35 408, tail 343, age 5 yrs 9 mths. When it was a repeat now on 26/12/64 it was 13 yrs and 1 mth old, had a 4-day-chick in its nest, had changed its tail code to 334, had lost its original ring 16 342 and so was given a new band M 4309.

And finally we came to M 4310. In 1963 when we were climbing up to band the final set of chicks in T, we found in G an adult with tail code 344, trying at that late date (17/1/63), to hatch an egg; now with tail code 334 we find him still in G with a 30-day-chick.

TABLE XIII

BANDS		26 / 12 / 64			Banded before 26/12/64			Present Age
Left leg	Right	Status	Where	Tail	When	Where	Age	Yr / M /Day
M 4301		Nest	Tb -14.6	332				6
M 4302		30 dc	Ta 16.2	443				6
M 4303		6 dc	U	434				6
M 4304	28 559	Not	U	343	7/ 1/56	M	76dc	9yrs2mth0dys
O 170	M 4305	Egg	U	243	3/ 1/59	T	100dc	6yrs3mth0dys
O 186	M 4306	35 dc	U	353	3/ 1/59	T	100dc	6yrs3mth0dys
35 441					7/ 1/58	Ta	6	
		Egg			30/ 1/58	still on egg		
	37 013	18 dc			22/11/58	Ta	7	
M 4307		N	U	434				
35 411	removed							
				Hat	25/ 9/58	T		
O 160					3/ 1/59	T	100dc	
	M 4308	90 dc	Tb -10.1	243	26/12/64			6yrs3mth0dys
	16 342*		T		8/ 3/52		0/3/7	
35 408		M T	T	343	30/ 8/57	T	5/9/0	
	M 4309	4 dc	T	433	26/12/64			13yrs1mth2dys
O 501		Egg	G	344	17/ 1/63	G	7	
	M 4310	30 dc	G	334				9
O 103				Hat	25/10/58			
					3/ 1/59	U	70dc	
	Found shot Nth U				26/12/64			6 2 ?
		*Later lost						

30 dc on nest with 30-day chick
Not near a nest but apparently having a year off
N near a nest but relationship uncertain
N T empty nest
Hat date of hatching
Age in "Banded before 26/12/64"
age is 100dc or 0/3/7

The 30, 35, 90 dc are reliable estimates of the chicks' ages but 100 dc seen here three times, is not so accurate. If a chick lives 88 days and has a 6″ tail, the tail will grow as he gets older. But if he wanders about "gossiping," and leaning back on his tail on jagged rocks, a 100 dc is one that has a good 6″ but there is a row of untidy spikes jutting out further. At Mahuki there are many with 7½″ tails, because they have a wide promenade between the rows of nests and the cliffs, which comes from many years of nesting gannets. When a parent is away fishing for the 100 dc, on return, while still airborne, he utters a long call-sign which all the chicks can hear, but only one answers it. If you are in the way, that one chick will brush past your legs as he hurries back to the nest in which he has spent the last few weeks, for he knows that the chick on that nest is the one that will be fed when the fisherman alights.

A QUIET PERIOD UNTIL 1968

During 1965, 1966 and 1967 the Blackback banding on the Frenchman near Christmas continued, and gannet recoveries continued to be reported from Australia and New Zealand, but there was nothing sensational at Horuhoru until we landed on 9/11/68. The spring had been so mild and the gales so few that we expected a count nearly 1600. Instead, strewn round in irregular groups, there were some 300 occupied nests. The oldest chicks were 24 days, instead of from six to seven weeks old. Every egg laid before the first week in September, and every egg hatched, had vanished in some catastrophe. There were lots of well made nests lying empty, and a few adults were standing doing nothing. Birds that were on the point of laying about 7th September, may have laid after the disaster, and some of those that had laid and lost their egg, may have managed to make a fresh start in October (there were a number of nests with new eggs in them). These, and the 24-days-old chicks, would have a good chance of surviving.

What had happened ? Was this caused by man or by Nature ? I asked for information from other rookeries, but no one had anything to say. We did a sample run from the landing to North Ridge; 1 in A and G, 10 in T and 8 in U using 36 801 to 36 820. Only one had a ring ! He had been caught on 17/1/63 in U, banded 0 534 aged 94 days, so now he was 5 yrs 3 mths 2 days old, an early layer.

We returned on 26/1/69 and caught 17 in T and U. Seven of them had rings, but there was still evidence of some upset, and the birds we found having a second try in November 1968, seemed to have given up ! Of the banded birds, one was an old friend. He had been banded as a chick in area T and had been found there three times sinces. Hatched on 21/10/52 he was now 16 yrs 4 mths

TABLE XIV

BANDS					BEFORE 29/1/69			
Left leg	Right	Status	Where	Tail	When	Where	Age	Present Age
0 510				334	17/ 1/63	G	6	
	36 268	14 dc	Tb - 4.6	342	26/ 1/69			12
36 350					30/ 8/61	T	6	
	36 267	9 dc	Te - 2.9	433	26/ 1/69			13
0 270					3/ 1/59	T	0yrs 3mths 0ds	
	36 272	20 dc	Td - 8.8	334	26/ 1/69			10yrs 0mths 2ds
36 345					30/ 8/61	T	8	
	36 274	egg	U - 3.4		26/ 1/69			14
36 275	Mate of 36 274		U - 3.4	343	26/ 1/69			6+
28 252			Za		3/12/55		0yrs 2mth 10ds	
	36 279	12 dc	Ta - 14.6	343	26/ 1/69			13yrs 3mths 6ds
15 552*					30/12/52	T	0yrs 3mths 10ds	
	37 037*				22/11/58	T	6yrs 2mths 2ds	
	36 309	9 dc	Td - 6.3	224	30/ 8/61	T	8yrs 11mths 10ds	
36 280		100 dc	Td - 6.3	234	26/ 1/69			16yrs 4mths 5ds
36 349*		egg		444	30/ 8/61	T	6	
	36 281	9 dc	Td - 16.8		29/ 1/69			14

* 15 553 getting thin was replaced 26/1/69
37 037 was lost between 1958 and 1961

Note: (1) 28 252 charged area from North Stack to North Ridge
(2) All the abscissae are negative!

6 days old, the oldest bird of which we knew the exact age. Banded 15 553 on his left leg on 30/12/52, he had an 18 dc in his nest when caught in one of our first sweeps in 1958, and received on his right leg, 37 037. This was a faulty ring for it had disappeared by 30/8/61 when he was banded 36 309 on that same leg. He was in Td –6.3 with a 9 dc and tail code 234. On 26/1/69 he was in the same nest Td –6.3, had the same tail code 234, but a 100 dc. His original ring could still be read, but it was getting thin, and so he received his fourth ring 36 280. Additional data is shown in Table XIV. The four birds caught first as adults in 1961 to 1963 and credited with 6 years as their ages then may be older than 36 280.

OLD AGE

Over the past twenty years of study, we have often wondered when a gannet feels Old Age coming on to slow up his reactions, and his desire to produce more young gannets to follow after him. They are increasing very, very slowly, for how long must they bring up families to accomplish this. Some years we have seen as few as ten per cent succeed in raising their one chick until it could try to reach Australia. And after that, how many perished on the crossing. Many people writing about gannets which they have seen trying to come ashore, through the high surf that runs up on so many of their east coast beaches, have told of their poor condition. N. R. Lawson, manager of the Aboriginal Station at Jervis Bay, where my first " recovery " came ashore, photographed the bird and, dissecting it, wrote that the stomach was absolutely empty. When they succeed in landing, most of our gannets seem to do well enough, but how do they fare when they face the equally perilous journey back across the Tasman ? Many have been found dead on the final section down our East Coast. Judging by the numbers that return to North Ridge, five per cent would be above the general average rate of survival. Taking into account the fact that most gannets wait for six or seven years before their first attempts at breeding, an average pair may well be over ten years old before they raise two chicks to replace themselves, and to effect the slow but steady increase that is seen in some of the colonies, some of the birds must be well over twenty years old.

A LADDER AT THE LANDING

We felt that another major sweep across North Ridge was due, but no opportunity came in the summer of 1969-1970. In the May holidays, however, on a calm afternoon when we were experiencing very low spring tides, we undertook a project which we had planned for years. I had bought a steel ladder heavily galvanised. The sides were of heavy flat-iron with holes into which ½" round rungs had been welded. We prepared half-a-dozen sugar bags of cement and shingle, a six-foot hexagonal crowbar with a point at one end and a wedge at the other, two heavy cold chisels, a sledge hammer and a gallon of cement-fast-setter. When we arrived at the landing below the Terraces, we stacked three of the sugar bags on the bow, and slowly guided the launch in until the bow was within two metres of the rock face. As the tide was running out quite swiftly, the launch moved sideways along the coast of Horuhoru at speed. We

TABLE XV

BANDS Left leg	Right	Status	Tail length inches	Feather Code	Age 31/12/70 Yr/M/Days	First banded	Age then days
36 890		12 dc	6	342	6yrs		
36 891		egg	7½	343	6yrs		
36 892		35 dc	7	443	6yrs		
36 893		10 dc	6	443	6yrs		
36 894		egg	7	414	6yrs		
36 895		35 dc	7	343	6yrs		
	17 016					20/ 2/54	63
36 896		10 dc	8	424	17y0m16d		
0 113						3/ 1/59	46
	36 897	10 dc	8	343	12y1m 9d		
36 349*						30/ 8/61	6 yrs
	36 281	16 dc				26/ 1/69	13 yrs
36 898		20 dc	7	323	15yrs		
	28 538					7/ 1/56	76
36 899		15 dc	7	333	15y2m 9d		
	28 619					10/ 1/56	80
36 900		10 dc	8	444	15y2m10d		

* lost

Caught first as chicks — 17yrs 16days; 15yrs 2mths 10days; 15yrs 2mths 9days; 12yrs 1mth 9days

Caught first as adults — one at least 15 years old; six at least 6

had selected a place for the ladder, where there were no out-lying rocks, and where the slope down to the sea was about 60°. As Waitangi came near the selected place, Peter started to hurl sugar bags ashore, and when he had finished, they lay six metres apart on the rock face. We backed out, got three more bags up onto the bow, and went through the same performance again. Then it was the ladder's turn. On each of the flat sides, we had welded three long projecting spikes. They made it much harder to handle, but when its turn came to be hurled at the sloping rock face, it slid down a bit, and then stuck fast in some cracks. Had it continued to slide, it would have landed on the sea-bed forty metres below us.

After this performance we anchored the launch a little further out and took all the rest of our gear ashore in the dinghy. Two hours of jabbing and hammering gave us six holes to take the six projections on the ladder. By the time the cement was mixed and

in, the tide had started to flow again. When the holes were full, we placed the empty sugar bags on top, and weighted them down with all the rocks we could find.

Next time we went out we breathed sighs of relief, for there the ladder stood. We have since had news from thankful yachtsmen, who have been using it, too. At high tide in a heavy swell, it covers over, but if you choose your tide, it will serve you well.

SEVENTEEN

The spring of 1970 gave us no chance to land again, but after gales at Christmas, there came a better spell, and on 31/12/70 we went out past Kauri Point, and crossed to Horuhoru. There was a big swell over the ladder, but we took the launch close in, and after three trips in the dinghy, we had a working party ashore. It was blowing up again, so we made a hasty trip up through the Terraces, and across North Ridge. We caught and banded only eleven birds, but four of them had one ring, and one had two. Best of all, one of the birds was just over seventeen years old. We did not take co-ordinates this time, but we measured all the birds' tails, and recorded their tail codes as is set out in Table XV.

The finding of this seventeen-year-old bird made us feel that we had passed a milestone in our quest. The editor of our Journal asked that an account be written of what had happened since, twenty years ago, our Society asked us to make periodic counts of the gannets on Horuhoru. Months have gone by since I started this account, and as I described one aspect of the subject, another would arise that had to be explained to make some point quite clear. At times I felt that I was getting further from my conclusion, instead of nearer it. The delay, however, has made it possible to include two items of great interest: (1) the Computer disclosed that since the beginning of 1971, seven recoveries had been made in New Zealand, of gannets originally banded in the Hauraki Gulf, and (2) in September the chance came of making a Major Sweep across North Ridge.

RECOVERIES 1971

The oldest bird in the seven recoveries had been banded in area U at the beginning of 1953. In September 1959, it had been found again with a chick in area G, at the top of the Terraces. A second ring was added to its other leg. And now on 7/1/71 it became a "repeat" as it was found dead, still in Waiheke, with both rings safe, and their numbers legible. For 18 years it had been dipping the older ring in salt water, many times a day, and it itself was 18 years 3 months and 7 days old. How much happier it would have been to find it home on Horuhoru. The second bird in order of age, was 17 yrs 1 mth 15 days old. While diving in choppy water near Whangarei Heads on 29/12/70, it had struck a rock just below the surface.

Then there were two birds that had been tangled in fishing nets at Awaaroa Bay, on the south coast of Waiheke Island. Their dates were well apart. The elder bird had been ringed on the Terraces in January 1954, and had been found to be dead when the net in which it had been entangled, had been hauled again to the surface. The younger was more fortunate. Early in 1956, it

had been banded on the North Promontory of Motu Karamarama, and when the net in which it was caught came to the surface on 4/8/71, the gannet was found to be alive. After being released, it was able to paddle slowly away. The fifth bird was found dead in Waipu Cove. Banded on North Cliff in January 1956, it was over 50 miles from home.

TABLE XVI

1971 Recoveries

Band No.	Banded	Where	Area	Age	Recovered	Age	
19 801	14/ 1/54	Horu	Terr	12 wks	1969	15+	Awaaroa Dr in net
19 005	8/ 1/54	Horu		56d	29/12/70	17yrs 1mth 15ds	Wh Heads Kld Diving
28 217	3/12/55	Horu	Za	40d	26/ 2/71	15yrs 4mths 4ds	Waikanae Dead on Bch
28 715	20/ 1/56	Horu	V	90d	17/ 1/71	15yrs 2mths 26ds	Waipu Cv
28 976	21/ 1/56	MotuK	NthPrm	98d	4/ 8/71	15yrs 5mths 2ds	Awaaroa Net/Relsd
15 621	7/ 1/53	Horu	U	14wk	7/ 1/71	18yrs 3mths 7ds	Waiheke Dead on Bch
0 401	13/ 9/59	Horu	G				
M 4580	25/11/61	Mahk	East	Juv	24/ 1/71	9yrs 5mths 0ds	Muriwai Dead on Bch

Horu	Horuhoru
Terr	Terraces
MotuK	Motu Karamarama
Wh Heads	Whangarei Heads
Nth Prm	North Promontory
Waipu Cv	Waipu Cove
Mahk	Mahuki
Juv	Between 6 & 14 weeks old
Dr	Drowned
Net/Relsd	Tangled in net but released alive.

TABLE XVII

AGES OF GANNETS

Horuhoru December 1971

Banded as chicks		Age for sure		
1952 - 1953	2	19 years		
1954 - 1955	2	17 years		
1955 - 1956	3	16 years		
1958 - 1959	5	13 years		
1962 - 1963	2	9 years		
Adults first banded				
1959 - 1960	3		Possible age 17 years	Much more likely 18+
1964 - 1965	1		12	13+
1968 - 1969	8		8	9+
Totals	14	12		

The other two gannets were found on the West Coast hundreds of miles by sea from home. One was a " fluffy " when banded on North Stack in December 1955. Over fifteen years of age, it was found dead on Waikanae Beach on 26/2/71. The other, banded M 4580 on 25/11/61 at the eastern end of the main group on Mahuki, was 9 yrs and 5 mths old when found dead at Muriwai on 24/1/71.

SUCCESSFUL SWEEP — SEPTEMBER 1971

Several circumstances made possible the very successful sweep across North Ridge on 25/9/71. At the eastern end of Waiheke, there were still two uncompleted squares in the New Zealand Mapping Scheme, and the upper one included Horuhoru. The Auckland Regional Group engaged on this work, had planned to travel to Orapiu at the south-eastern corner of Waiheke, by the steamer which runs to Pakatoa on Friday nights. They were to work through the week-end from the Friday until Sunday, 26/9/71. We had undertaken to get a party of them out to Horuhoru on the Saturday, if it were at all possible.

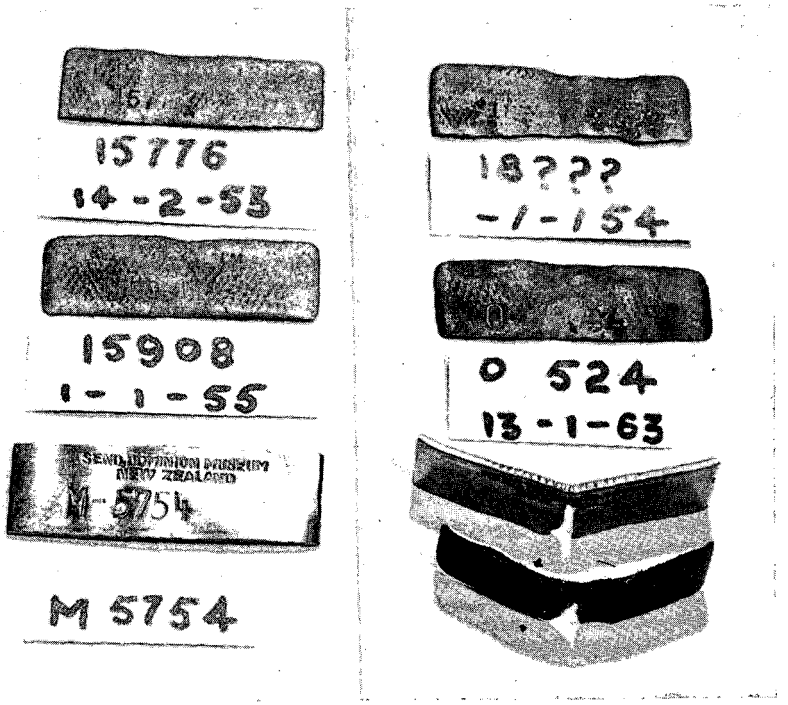
The weather up to Thursday had consisted of a series of minor gales with rainy intervals between. It cleared enough on the Friday afternoon for us to go by launch to Arran Bay, and we spent the night there. When Mrs. Reed rang through early on Saturday morning it had brightened still further, so we arranged for them to walk over from Orapiu to Arran Bay, counting and recording their findings as they came. Peter arrived by plane in the morning and when all 10 assembled before noon, we decided to make the attempt. As we travelled to Kauri Point the sea went down even further, so we crossed to Horuhoru and made a slow circuit of the island.

There was great activity on South Ridge; we counted 29 nests in area S. The Terraces were crowded with what seemed to be a record number of nesting gannets. North Stack was also full of birds, and a double row of " Spotties " after a good morning's fishing, were sitting drying themselves in the sun.

On completing our circle round the rock, we came close in to the landing again, and in four trips of the dinghy, had the banding gear and all nine members of the party safely ashore. After carrying the dinghy well up on the wave platform, they began the climb to the top of the Terraces. There were many birds showing one band, and one two. As the weather was threatening to break again, they decided to catch only banded birds.

From the landing up to " A," and again from " A " to " B," there is a steep rise, and it is often possible to catch a glimpse of a ring from the lower level as you approach; two birds were caught, one in " A " and the other in " B," and they were banded 44 401 and 44 402. From area G the passage to area T has become very wide, as birds in finding new nesting sites have trampled the scrub right down. Since the landing on 3/12/70 another twenty square metres have been cleared, and a fair number of nests have to be passed before we come to the " fences."

Ron went well ahead and using the reversed catcher, he raised each sitting bird a little until he could see its legs. Most of the sitting birds were quite apathetic to this procedure; there were few protests. Having located a ringed bird he would reverse the catcher



[N. M. Gleeson

FIGURE 16 — Rings from banded Gannets after from 12 to 18 years at sea.

and get the loop in place to bind the bird's wings closely to its sides. Then he swung the gannet slowly round to Peter who, following close behind, secured it by its beak and one wing. Mrs. Reed entered on the ruled Whakaboard all the details required. The remainder of the party, Win Mitchell, Brigit Pike, Connie Schischka, Pen Smith, Stan Brown and Tony Wilkins, in turn, performed the operations needed to complete a good day's banding. One prepared the next ring while Stan Brown called its number to the Recorder. Peter gave the bird's position, and with Connie Schischka, its tail feather code. When the additional band had been closed round the bird's leg, all moved on to where Ron had looped the next bird. In this way, starting from 44 421, they banded 19 birds in T and 4 in U. On the way back to the landing they banded the 26th gannet in B, using 44 434.

Some of the bands were so worn that they were removed and brought back to Auckland for identification. Some of them are shown in Fig. 16, with a new band (M 5754) for comparison. An end view to show how thin some of the rings had worn, is also included.

While this was going on, I had circled the island eight times, slowly counting the nests in all the areas that slope down to the sea, at an angle of 30°. I was able to get that A+B+C = 148, and P = 41 and S = 29. I thought that there were well over 1550 nests occupied. At the same time Mrs. Reed counted the nests with eggs in T and found:— Ta 21, Tb 18, Tc 28, Td 56 and Te 73; Total 196.

I brought the launch in to the landing again and using the ladder to embark, we soon had the Regional Party back at Orapiu. We returned to Arran Bay feeling that the day had been well spent. Peter returned to Horuhoru on 24/10/71 and caught 28 588 by hand; banded when it was three months old on 7/1/56, it was now just over 16 years old. He reported that the " cloud burst " on the 18th had washed a number of eggs out of nests in area L, and that they had fallen onto the rocks at the landing, and been smashed. When we passed close in on 1/11/71 during the Hauraki Gulf outing with the 70th Congress Party of the R.A.O.U., there was no marked gap in the nesting birds in area L.

It was only when we returned to our records in Auckland, that we could work out all the details. There is a book for each year back to 1951. In most cases the area in which the bird was banded is stated, and in every case the bird's age is given, up to 1954 in weeks, but after that in days. In the period 4/12/54 to 8/1/55 we banded 707 birds on Horuhoru and in the space " where " it says " Horuhoru "; the area letters were omitted. Some of the records took hours to trace. In the case of the bird rebanded 44 424 on the old ring only the first two digits, 28, were recognisable. One hundred of these had been used at Mahuki and also at Motu Karamarama and 642 at Horuhoru. The oldest of these was 90 days old on 7/1/56, and the youngest 40 days on 3/1/55; this made them only a week apart in age, 15 yrs 11 mths and 16 days, and 15 yrs 11 mths and 23 days. Unfortunately there was a further complication. There were nine adults banded in that period, 1 in B, 1 in G, 2 in H, 1 in M, 1 in U and 3 in Z. If the adult in U, 28 973, be selected and credited as being 6 years old then, he would now be 22 ! Apart from this, the oldest contender was banded 15 685 in H on 22/1/53 and recovered in Te on 23/11/57 when just over five years old, and rebanded 35 423. On 25/9/71 it was still in Te, and then 18 yrs 10 mths and 26 days old. The older ring was removed and replaced by 44 427.

The next in order of age was 98 days old when banded in T on 14/2/53, and now in B was almost 19: 18 yrs 10 mths 18 days. The other two-digit ring was also a problem. At Motu Karamarama on 10/1/55 we had used 18 437 to 18 486, and at Horuhoru from 27/12/54 to 8/1/55 we had used 18 501 to 18 997. The youngest, which was 64 days old on 1/1/55 was now just over 16 yrs old. Those banded as adults on 12/9/59 were all in area T both then and now, and if 6 years old then, were now over 18 years old. All the other information that we have about these birds is given in Appendix E. After a great deal of paper work, we found that we had banded again 14 originally banded as chicks and on 25/9/71 two were over 18 years old, one nearly 17, two over 16 and two

just under it, two exactly 13, three more near it and two over 9. These ages are known exactly, and their average was over 14 years and 4 months. Of those banded as adults, three were over 18, one 13, seven over 9 and one over 7: the total average is almost 12 years, an admirable record.

THE UNDISCLOSED BALANCE

The adults breeding in area T may be divided into three classes, (1) those that started their lives there, and have been to Australia and back, (2) a very few that have come in from other areas on Horuhoru and (3) those that were in the area before we started serious banding in 1952. These must now be twenty years of age and older. If we accept as fact that very few gannets start breeding before they are six of seven years old, we need not consider in our figures any fledglings that have departed since the 1964-1965 season. It is possible to get quite a good idea of what fraction we have banded of those who have left during this period, and it is outlined in Appendix G.

In most of the banding schedules, the area in which each chick was banded is stated on the sheet, but there are some exceptions. In 1955 the space headed "where" says "Horuhoru," and in 1958 and 1961 three schedules* in each year say "North Ridge." Again in 1960, 1962 and 1964, no chicks were banded in area T. If we make allowances for these gaps in the records, using the very accurate figures recorded for the other periods, we arrive at 739 out of 1523, or 48%, for which a working fraction of ½ is reasonable.

Some of the chicks departing with bands returned without them. There are two causes of this failure in our plans: (a) Fair wear and tear and (b) the ill-considered zeal of anglers who on finding living gannets on their spinners, remove the ring and post it back to Wellington, instead of making a note of the number and freeing the bird with band in place, so that it could return to Horuhoru a recognisable member of the community, instead of an unnumbered prodigal, among many other unbanded birds.

(a) The number lost by fair wear and tear, includes rings which lose their tension and open out, so that they can be knocked off. There are very few of these. Among two-ringed birds we have only two records of one of the rings being lost, before we caught the gannet for a third time. In one case when a ringed bird was recovered† its ring was found to be very much worn, so a new one was placed on its other leg. When it became a repeat‡ the worn ring had disappeared and so a third one was added. In the other case it was the new ring that disappeared; probably the pliers had

* Nos. 123, 124 and 125, and 131, 132 and 133.

† When a banded bird is caught again, a second ring is placed on its other leg. When it is caught a third time, the older ring is replaced by a new one.

‡ When a bird that has already been banded is caught for a second time, it becomes a "recovery." When caught for a third time it is a "repeat."

failed to close the gap completely. Only one ring has been found lying among the nests on Horuhoru. It was in the area in which it had originally been used.

(b) Of the rings returned, well over 90% were from dead birds. When a living bird had become entangled with a spinner, in about two-thirds of the cases reported, the angler had removed the ring. After this had happened a number of times, I wrote to several papers and people about the correct procedure; some of the more interesting results are set out in Appendix L.

THE BALANCE

I shall now attempt to show that when all allowances have been made for the birds which have returned to area T, from those raised there during the years from 1951 to 1965, there is still a considerable balance of additional birds, whose presence has not yet been explained. It is true that a few of them may have come in from other areas, but these will have little effect, for some will also have gone away. Of the birds caught in T on 25/9/71 and previously banded as chicks, 1 came from H, and 2 went to B. Of the 12 banded first as adults, 6 stayed in T, 1 went to A, and 5 came from U which is the adjoining area. We have found, too, that over 90% of the birds banded as chicks on Horuhoru, returned to their old area to breed. Of the many imponderables with which we will have to deal, this will be a very minor one. I shall have to make some arbitrary choice in some of the ratios with which we shall have to deal, but I can show, that if we select other ratios, the Undisclosed Balance will become greater. If my calculations can be trusted, I shall give evidence that a considerable number of the birds in area T, were there before we started banding in 1951, so that they must now be over twenty years of age. I shall now show that by using calculations like those made in the Insurance profession, we can get some idea of what those ages may be. Proof, of course, must wait until further work is done on Horuhoru.

THE THEORY

On 25/9/71, we found in area T, 19 birds with a ring each, in 197 nests containing an egg each; this may be taken as 10%, but we will call it 12% to allow for the rings lost by fair wear and tear, and by zealous anglers. Now we come to the hardest part of the problem. If 12% here have, or had rings, what about the other 200 birds away fishing ?

Suppose we take ten nests each with a bird sitting on an egg, and use ten bands to ring them. There are another ten birds without rings away on other duties. If we return in a day or two, we would be astonished to find either ten banded or ten unbanded birds on the nests. Nine to one would also be impossible, even eight to two fairly unlikely. Three to seven is possible and four to six or five to five are quite likely. We shall choose two to eight, because the more likely ratios can be shown to increase the Undisclosed Balance. Our 19 ringed birds in the nests mean that if none had been lost 22 ringed birds would be present. On the assumption that choosing 22 in the nests means 88 at sea, or a total of 110 ringed. Assuming that the birds banded (birds without rings on the way to Australia, is followed by a fifty:fifty ratio in the returning birds, 110 ringed birds in this area now, means that 220 of the birds here now

have been reared here since 1951. But 197 nests require 394 breeding birds, so that 394 — 220 birds in this area now, were not reared here in the period 1951-1965; 174 birds have to be accounted for. Again it is true that some of these have come from other areas but these are very few and are probably balanced by a few going out. In any case, there is a large section that must have been in area T before 1951, who are still there. They must be twenty years of age or older.

PERIODS OF DECLINE

In constructing Insurance Tables actuaries deal with the lives of human beings, who after a short period of relatively high infant mortality, come to longer periods when most individuals settle down to healthy life during which a few die from accident. After a certain stage, they died from natural causes, and during this period the numbers that live on, decrease in Geometrical Progression after this style:— ar^3 ar^2 ar a. The values of a and r have to be determined, and the periods defined. Suppose we take periods of six years. Our gannets spend one period of six years before they breed; on Horuhoru there are now a number of unemployed birds at this stage. Then for two periods of six years they live robust lives and breed. Of the 26 we rebanded on 25/1/71, 10 are in the second period (7 years to 11) and 12 in the third (12 to 17) and four have entered the fourth (18 to 23). Any unemployed birds were in the first period, and the 180 (or 174) unbanded birds, are in the fourth and later periods.

How are they distributed in these later periods? Let us try a couple of cases. Suppose $a=12$ and $r=2$. Then of the 180 birds 96 are in the fourth period (18 to 24 years) and will die before its close, 48 are in the fifth period (25 to 30), 24 in the sixth will die before they are 36, 12 in the seventh (37 to 42 years). On the other hand if $a=14$ and $r=3$, the figures will be 126 in the fourth, 42 in the fifth, and 14 in the sixth (31 to 36 years). In the first case $96 + 48 + 24 + 12 = 180$ and in the second $126 + 42 + 14 = 182$. Only further work on Horuhoru will test these and other theoretical life tables. If someone is prepared to band all the chicks on North Ridge yearly from 1972 until 1977 and to make sweeps such as ours across areas Tc, Td and Te every two or three years from now until 1983 he, or she, will have the answer. If my ratio for the number of banded chicks compared with the number that depart, is too high, the balance will be reduced, and if my proportion of ringed birds found in the nests be taken as 3 to 7, or 4 to 6, or 5 to 5, the Undisclosed Balance will be greater.

THANKS

This work could not have been attempted without a great deal of help. I have already thanked by name, the host of friends and relations who have helped at Horuhoru; I thank them now again, collectively. In connection with this paper I have special thanks, for the excellence of their photography, to Ron Attwell, to Ted Driver, and to Noel Gleeson, to Don Branch for his clear and helpful diagrams and graphs, to my children for their great work and forbearance, to Dick Sibson for his wholehearted co-operation, and to Charles Fleming and my dear wife for their kindly criticism, gentle restraint and continual encouragement.

APPENDIX A

Field name	Age of chick in days	More scientific name
Black	0 – 15	Naked
Whitish	15 – 20	Down appearing
White	20 – 30	Early down
Fluffy	30 – 42	Down fully white
Trace	43 – 60	Early fledgling
Advanced	60 – 80	Mid-feathered
Tufted	80 – 90	Late-feathered
Complete	90 – 108	Completely feathered

APPENDIX B

No	Area	Date laid	POSITION feet	Direction from	Reference point	Description on 23/10/54
I	A	E 9	8	S	1953 red Mk 3	Hatching: ½" hole
II	B	L 8	2	W	" " " 3	Addled
III	C	9	4	NNW	" " " 3	Cracked ¾ way round
IV	DE	L8E9	1½	SSW	Flat rock	4-day old chick!!!!
V	DE	"	3½	SSW	" "	Hatching
VI	Q	"	1½	NNW	Green stump	Just hatched
VII	Q	"	3½	ENE	" "	Just hatched
VIII	Ta	9	2	SSE	Red rock	Addled
IX	Ta	L8E9	6	SW	End fence one	Gone: nest deserted
X	U	8	6	E	Umbrella tree	Died hatching 22nd
XI	U	8 – 9	1	S	Mid/fence 17	Just over one-day chick
XII	Ta	8	4	NE	XIII	Hatching
XIII	Ta	8	1	E	Red rock	One-day chick
XIV	Ta	8 – 9	3½	SW	XIII	Gone: nest deserted
XV	Ta	7	3	E	XII	Two-day chick
XVI	Ta	8	5	N	XV	1 2-day chick
XVII	Ta	7	1	S	Fence one	Two eggs: one old
			10	N	Red rock	one new
XVIII	Ta	8?	2	S	Sth end fence one	
			3	WSW	XVII	One-day chick
XIX	Ta	9	2½	W	XIII	Hatched early to-day
XX	Za	9	1	E	Rock face	Hatching: almost out
XXI	Za	9	4	E	" "	Hatching: egg tooth showing

Day laid was either 8/9/54 or 9/9/54.
E 9 means early on the 9th.
L 8 means late on the 8th.
L8E9 means from noon on the 8th to noon on the 9th.
8-9 means somewhere between 6 a.m. on 8th to 6 p.m. on 9th.
7 probably late on the 7th.

APPENDIX C

Recoveries: 1959-1960 Nos (1), (2), (3), (6) and (45)

(1)
35 428 left leg

29/12/57 On Gertie's nest in G
Age 6+ Tail 2+6+2
Thought to be G's mate
12/ 9/59 On G's nest
Age 8+ Tail 2+4+2

(2)
37 007 left

27/10/51 Egg laid in V
9/12/51 Hatched
28/ 1/52 Ringed 16 166 right
8/ 3/52 Seen in V
26/ 3/52 Departed; very late
22/11/58 In "I" overlooking "D"
M T nest
16 166 very worn
Replaced by 37 007(1)
7/10/3 Tail 3½+3½+3½
12/ 9/59 Point nest in "I" Nearly 8
on egg Tail 3+3+4
Ringed 0 302 (right)

(3)
37 010 left

22/11/58 Ta -2.6 6+
19-day chick Tail 3+7+2
12/ 9/59 Ta -2.4 7+
new egg 3+7+2

(6)
35 425 right
3/ 9/53 Tc 3.9 (Omega nest)
By new laid egg 6+
Tail still wet Ringed 15 787 left
23/11/57 On egg (new laid) 3' NW Omega
Ringed 35 425 Tail 3+6+3
The ringed bird then flew off; ten mins later its mate landed to stand by nest
Caught. Found it was 15 787 left
Placed 35 425 on right leg
Pair now 35 426 male
15 787/35 425 female
1958/59 season 8 unsuccessful attempts to catch.
12/ 9/59 Tc 3.9 on egg Tail 3+2+3

(45)
35 407/16 129
12/11/51 Hatched very top of "G"
28/ 1/52 Ringed 16 129 right

30/ 8/57 Recovered 5yrs 9½mths
16 129 very little/35 407 left
Now 2nd nest in "A" 10' from cliff
Now 50' west & 40' down from "G"
Photographed tail 3w 1v 2b 1v 3w = 10

Oct 57 On egg
23/11/57 Egg gone: nest deserted
Another egg laid
30/ 1/58 On chick tail 3w+3b+2 small +3w
22/11/58 2nd nest in "A" Age 7yrs 3days
With chick tail 3w 1v 2b 5w = 11
12/ 9/59 2nd nest in "A" Age nearly 8
tail 4w 1v 1b 4w = 10

APPENDIX D

Contents of Gannet Nest

Carpophyllum flexuosum	275	
" maschalocarpum	36	
" plumosum	65	376
Sargassum sinclairii	50	
Mesembryanthemum australe	23	
Feathers	25	
Twigs of Metrosideros excelsa	19	117
6 stalks	6	
5 each of Salicornia australis, torulosa	10	
4 each of grasses, Cystophora retroflexa, Laurencia distichophylla	12	
3 each of bone, Chalina racemosa Hormosira banksii, Parietaria debilis	12	
2 each of animal, Coprosma repens, Halopteris hordaceae, gannet foot	8	
and 1 Norfolk pine bract	1	49
		542

APPENDIX E

BANDS Left leg	Right	AGES Chick	Adult	Date	Where	Tail	Present Age
18 ???	say 44			1/ 1/55	T		
	44 401			25/ 9/71	B	444	16yrs 10mths 7days
36 811			6 yrs	9/11/68	Ta 2.2		
	44 402			25/ 9/71	A	354	9yrs
36 802			6 yrs	9/11/68	U	444	
	44 411			25/ 9/71	Tc	453	9yrs
0 319			6 yrs	12/ 9/59	Tb -4.2	423	
	44 412			25/ 9/71	-Ta	524	18yrs
0 363			6 yrs	12/ 9/59	Tc -12.5	344	
	44 413			25/ 9/71	-Tb 1	444	18yrs
0 133		86		3/ 1/59	Tb		
	44 414			25/ 9/71	-Tc	424	12yrs 11mths 16days
36 273			6 yrs	26/ 1/69	Ta		
	44 415			25/ 9/72	Td	454	9yrs
0 234		96		3/ 1/59	Tb		
	44 416			25/ 9/71	Td	424	12yrs 11mths 26days
0 184		98		3/ 1/59	Tc		
	44 417			25/ 9/71	Td	453	12yrs 11mths 28days
0 394			6 yrs	12/ 9/59	Te -10.5	243	
	44 418			25/ 9/71	Td	363	18yrs
36 277			6 yrs	26/ 1/69	U		
	44 419			25/ 9/71	Te	434	9yrs
M 4302			6 yrs	26/12/64	T-U	444	
	44 420			25/ 9/71	Te	444	13yrs
36 275			6yrs	26/ 1/69	U	(mate of 36 274)	
	44 421			25/ 9/71	-Te	443	9yrs
36 278			6yrs	26/ 1/69	U		
	44 422			25/ 9/71	Te	444	9yrs
36810			6yrs	9/11/68	U	224	
	44 423			25/ 9/71	Te	544	9yrs
	28 ???	90		7/ 1/56	Te		15yrs 11mths 16 days
		40		3/12/55	Te		15yrs 11mths 23 days
			6yrs	3/12/55	Te		22yrs
44 424				25/ 9/71	Te		
	28 594	90		7/ 1/56	Te		
44 425				25/ 9/71	Te	444	15yrs 10mths 28 days
18 ???	say 64			1/ 1/55	Te		
	44 426			25/ 9/71	Te	443	16yrs 0mths 21 days
15 685 *		84		22/ 1/53	H		
	35 423		5yrs 0mths 24days	23/11/57	Te		
44 427				25/ 9/71	Te	363	18yrs 10mths 26 days
.0 199		100		3/ 1/59	T-U		
	44 428			25/ 9/71	U	444	13yrs 0mths 0 days
0 230		100		3/ 1/59	T-U		
	44 429			25/ 9/71	U	444	13yrs
0 504		56		17/ 1/63	U		
	44 430			25/ 9/71	U	444	8yrs 9mths 2 days
15 908*		70		1/ 1/55	U		
	0 409		5yrs 2mths 26days		U	343	
44 431				25/ 9/71	-U	444	16yrs 11mths 2 days
0 525		84		17/ 1/63	T		
	44 432			25/ 9/71	-Te	242	8yrs 10mths 0 days
36 819			6yrs	9/11/68	Ta -6.1	444	
	44 433			25/ 9/71	-Te	444	9yrs
15 776		98		14/ 2/53	T		
	44 434			25/ 9/71	B	434	18yrs 10mths 18 days

*removed

APPENDIX F

Gannet Counts in the Spring of 1954.

	Terraces		South Ridge		North Ridge		Cliff Stack		Total	Stk	Clf	Rdg	Ter	SR	Total
	A-G	H-P	QR	S	T	U	VW	XYZ							
9/ 9/54															
Nests	244	269	120	18	124	113	54	179	1121	179	54	237	513	138	1121
Eggs	37	27	22	9	22	12	7	32	168	32	7	34	64	31	168
Total	281	296	142	27	146	125	61	211	1289	211	61	271	577	169	1289
Adults Present	225	350	134	34	140	121	68	165	1237	165	68	261	575	168	1237
23/10/54															
Eggs	219	383	122	18	100	119	55	198	1195	198	56	219	582	140	1195
Hatching	6			3			1	4	14	4	1		6	3	14
Black	19	11	9	6	8	9	2	26	90	26	2	17	30	15	90
Whitish		1	1		3	1	1	4	11	4	1	4	1	1	11
White	4	2	3	2	1		1	4	17	4	1	1	8	5	17
Fluffy					1				1			1			1
Total	248	377	135	29	113	129	61	236	1328	236	61	242	625	164	1328
Adults Present	318	471	171	41	163	161	68	230		230	68	324	789	212	1623
	A-G	H-P	QR	S	T	U	VW	XYZ		Stk	Clf	Rdg	Ter	SR	Tot
4/12/54															
Eggs	25	19	18		12	3	3	27	107	27	3	15	44	18	107
Black	9	25	16		11	12	6	13	92	13	6	23	34	16	92
White	64	70	42	10	30	36	17	75	344	75	17	66	134	52	344
Fluffy	91	72	29	8	35	39	20	69	363	83	20	74	163	37	363
Trace	20	13	12	7	19	5	4	27	107	27	4	24	33	19	107
Advanced	2	1	2	1	2				8			2	3	3	8
Tufted		1			1			2	4	2		1	1		4
Complete															
Total	211	201	119	26	110	95	50	213	1025	213	50	205	412	145	1025

APPENDIX G

GANNETS BANDED in HAURAKI GULF

	A-P	QRS	T	U	VW	XYZ	Other Islands	Total	Adults	AREA Chicks banded	AREA Total Chicks
1950-1951			28					28	4	28	
1951-1952	64	36	27	22	13	36		198	3	27 out of	29
1952-1953	87	27	64	51	7	14	10 a	270	4	64	70
1953-1954	235	84	70	57	40	148		634	6	70	90
1954-1955	239	109	90	83	42	145	50 b	758	6	90	96
1955-1956	338	94	76	68	38	126	100 c	840	7	76	84
1956-1957	308	98	107	9	32	72	100 b	726	4	107	118
1957-1958	50		42	47	10			149	75	42	68
1958-1959			113	87				200	123	113	148
1959-1960									114		90
1960-1961	11		52	38			300 c	401	-	52	70
1961-1965			70					70	110	70	660
1965-1971									156		
Totals			739				560	4274	612	739 out of	1523

a Motu Takupu b Motu Karamarama c Mahuki

APPENDIX H

Adult Gannets banded on Horuhoru

	A	B	C	D	G	HI	JK	MNO	PR	Ta	Tb	Tc	Td	Te	TU	U	VW	XYZ	?	Total	T	TU	U	North Ridge
55 56																		1	29	30				
56 57		1			1				1				1							4				
57 58	4	2		6	4			4	1	4	3	2	7	12	1	22				75	28	1	22	51
58 59			1	2	1	1				2	5	4	5			1			102	123	16		1	17
59 60					4	5	1	1		13	18	35	27	4		1	2			114	97		1	98
60 61	A	B	C	D	G	HI	JK	MNO	PR	Ta	Tb	Tc	Td	Te	TU	U	VW	XYZ	?	Total	T	TU	U	North Ridge
61 62					1										60					61		60		60
62 64																			29	29				
64 65	2				1						1	2	3	2		9				20	8		9	17
65 68	2				2					1	1	2	3	2	60	9				82	9	60	9	78
68 69	1				2					1	6	2	[illegible]	5		11				37	33		11	34
69 70	A	B	C	D	G	HI	JK	MNO	PR	Ta	Tb	Tc	Td	Te	TU	U	VW	XYZ	?	Total	T	TU	U	North Ridge
70 71	2	1	1	3	1							1	1				1			11	2			2
71 72	1	2								3	1	2	4	10		4				26	19		4	23
Total	12	6	2	11	17	6	3	5	2	23	35	50	60	35	121	57	4	3	160*	612				

* In the schedules from which these numbers were taken the "Area in which banded" was not indicated.

APPENDIX J

SHETLAND SANCTUARY

In Shetland Sanctuary* Richard Perry has three chapters about the gannets of Noss, which build on the Noup, a great cliff-face on the southern coast. Here there are thousands of hollows, shelves and pockets, where countless other sea-birds build. The gannet nests are from 20 metres above the sea, up to over 100. From a rocky projection he could observe six, level with his eye, only 10 metres away, but three dozen more were on a ledge 20 metres below him. For over four months he watched at intervals from 3 a.m. to after midnight. He describes their nest building: when dozens of birds plucked large mouthfuls of grass from the pasture at the upper edge of the Noup, while others gathered bladder weed from a reef out of range of his binoculars, and many more went to the Mainland to bring back tangle. He was so close that the rustle of the pages of his field book disturbed the birds. Yet after the egg was laid, the two parents attended it so closely, that it was up to five days before he was sure an egg had hatched. On Horuhoru our attention is drawn to hatching chicks, by the little puppy barks they make, as soon as they have a ½" hole cut through the egg shell.

In his second chapter "Nine Weeks a Growing," he speaks of the birds being fed for 8 and 9 weeks but it is not clear how long the parents attend them, although many stay for weeks after the chick departs.

In Chapter 3 "The Young Go Down To The Sea," he tells of gannet chicks exercising their wings facing the rock for some days before they leave, but on the day it is to leave, the chick does its exercising facing the sea. In spite of his close attention, he missed the first half dozen flights, and did not observe the chick until he saw it floating on the water, *tail awash,* travelling short distances by paddling, but mostly drifting about with the tides for several days, during which the parents still stayed at the nest. At times when a chick fell from the nest or wandering, was trampled down by careless neighbours, the adults took no notice but still roosted at the empty nest.

Perry has only three names for the young. During our black, whitish, white and up to "fluffy" they are "nestlings," then they become "chicks," but on the instant they leave the ground when they cast themselves into space, they are "fledglings" — so much for our attempt at using feather-stage-names, acceptable to European ornithologists.

* Faber and Faber Ltd., 42 Russell Square.

APPENDIX K

"DOWN TO THE SEA" FROM MOTU TAKUPU

One morning, 5/4/53, when we were bound for the Coromandel Rookeries, Margaret noticed a young gannet on the water, only a short distance north of Motu Takupu. After we had run up towards the Little Barrier we found it, *tail awash,* making slow progress by paddling a while, and then making short spurts by flapping along the surface of the water for half a dozen beats of its two wings, then taking a long rest. We tried to pick it up by stretching out from the cockpit but it eluded us three or four times, so we lowered the dinghy and tried again. This enraged it, and it ran and flapped along the surface of the sea, and bit the dinghy savagely in the side.

Catching it, we banded it 15 778, placed it back on the surface of the sea, and went on to Motu Takupu. When we climbed up the ridge there, it was clearly visible like a pale mooring buoy, less than a kilometre to the north: but after we had finished our short visit of about 20 minutes, we could not find it: it had vanished.

We ran north for 2 to 3 kilometres and from 1 to 2 out on each beam, but there was no sign of it. Some large fish had swallowed it. We have had news of this happening several times before. With one of our very early "recoveries" we had news from some shark fishermen working out of Two Fold Bay on the coast of N.S.W., who had caught a nine-foot tiger shark, and when they opened it up, they found one of our rings in its stomach, but no trace of the gannet. Off Kawau, another early recovery was picked up without a tail. It could not rise from the surface of the sea, and although it was fed on yellow-eyed-mullet, it died next day. During the 70th Congress of the R.A.O.U. we made one trip to Ohope Beach, and with a dead Buller's Shearwater and a Grey-faced Petrel, found a gannet which had lost its tail, too. Seagulls also are often seen with one foot bitten off. I think that many of our seabirds, floating asleep on the surface of the sea, must often fall victims to sharks.

APPENDIX L

BANDS REMOVED FROM BIRDS TRAPPED ALIVE

After I had news of rings removed from birds caught on spinners, I wrote to several papers and people to pass on the news, that these rings should be left on the birds when they were released, but that a careful note should be made of the number; the tag reads "Send Dominion Museum New Zealand." There was a fair bit of publicity. Australian papers make far more comment than is made in New Zealand.

There were several interesting results: "People" paged me between Winthrop Rockerfeller's wife Bobo, and Phar Lap the famous racehorse. From the Queensland Marine Department I received a copy of their "Quarterly Gazette" containing an "Advice to Masters of Trawlers." In New Zealand one sensible angler from Whitianga made a note of the number on the white painted counter of his friend's launch, using his wife's lipstick.

SHORT NOTE

LESSER YELLOWLEGS AT TIMARU

During the course of a visit to Washdyke Lagoon at Timaru on the morning of 1/2/71, I noticed an elegant and active wader feeding amongst Pied Stilts *Himantopus leucocephalus* in shallow water fringeing a small mudflat. Observed through 10 x 50 binoculars and against the light at a distance of nearly 100 yards, the bird resembled a Greenshank *Tringa nebularia* in build, but was a smaller and darker bird.

I altered my position so as to have the sun behind me and was able to approach the bird to within 35 yards. The upper parts, including head and neck, were greyish brown with the feathers on the mantle having whitish tips, giving a spotted effect. The wings were a similar colour and without a white wing-stripe, but when seen in flight the fore-edge and especially the wing-tip were noticeably darker. The tail was pale and rump was white, and contrasted with the mantle and wings when the bird was in flight. There was no distinctive eye-stripe. The chin and throat were whitish while the chest and upper breast were a brownish colour. There was an indistinct border between the brownish chest and the rest of the underparts which were white, although there were obscure greyish shades on the belly.

The bill was black, straight, markedly fine but stouter at the base. I estimated it to be about the length of its own head and ½ - 2/3 the length of the bill of a Pied Stilt. The long legs, which were yellow with a reddish tinge, were one of the bird's most notable features. From my previous position the legs had appeared red, probably because of poor light, but in good light the yellow showed up distinctively. In flight the legs trailed behind the tail to a very similar length as in a Greenshank. (A Greenshank had spent the summer a few miles further north at the mouth of the Opihi River, allowing me to make some useful comparisons.)

By this time I was convinced the bird was a Yellowlegs and for some time watched it feeding. It was particularly active with jerky movements and preferred to feed in shallow water, stabbing with its beak. Occasionally it waded into the water to its belly and was seen to plunge its head beneath the surface. The Yellowlegs was more touchy than the Greenshank mentioned, and did not show as much confidence amongst the stilts as that bird had. During my presence it was twice pursued momentarily by a stilt. On more than one occasion I thought I had lost the bird after something had startled it into flight over the lagoon, but each time it returned. No calls were heard from the Yellowlegs; if it did call the notes were lost amid the clamour of gulls and stilts. Other waders in the vicinity were South Island Pied and Black Oystercatchers, Banded Dotterels and a pair each of Spur-winged Plover and Turnstone.

After consulting reference books I concluded that the bird I had seen was a Lesser Yellowlegs *Tringa flavipes*. The length and form of the bill answered that of this species, and eliminated the Greater Yellowlegs *T. melanoleucos* which has a longer and more strongly built bill. The absence of white up the back, darker body-colouring and the colour of the legs ruled out the Marsh Sandpiper *T. stagnatilis*.

The Lesser Yellowlegs was not present that afternoon, nor on 2 and 4 February 1971, so a photograph was not obtained. On 2/2/71 I continued to the Opihi River, but the Greenshank was the only arctic wader to be found.

— RAY PIERCE

NOTICES

SOUTH AMERICAN TOUR 1972

It is proposed to organise a 28-day ornithological tour during October-November, 1972, taking in the following:— Santiago, southern Chilean lakes inland from Puerto Montt, Guayaquil, Galapagos Islands. Travel within the continent partly by air, partly by bus. Some camping, possibly some boating. Total cost $1700 - $1800. *This is a ceiling cost and includes pocket money.* Chile has a tremendously rich and varied bird life, and many seabirds are closely related to those of New Zealand. The minimum number required to make the tour possible is fifteen. Would those interested please write to Mrs. S. M. Reed, 4 Mamaku Street, Meadowbank, Auckland 5, not later than mid-March, 1972.

CLASSIFIED SUMMARISED NOTES

Towards the end of 1972, a summary of all notes supplied to the Recording Scheme from 1964 to 1970 will be published as a supplement to be designated Vol. 19 No. 5. As from 1/1/71 summarised notes will be published annually. Members are urged to supply notes through their Regional Representative, to be forwarded to Mr. A. T. Edgar by 30th September in each year for editing.

BIRD MAPPING SCHEME

Would contributors please send all remaining 1971 lists to their Regional Representative as soon as possible, and in any event before 31st January, so that the annual report can be prepared on time.

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REVIEW

The Birds Around Us, by R. H. D. Stidolph, Hedley's Bookshop Ltd., Masterton, $5.50. How many bird-watchers' note-books of real value, and containing a wealth of information, never see the light of day, and die with the authors. However, Bob Stidolph's notes, extending from 1921 to the present day, have now fortunately been published in an eminently readable and informative volume of 140 pages, and the author and Hedley's are to be congratulated on their enterprise. It is printed in easy to read 12 point Baskerville type, and is illustrated with four paintings by Mrs. Stidolph, and eight photographs, several taken by the author. I have read the book with deep interest. To select a few items at random, the author's observations on the nesting and hunting behaviour of the Harrier are striking, in fact exciting, and on the Grey Warbler/Shining Cuckoo relationship are of special interest. His earlier enquiries from old settlers add materially to our knowledge of the extinct Huia.

The author will be known personally to many of the older generation of ornithologists and bird-watchers, and by reputation to many of the younger, for he was for 10 years the first editor of "Notornis," and has over the years contributed articles on birds to several journals. Many thousands of New Zealanders have at least a passing interest in our birds, and to them the book is recommended, as well as to the more knowledgeable bird-watcher or ornithologist, who can be assured they will have no cause to regret having added this interesting book to the library.

— A.B.

REGIONAL REPRESENTATIVES

FAR NORTH & NORTHLAND: A. T. Edgar, Inlet Road, Kerikeri
AUCKLAND: Mrs. S. Reed, 4 Mamaku Street, Auckland 5
SOUTH AUCKLAND: H. R. McKenzie, P.O. Box 45, Clevedon
WAIKATO: D. W. Hadden, Waingaro Schoolhouse, Waingaro, R.D.1 Ngaruawahia
BAY OF PLENTY: R. M. Weston, 250 River Road, Kawerau
VOLCANIC PLATEAU: R. W. Jackson, 9 Kenrick Road, Rotorua
GISBORNE/WAIROA: A. Blackburn, 10 Score Road, Gisborne
TARANAKI: D. G. Medway, P.O. Box 476, New Plymouth
WANGANUI: Vacant.
MANAWATU: Dr. I. G. Andrew, 6 Eaton Place, Palmerston North
HAWKES BAY: N. B. Mackenzie, Pakowhai, Napier, R.D. 3
WAIRARAPA: B. W. Boeson, P.O. Box 30, Carterton
WELLINGTON: R. Slack, 31 Wyndham Road, Pinehaven, Upper Hutt
NELSON: F. H. Boyce, 19 Marybank Road, R.D.1, Nelson
MARLBOROUGH: J. A. Cowie, P.O. Box 59, Kaikoura
CANTERBURY: J. R. Jackson, 103 Linwood Avenue, Christchurch
WEST COAST: Vacant
OTAGO: Mrs. J. B. Hamel, 42 Ann Street, Roslyn, Dunedin
SOUTHLAND: R. R. Sutton, P.O., Lorneville, Invercargill

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LITERATURE AVAILABLE

From all bookshops:

Annotated Checklist of the Birds of New Zealand. $4.95.

A Field Guide to the Birds of New Zealand, by R. A. Falla, R. B. Sibson and E. G. Turbott. 2nd Revised Edition, $5.00.

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

A Biology of Birds, by B. D. Heather. $1.33 post free.

From B. A. Ellis, 44 Braithwaite Street, Wellington 5:

Field Guide to the Waders, by Condon and McGill. Price 75c post free.

The following are available on order from Mrs. H. R. McKenzie, Box 45, Clevedon:

Back Numbers of Notornis at 60c each (Vol. 18 $1.00 each). Large orders for full or part sets at special prices.

O.S.N.Z. Library Catalogue, 70 pp., 50c.

Banding Reports, Nos. 8 to 14, 50c each. Nos. 1 to 7 are incorporated in early issues of 'Notornis.'

Kermadecs Expedition, 1964, by A. T. Edgar. Reprints at 45c.