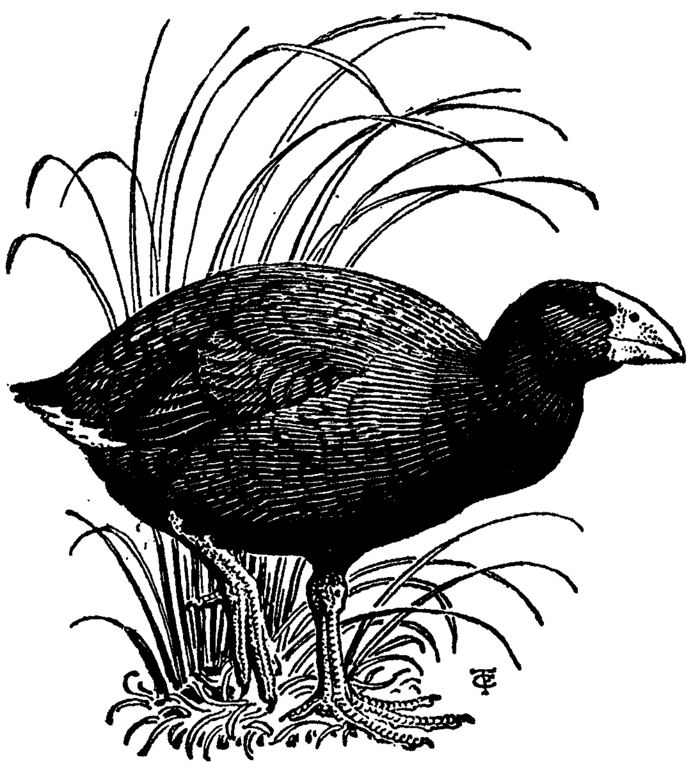
NOTORNIS

Journal of the Ornithological Society of New Zealand



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CONTENTS

ST.PAUL, R. A bushman's seventeen years of noting birds. Part F (Conclusion of series) — notes on other native birds ... 65

GILL, BRIAN J. Counts of birds from a car in the Manawatu ... 75

RALPH, C. J.; RALPH, C. P. Some observations on the winter distribution of the New Zeñland Kingfisher 82

HEATHER, B. D. The Vanua Levu Silktail *(Lamprolia victoriae kleinschmidti)*: a preliminary look at its status and habits 94

CALDER, W. A.; ROWE, B. Body mass changes and energetics of the Kiwi's egg cycle 129

Short Notes

FOX, N. C. One-winged Australasian Harrier 74

McKENZIE, M. E.; REED, S. M.; McKENZIE, H. R. Variation in hatching to flying period of N.Z. Dotterel chicks 136

VOOREN, C. M. Sea bird observations off the west coast of the South Island, New Zealand, October-November 1975 137

FOX, N. C. N.Z. Falcons taking poultry 140

MORRIS, R. B. Juvenile Chatham Island Shag observed offering nest material to a breeding adult 141

STIDOLPH, R. H. D. Fluctuations in Whitehead population 141

Reviews

C.A.F. Wishbones for Wetmore: Collected Papers in Avian Paleontology honoring the 90th birthday of Alexander Wetmore 144

J.M.C. Birds of Paradise — the world's glamour birds. *BHP Journal* 146

About our authors 147

The Society and its officers .... inside front cover

Regional Representatives .... inside back cover

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A BUSHMAN'S SEVENTEEN YEARS OF NOTING BIRDS

PART F [CONCLUSION OF SERIES] — NOTES ON OTHER NATIVE BIRDS

By R. St.PAUL

(Edited by H. R. McKenzie)

Although some of the native birds of this Part have been charted fully they are discussed more briefly because they show little or no variation seasonally or annually, are in small numbers throughout, or have appeared irregularly. Mention is made of birds no longer present in the area and some which may have once been present. Evidence for the latter was hard to get because " old hands " did not retire in the area. Ned August, an elderly Maori, was my only reliable personal informant about earlier times.

FURTHER BUSH BIRDS PRESENT

NORTH ISLAND KIWI *(Apteryx australis mantelli)*

Proportion seen to heard: 1 seen to over 50 heard but not seen.

This flightless bird would once have been very common here and quite a healthy remnant remains in heavy and light bush and sometimes in scrub or fern. Since it is nocturnal it is very seldom seen. Its enemies here are mostly pig-dogs and the traps of possum hunters.

I have not observed its hunting except to notice where it has been boring for worms and scratching the ground with its feet. Its food is mostly worms, grubs and fallen berries.

The call of the male is a high " kwee-kwee-kwee " repeated ten or more times, getting faster and more shrill. The female's notes are gruff, low key, slower and fewer in number than those of the male. When camping out in the bush one will sometimes hear the snuffling noise which the Kiwi makes when questing for food in the dark.

FIGURE 1 — Robert ("Bob") St.Paul.

NEW ZEALAND FALCON *(Falco novaeseelandiae)*

Proportion seen to heard: 1 seen to 3 or 4 heard but not seen.

This endemic falcon has the usual characteristics of the family, being noted for its fearlessness and hunting prowess. Though admired for these it is disliked for its taking poultry and domestic birds. Bushmen and hunters have often shot it here and elsewhere because of its ruthless predation on other native birds. It is now rare in most parts and territorially is fairly sedentary, though odd ones will at times wander a great distance within New Zealand. It is mostly a bird of the forest but occurs often in adjacent open country and even in towns. At Tihoi my top count in a day was 3 seen, once only. Minginui had top counts of 6, 5 and 4 seen. On hunting trips to Waiau, Parahaki and Upper Whirinaki on three trips of up to eight days each counts were 1 to 5, 1 to 4 and 2 to 4, but other trips there yielded none or just one or two on odd days. I would have heard more, of course, as the sharp calls carry a long way.

The Falcon has a flapping flight when going in a straight line and it is quite fast. If it thinks it sees something it will circle two or three times, then fly on, but if quarry is sighted it goes into a lightning swoop.

It gives away the locality of its nest by the fuss it makes. I have seen the odd nest away up in a rhyolite cliff, but it will often nest here on the ground on a steep slope or a hole in a rock, in epiphytic growth and sometimes in a hollow branch of a tree.

The food of the Falcon is mostly birds, taken alive. I have not seen it eating carrion and have heard of its doing so only once. I have not known it to return to a kill of the day before. When nesting near open country it feeds its young largely on the New Zealand Pipit.

It is an inveterate hunter. Sometimes, though not very often, it will chase birds for fun, not trying to catch them, but usually it is in deadly earnest and displays a lust for killing. When hunting the pigeon it flies along the face of the bush to frighten one out, then comes down like a shot from a gun and strikes. When working on pigeons it will kill all it can find. One man told me he knew one bird to strike down seven in one morning. Killing Starlings is one of its favourite pastimes. There was one three-mile stretch of bush edge where Starlings nested every year. As the adult Starlings came out from the nests, heading down to the open for food, the Falcon would swoop and knock one out, then go back and kill the next one, five or six birds one after the other. It did not eat them. It was just for the sake of killing, as with the stoat. Pack hunting is sometimes used, two or three birds combining to make a kill. I saw one following a pigeon through the trees while two others flew above waiting for a chance to strike. The strike is lightning fast. One following through the trees needs only the clear space afforded by a narrow truck road to hit and kill a pigeon. The clenched feet, or the heel, not the claws, are used for this, but small prey may be killed in the air either with the claws or the heel, or with the claws only if the prey is on the ground.

A repetitive " kek-kek-kek " of a cruising bird builds up into a scream when it is chasing anything. From a perch it will call angrily or agitatedly if someone is near the nest.

Few birds will attack the Falcon but the Kaka and the Tui will do so if it comes near their nesting place.

MOREPORK *(Ninox novaeseelandiae novaeseelandiae)*

Proportion seen to heard: 1 seen to 50 or more heard but not seen.

The Morepork may now be the only native owl extant in New Zealand. It is relatively plentiful throughout the country and is well established as it lives in exotic as well as in native tree growth.

The territorial habits here are puzzling. Three or four pairs may be found in a small area with no others for some distance in the surrounding bush, yet they do not form even small flocks. In the Waiau River area I located from one spot eight pairs calling, some appearing to answer the others.

The flight is of even medium speed when travelling along but when in a hurry it can turn at a sharp angle to come down onto prey in a flash. Its wings make no noise at all and it can be startling when it ghostily passes closely in the near-dark. In the mill yard near my hut a strong electric light attracted many moths and other insects. A Morepork, gyrating crazily, would make a harvest of these, while the little bats worked just clear of it.

Breeding usually takes place in a hollow tree, but also in odd places, such as in a clump of Astelia on a tree. Two eggs, or sometimes three, are laid. In 1915 I found three chicks in a hollow hinau tree at Moumoukai, in the Hunua Ranges.

I have never known it to attempt to hunt in daylight, not even in the darkest bush gullies. I had the unusual experience of seeing odd ones on the bush edge sunning themselves between 3 and 4 p.m. on cold trosty days in June 1955.

The food consists of any insect at all practically, from the largest to the quite small, also rats and mice, which are killed with the feet, slit open, neatly skinned and consumed. The rat tails and hind legs are left, still joined together. The skin seems to be swallowed sometimes. Some birds are taken in the bush but not many.

The main call is the one known as " morepork," but this really is more like " kwawk-kwawk," with numerous variations. There are about eight fairly definite calls but every one of them has variations so that it is difficult to define them. One bird will sometimes appear to answer another at quite a distance, apparently not a pair. It can be heard at night all the year but particularly from early spring on to late summer or autumn. Occasionally calls will come from deep dark gullies, which are favoured for roosting during the day. Calling is particularly noticeable when rain is approaching.

Small birds do not like the Morepork and it is vigorously mobbed by Tui, Bellbird, Whitehead, and, to a lesser extent the Grey Warbler. They make a great fuss and noise and go quite close to their enemy, which is at a disadvantage in the daylight and does not retaliate. Introduced birds, such as the Blackbird, join in to some extent. However, all soon tire and leave it or else it flies away to a darker place.

BIRDS OF THE RIVERS AND STREAMS

BLACK SHAG *(Phalacrocorax novaehollandiae)*

This large shag occurs fairly regularly in small numbers in the streams at Tihoi and Arataki, the rivers at Minginui, and, sparingly, the bush streams of the Waiau area. I heard of only one record of nesting which was of two or three nests in the Longfern area on a tributary of the Whirinaki River.

LITTLE SHAG *(Phalacrocorax melanoleucos brevirostris)*

A few of this species came to the main rivers. Odd parties of up to 16 could have been Little Black Shag *(P. tenuirostris)* but I did not ascertain this.

BLACK SWAN *(Cygnus atratus)*

One party of five seen flying across the Whirinaki valley. It is possible that swan and other waterbirds occurred occasionally on Lake Arahaki but I did not find any there. This lake would be dry for long periods. The bushy edges are not suitable for water and wading birds.

PARADISE DUCK *(Tadorna variegata)*

Two were seen at Tihoi in 1944. At and about Minginui scattered pairs and small parties occurred along the larger streams and sometimes a little way up into the bush. The highest count in a day was 9. One nest was found.

GREY DUCK *(Anas superciliosa superciliosa)*

The Grey Duck was not plentiful but had a wide distribution, being found at and about Tihoi and from the Whirinaki River right back to the streams of the Parahaki and Waiau areas. Few cases of breeding were noted. I saw a female calling down her newly hatched young from a nest in a clump of astelia c 12 m up in a tree (St.Paul 1956).

BLUE DUCK *(Hymenolaimus malacorhynchus)*

Proportion seen to heard: 6 seen to 1 heard and not seen.

This is a bird of the upper streams mostly but sometimes it comes down to the main rivers. Up to five at once were seen on the Mangakino River at Arataki but it was seldom noted there. The population at Minginui and the whole Waiau area was about 40 but a deer culler shot nearly all of them. Some of the few that were left in the eastern part spread back later to the Upper Whirinaki Stream. It is thrilling to hear the whistled " Whio " of the male. The female call of " krrr " is something like that of the female Kiwi.

BIRDS OF SWAMP AND DAMP COVER

AUSTRALIAN BROWN BITTERN *(Botaurus stellaris poiciloptilus)*

One came most years to a small swamp by the Whirinaki River to moult in May-June. No call was made.

SPOTLESS CRAKE *(Porzana tabuensis plumbea)*

The only record I have is of a cat taking six in the Whirinaki valley.

PUKEKO *(Porphyrio porphyrio melanotus)*

Only a few were scattered along the Whirinaki valley. The terrain is not very suitable for the species.

PIED STILT *(Himantopus himantopus leucocephalus)*

Up to four seen on the Whirinaki riverbed but very rare. The small swamps here are not of the type it prefers.

NORTH ISLAND FERNBIRD *(Bowdleria punctata vealeae)*

This furtive little bird, with its down-hanging frayed looking tail, is sometimes plentiful, sometimes scarce in the Whirinaki and Minginui River areas. Usually it is in rushes, low shrubbery, sedges, or a mixture of these. In bracken fern *(Pteridium aquilinum esculentum)* I have found it on the top of a ridge, but stranger still, living in pure bracken fern across the Minginui River from my hut on a steep, wet, almost vertical bank about 16 m high. I have not seen it in the bush.

The Fernbird seldom flies more than 45 m. I have seen one fly that distance across a river. By the way it transfers from one isolated habitat to another it must, like the rails, fly much further at night.

The usual call is a sharp " u-tik," each syllable uttered by a different bird, sometimes, but rarely, reversed to " tik-u." Single sharp " tiks " are common, especially at evening.

AUSTRALASIAN HARRIER *(Circus approximans gouldi)*

The Harrier is included in this section because it relies on swamps so much for nesting, sleeping and hunting.

Proportion seen to heard: 6 seen to 1 heard and not seen.

Daily counts of birds ranged from 0 to 4 mostly, the highest daily counts being 12, 7, 7, 6, 6 and 5. Counts could be exaggerated owing to the Harrier's habit of making more than one flight cycle in one day.

This, the only representative of the Accipitridae we have in New Zealand, though common in so many parts is not plentiful in such habitat as the thick forest of the Urewera ranges. It is easily observed owing to its being large and often high-flying. No set seasonal pattern is revealed by my notes. Very few sightings were made on hunting trips deep into the ranges but the more open areas were quite fruitful.

Several flight cycles are made over the same course in a day and cover a considerable number of flight miles. Special spots are visited frequently in the Whirinaki valley, say at a swamp to look for Pukeko, or where a marshy pool allows the bird to have a wash.

Breeding is inhibited in the area because swamps are absent in the bush ranges and are few and small in the open valleys. I have heard of only one local nest, in bracken fern, away from the bush. I have not seen food being carried as if to a sitting mate, though most seen are adult birds.

Hunting over the bush canopy does not seem to be very profitable but Starling nests in epiphytic clumps of growth on big trees at or near the bush edge are particularly vulnerable to attack. The open riverbeds and a few small natural clearings in the bush provide opportunity for catching any kind of rodent or a sick young bird. The tussock lands and scrub areas of Tihoi provide good hunting. The open flats along the Whirinaki River, with single hawthorn trees and rough scrub have for prey exotic birds and other animals as well as the native species. The main road, Route 38 and the Minginui Road provide car-killed birds. Much time is spent watching for frogs in the small swampy places and a bird will spend hours watching for mice in patches of grass. All catching is done with the foot. Carrion is appreciated by the Harrier as well as living prey. Hunters provide much carrion in the form of deer and pig carcases and offal. Such is usually revealed when a bird is seen taking off from a clear space, such as a river-bed.

The calls vary quite a bit. In the spring, starting in August, it gives a piercing whistle each time it goes round when looping the loop. Of the ordinary calls one is like an exaggerated chirp. There is no sustained calling, nor does it have a hunting call like the New Zealand Falcon.

The Harrier has to give way to the Falcon or Bush Hawk, though the latter is only half its size. When the Falcon swoops the Harrier turns upside down and extends its armoured feet. The Falcon then sheers off but returns and attacks again and again until the Harrier retreats. The aerobatics they display at such times are marvellous. Native birds which mob the Harrier are the Tui and Bellbird, in the breeding season. Smaller birds do not join in.

BIRDS PERHAPS FORMERLY PRESENT

WHITE HERON *(Egretta alba modesta)*

Best (1925: 58) wrote " . . . a pond or lagoon at Manu-ohu was famous as a breeding place of the Kotuku." This place is a little north of my boundary, Route 38, so the birds could easily have visited the Whirinaki riverbeds in my area.

BROWN TEAL *(Anas aucklandica chlorotis)*

Although the Urewera is not ideal country for the Brown Teal it should be safe to assume that it would have occurred in some parts, it being a very adaptable species.

KAKAPO *(Strigops habroptilus)*

The latest report I have of the Kakapo was made by G. M. Maning (pers. comm.). Near the top of the Huiarau Range, at Christmas 1927, he had a clear view of one standing on a log. It scuttled away on the ground into the bush.

In 1950 I was told by Ned August, a Maori bushman, that when his grandfather was with the rebel chief, Te Kooti, in the Waiau, in the Huiarau Range, their main food was the Kakapo (St.Paul 1951: 52).

Best (1925: 296) stated that the Kakapo abounded in the Parahaki district. He mentioned (p. 17) a party of Maoris setting out from Te Whaiti to hunt Kakapo, being caught by an enemy tribe, killed and eaten.

RED-CROWNED PARAKEET *(Cyanoramphus novaeseelandiae novaeseelandiae)*

I did not see this species either at Tihoi or in the whole of the Minginui area. The nearest reported occurrence I had was from G. E. Sopp (pers. comm.) who saw a pair near the shore of Lake Waikaremoana, about 1957. It could perhaps have once lived in the podocarp forest about Minginui.

NORTH ISLAND LAUGHING OWL *(Sceloglaux albifacies rufifacies)*

Several writers, the first of whom seems to have been Oliver (1955: 437), have stated that, according to information from Maoris, this bird was once common in the Urewera country, which includes Minginui, Parahaki, Waiau and Upper Whirinaki areas. A. Blackburn (pers. comm.) heard it in 1925 at Wairaumoana, the south-western arm of Lake Waikaremoana.

NORTH ISLAND BUSH WREN *(Xenicus longipes stokesi)*

Several sightings have been reported in the neighbourhood but none has been confirmed. The first I have of these is by Sir Robert Falla (pers. comm.) in 1925, at the top of the Huiarau Range on Route 38, which is on the boundary of my area. Others were in the Lake Waikaremoana area, *viz,* at Lake Waikare-iti (Edgar 1949: 172); in the Aniwaniwa valley, several wrens, larger than riflemen, seen up to 1955 by G. E. Sopp (pers. comm.); 2 seen on 2/5/55 by G. E. Sopp and W. P. Mead (pers. comm.); 1 well seen on 17/11/55 by H. R. McKenzie (pers. comm.). These sightings were so close to the Parahaki side of the Huiarau Range that the bird could well have been present there at the same time and perhaps in the Waiau catchment also.

NORTH ISLAND WEKA *(Gallirallis australis greyi)*

It is generally recognised that this Weka was once present throughout the North Island. Recent liberations have shown that it thrives in neighbouring country so it could hardly have been absent here.

NORTH ISLAND SADDLEBACK *(Philisturnus carunculatus rufusater)*

This was once a widespread bird of the bush and may have lived at Tihoi, Minginui and Waiau. The nearest unconfirmed report was of two seen at Okataina. The last confirmed sighting on the mainland of the North Island was of a pair seen in February 1935 at the Kopuapounamu River beneath Raukumara Peak, in the northern part of the Raukumara Range, towards East Cape, in similar country to that of my area here (Fleming 1939-40). Best (1925: 303) mentioned Pari-tieke, the name of a place on the Manga-o-hau Stream, some miles north of Route 38. This place name may indicate the presence of the Tieke there at some time.

HUIA *(Heteralocha acutirostris)*

Phillips (1963) discussed the several reports or possible sightings in the Waikaremoana-Urewera section. I have not any other evidence.

NORTH ISLAND KOKAKO *(Callaeas cinerea wilsoni)*

I did not see or hear a Kokako in the years that I worked at Tihoi and Arataki. This is remarkable since Pureora, only approximately 16 km away was, and still is, one of the best places to observe this bird. I would certainly not have missed it as I have known it well ever since my early childhood. It was once plentiful in the Whakatane and other river valleys towards Bay of Plenty. The Whakatane and its upper tributaries have their sources south of Route 38 so it is highly probable that the Kokako would have extended into my area.

NORTH ISLAND THRUSH *(Turnagra capensis tanagra)*

I have not had any record of this bird since it has been seen and heard recently in the Hopuruahine and Aniwaniwa valleys (G. E. Sopp 1957). It could well have been in the nearby Parahaki, Waiau and Upper Whirinaki catchments also.

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SHORT NOTE

ONE-WINGED AUSTRALASIAN HARRIER

On 27 June 1974 I banded an adult female harrier *(Circus approximans)* No. L15317 and she was recovered on 7 February 1977 from a waterhole on our neighbour's property about 1.5 km from the banding site. She was alive and in good condition and I was most surprised to find that her right wing was missing and that the stump of the humerus had healed over. She may have subsisted on frogs or perhaps had been supplied by her mate; the pellet she cast next day contained only vegetation detritus. Seven years ago I rehabilitated a Common Buzzard *(Buteo buteo)* with only one wing. It had survived for 8 days by being fed by its (presumed) parents, although it must have been fledged for well over a month.

Nobody in this area has to by knowledge been shooting or trapping harriers and it seems that the cause of this bird's injury was probably wire or possibly traffic. The only road here is about 0.5 km from the waterhole and is a little-used dead end. We have had 2 wire-casualty harriers sent here in the last 2 years and wire seems to be the most likely cause.

Harriers have been known to survive without feet and this bird has shown that they can survive without a wing. The tenacity of the species is remarkable !

Incidently, this female was at least 5 years old at the time of recovery and her irides were still dark brown.

N. C. FOX, *RD 2, Rangiora*

COUNTS OF BIRDS FROM A CAR IN THE MANAWATU

By BRIAN J. GILL

ABSTRACT

A transect through pastoral land, from Foxton on the coast to Palmerston North inland, was traversed regularly by car. Counts of most birds except finches, showed Starlings to be commonest in the area, followed by White-backed Magpies and Southern Black-backed Gulls. There was little seasonal variation in Starlings for 1974 but an apparent increase in numbers during 1975. Magpies, gulls, Australasian Harriers and Pukeko were seen less often during spring than at other times of year, whereas Blackbirds and Welcome Swallows were more frequently counted in spring or summer. Fewer Starlings, Blackbirds, and Kingfishers were seen near the coast than elsewhere, while magpies and harriers were most abundant near the coast and less frequent inland.

INTRODUCTION

It is usually impossible to count directly all the birds in an area at one time. However, systematic scores of birds seen or heard over an interval of time or space can yield indices of abundance in an area. Indices do not measure total populations, but they may indicate the relative abundance of a species at different times or in different habitats. A major limitation is that indirect counts are influenced by the conspicuousness of a species as well as by its abundance. Magpies, for example, with their striking plumage, large size and strong flight are more obvious to the observer than swallows; and male Blackbirds are more conspicuous in spring and summer, when they sing from prominent perches, than at other times.

Dawson & Bull (1975) described a technique for counting birds in New Zealand forests. Counts of birds from a car travelling through farmland can also be profitable.

METHODS

On mornings about once a week, between March 1974 and September 1975, I travelled as a passenger in a car from Foxton to Palmerston North (Fig. 1), and counted some of the more easily recognizable birds. Finches and certain other species were ignored, as identification from a rapidly-moving vehicle without hearing their calls was difficult. Starlings *(Sturnus vulgaris)*, White-backed Magpies *(Gymnorhina tibicen hypoleuca)* and Southern Black-backed Gulls *(Larus dominicanus)* were the main birds counted.

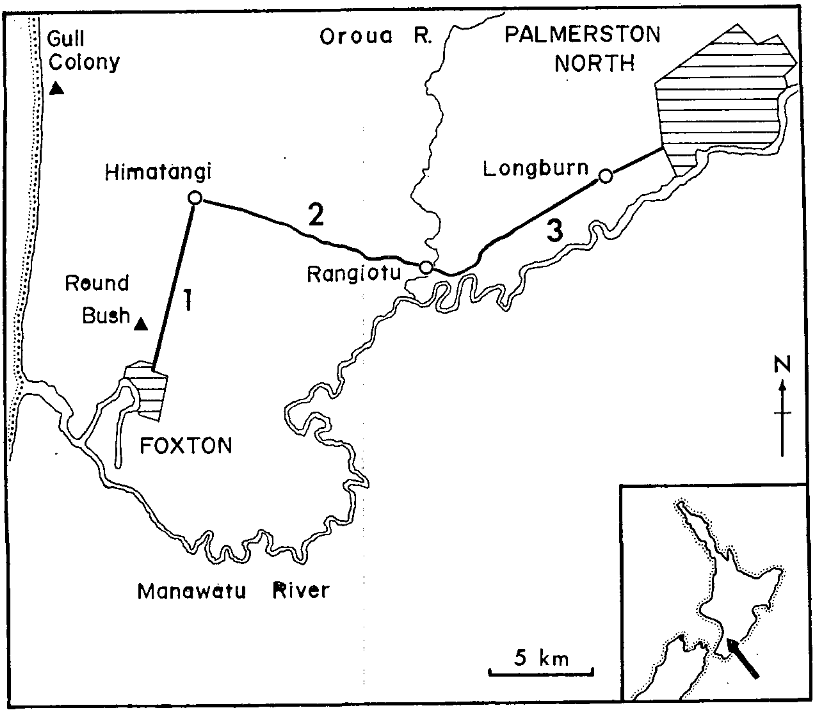

FIGURE 1 — The study area showing sub-division of the route into three sections.

The habitat for birds in the area traversed was mostly uniform, comprising open grassland with shelter-belts of *Pinus radiata* and *Cupressus macrocarpa.* However, the transect fell readily into three sections (Fig. 1) differing in their soils, rainfall and intensity of farming. Section 1 (8 km), from Foxton to Himatangi, ran parallel to the coast at about 7 km inland along the stretch of road known locally as the 'Himatangi Straight.' Section 2 (11.5 km) extended at right angles to the coast, eastwards from Himatangi to the bridge near Rangiotu where the road crosses the Oroua River. This point marks the eastern limit of the coastal Manawatu sand-country with its characteristic dune and basin topography. The third section (13 km) ran north-east to Palmerston North on flat alluvial plains farmed more intensively than the sand-country. In addition to the abrupt change in soils at Rangiotu, the rainfall increases inland from an average of 813 mm per annum along section 1 and the western part of section 2, to 864 mm at Rangiotu and 1002 mm at Palmerston North (Cowie *et al.* 1967, *N.Z. Official Yearbook 1975*).

The results were obtained from up to 56 counts each covering 32.5 km of road at an average speed of 75 km/h, and lasting on average for 26 minutes (range: 20-30 minutes). Counts were started at between 0600 hr and 0830 hr (N.Z. standard time), but mostly at between 0730 hr and 0800 hr. Hence the times of observation were fairly constant by the clock but varied in relation to sunrise. Loss of visibility through rain was less of a problem than a bright sun low on the horizon, but neither made counting impossible. The sky was overcast for approximately half the time. The number of counts per month varied from one to six, but for most months I was able to complete four.

I began counting at the northern boundary of Foxton on State Highway 1, and ceased at the south-western edge of Palmerston North at the intersection of Provincial Highway 56 with Maxwell's Line. A separate tally was kept for each section. I sat in the front passenger seat and scored in a note-book birds visible in the forward quadrant of the left-hand side of the road. To confirm an identification or count birds in a flock it was often necessary to look back into the left-rear quadrant. The same method was used by Bull & Dawson (1969).

RESULTS AND DISCUSSION

GENERAL

During 24½ hours of counting and 1 820 km of travelling a total of 10 472 birds were scored; 187 per count on average (Table 1). The data for 11 species showed Starlings to feature most prominently overall, and they were recorded from all sections of every count. Starlings are possibly the most abundant birds in the area, although the sand-country is noted for its uncommonly high density of finches (Falla 1957).

Magpies and gulls were next in frequency of the species counted. Magpies were seen on every count (although twice not noted from section 3), but gulls were more irregularly distributed, occurring in every month, but sometimes absent from some or all sections. Magpies ranged in number from 9 to 44 in a count whereas gulls showed less stability ranging from 0 to 166. This probably reflected the fact that gulls neither bred nor roosted in the habitat of the transect, but made daily migrations to it. They often congregated on ploughed fields, but were mostly seen flying directly from the coast to the freezing works at Longburn (Fig. 1).

Blackbirds *(Turdus merula)* appeared about twice as common as Song Thrushes *(T. philomelos)*, but perhaps the latter were less noticeable. Both species were not seen at all in some months, and when seen were usually absent from some sections. Australasian Harriers *(Circus approximans)* seemed to be the commonest native bird in the area; they were certainly the most conspicuous, and were seen every month. Sightings of the small native passerines were

TABLE 1. AVERAGE NUMBER OF BIRDS SEEN PER COUNT (n = 56), SEASONALLY AND OVERALL.

	1974			1974/5		1975	Overall		
	Autumn	Winter	Spring	Summer	Autumn	Winter	mean	S.E.	Range
Starling	106.1	111.7	107.5	115.4	209.9	183.0	130.03	6.97	56-285
White-backed Magpie	30.3	25.7	18.1	28.2	26.1	36.0	26.07	1.21	9-44
Southern Black-backed Gull	33.3	26.5	3.3	13.6	37.8	11.0	21.30	4.12	0-166
Blackbird	0.6	0.9	5.4	1.4	1.4	3.3	2.11	0.37	0-11
Australasian Harrier	2.3	2.8	0.8	2.1	2.4	2.7	2.05	0.20	0-6
Welcome Swallow	0.3	0.5	1.0	3.9	1.3	0.7	1.38	0.30	0-11
Song Thrush	0.4	1.6	1.4	0.9	0.8	2.0	1.07	0.22	0-7
Pukeko	2.2	1.8	0.1	0.2	0.6	0	0.89	0.27	0-11
Mallard	0.4	0.2	2.3	0.2	0.1	2.7	0.80	0.25	0-9
White-faced Heron	0.2	1.1	0.8	1.1	0.1	0.3	0.66	0.14	0-5
Kingfisher	1.1	0.3	1.1	0.2	0.2	0.7	0.61	0.12	0-4
ALL SPECIES	177.2	173.1	141.8	167.2	280.7	242.4	187		
Number of counts	11	10	12	11	9	3	56		

negligible. The rarest bird seen was a New Zealand Falcon *(Falco novaeseelandiae)*, sighted on one count near Round Bush Scenic Reserve (Fig. 1; Gill 1976), and omitted from the calculations.

SEASONAL TRENDS

To reveal any temporal changes in the counts of birds I grouped the data into four seasons: autumn (March, April, May), winter (June, July, August), spring (September, October, November) and summer (December, January, February). Table 1 shows the seasonal pattern for 11 species expressed as average numbers seen per count. The results for winter 1975 should be viewed with caution, as the sample size was low (3 counts) and there were no counts for July 1975. For each of the other seasons there were between 9 and 12 counts covering all months within a season.

The counts of Starlings were similar for the seasons of 1974 at between 100 and 120 birds on average, but the numbers doubled in 1975. This rise may have reflected an increase due to breeding, and monthly means for autumn 1975 showed a peak in March, when young were conspicuous. However, it is not clear why numbers were low in autumn 1974 unless there was a real difference between the years.

Except for a drop in spring the numbers of magpies were reasonably consistent at 25-30 birds per count on average. Gulls, as well as showing the vernal drop in conspicuousness or abundance, were reduced in summer (and in the poorly-documented winter of 1975). Autumn peaks in the size of flocks are normal for gulls (Fordham 1968). The low counts in spring of magpies, gulls and harriers can no doubt be interpreted as a reduced chance of encountering birds during the breeding season. The decline was most apparent for Black-backed Gulls, which become closely tied to their colonies during breeding (Fordham 1968); in this case a point on the coast about 2.5 km north of Himatangi Beach (Dr R. A. Fordham, pers. comm.; Fig. 1). Pukeko *(Porphyrio melanotus)* were relatively scarce in spring and summer because their habitat becomes restricted during the drier seasons and they disperse to territories (Dr Fordham, pers. comm.).

The marked increase in Blackbirds counted for spring was probably due to the onset of territorial behaviour causing increased conspicuousness. The same pattern would be expected for the Song Thrush but did not occur. The peak in observations of the Welcome Swallow *(Hirundo tahitica)* for summer was possibly due to the fledging of young from early broods. The results for Kingfishers *(Halcyon sancta)* in the Manawatu parallelled those of Taylor (1966) who found them to be most obvious in the Nelson district in September, October and November. Mallards *(Anas platyrhynchos)* and White-faced Herons *(Ardea novaehollandiae)* occurred irregularly throughout the year.

DIFFERENCES BETWEEN SECTIONS

The frequency of birds per 10 km of each section of the transect (Table 2) suggests that the 11 species combined were slightly less abundant in the coastal strip of the Manawatu than elsewhere. However, when comparing numbers it is not valid to treat as one, several species of varying conspicuousness. Falla (1957) suggested that the semi-cultivated sand-dune country of the Manawatu (close to section 1) may support a higher density of birds than any other habitat in New Zealand. Such numbers will in large part comprise finches which were not included in the present results.

TABLE 2. AVERAGE NUMBER OF BIRDS SEEN PER 10 km OF EACH SECTION (n = 55).

	Section		
	1	2	3
Starling	32.3	46.8	39.7
White-backed Magpie	13.0	7.8	4.6
Southern Black-backed Gull	5.9	2.6	10.5
Blackbird	0.16	0.33	1.33
Australasian Harrier	1.02	0.46	0.55
Welcome Swallow	0.43	0.35	0.49
Song Thrush	0.11	0	0.77
Pukeko	0.11	0	0.57
Mallard	0.21	0.22	0.43
White-faced Heron	0.23	0.27	0.14
Kingfisher	0.09	0.14	0.28
ALL SPECIES	53.6	58.9	59.3
Length (km)	8	11.5	13

The data suggest that Starlings were most common between Himatangi and the Oroua River (section 2) and least abundant near the coast (section 1). It seems likely that the coarser pastures of section 1 are less suitable to Starlings than is the farmland managed with increasing intensity away from the coast. However, it could have been that Starlings were more often obscured from view when feeding in the longer grass.

Magpies appeared to predominate near the coast and to decline inland, suggesting that they respond to the habitat in a way opposite to that for Starlings, and perhaps favour the coarser pastures. Harriers were also best represented nearest the coast.

Gulls appeared to be most numerous in section 3, due, no doubt, to the attraction provided for them by the freezing works at Longburn. Both species of *Turdus* were seen decidedly more often in section 3 than elsewhere, perhaps an indication that the habitat away from the strong coastal winds and drought-prone sand-country soils is for them more suitable.

Pukeko seemed most abundant in section 3, but in fact were restricted to two points at which the road cut across suitable marshy habitat; a few were seen in section 1 at grid reference 815255 (NZMS 1 N148), and they were commonly seen at a drain near the Oroua River (NZMS 1 N148 958267) in section 3. Other species were seen more uniformly along the transect.

CONCLUSION

Counting birds from a car is a useful and simple technique by which an ornithologist travelling regularly between two locations may quantify the incidence of various birds in different seasons and habitats. Interesting comparisons might emerge from similar work in other regions.

ACKNOWLEDGEMENTS

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SOME OBSERVATIONS ON THE WINTER DISTRIBUTION OF THE NEW ZEALAND KINGFISHER

By C. JOHN RALPH and CAROL PEARSON RALPH

ABSTRACT

A census of kingfishers was taken between the Waikato district and the Canterbury Plains and linear density calculated by a new method. Kingfisher density declined progressively to the south, where birds were especially concentrated at lower elevations. They preferred open pasture habitat created by man. Contrary to established notions, the kingfisher may be at least partially migratory in New Zealand.

INTRODUCTION

The Sacred Kingfisher *(Halcyon sancta)* is widespread in the Australasian region. The various subspecies apparently differ in the patterns of seasonal distributions, some being migratory, others not. In this study we contribute to the knowledge of the species' habitat, winter movements, and range in New Zealand.

The Australian subspecies, *H. s. sancta* breeds throughout most of the wetter portions of the continent (Keast 1957). At least the southern populations migrate in the autumn to northern Australia, and as far north as Borneo, Sumatra, New Guinea, and the Solomon Islands (Stresemann 1914). A few individuals on the east coast winter as far south as Sydney (Hindwood & McGill 1958). Frith (1969) suggested that the entire Australian population may be migratory. Through colonization. the species has established additional subspecies to the east of Australia, one each on Norfolk Island, Lord Howe Island, New Caledonia, and the Loyalty Islands, as well as New Zealand and its offshore islands (Peters 1945). These subspecies are not thought to be migratory, although Guthrie-Smith (1910) and Oliver (1930) noted apparent altitudinal migration in the New Zealand subspecies *(H. s. vagans)*. Taylor (1966), in the Nelson region of the South Island, observed that at altitudes above 120 m birds were abundant only during the spring breeding season. Below 120 m, nearer the coast, he found birds in approximately equal numbers throughout the year. Stead (1932) even suggested that regular movements may take place between the North and South Islands, although he did not state the basis for this impression.

In New Zealand, the species has adapted with alacrity since the European discovery to man-made habitats such as pastures. As Taylor (1966) noted, it is easily censused because of its conspicuousness on exposed perches.

NOTORNIS 24: 82-93 (1977)

In this study we attempt to document the winter distribution of the New Zealand race over a broad latitudinal range, comparing its behaviour with that of other subspecies.

METHODS

Between 21 June and 12 July 1975 we surveyed the abundance of kingfishers in eleven geographic regions from the Waikato district in the North Island to Christchurch in the South Island (Fig. 1). We defined these regions by what we considered to be important geographical features. For our entire journey through these regions,

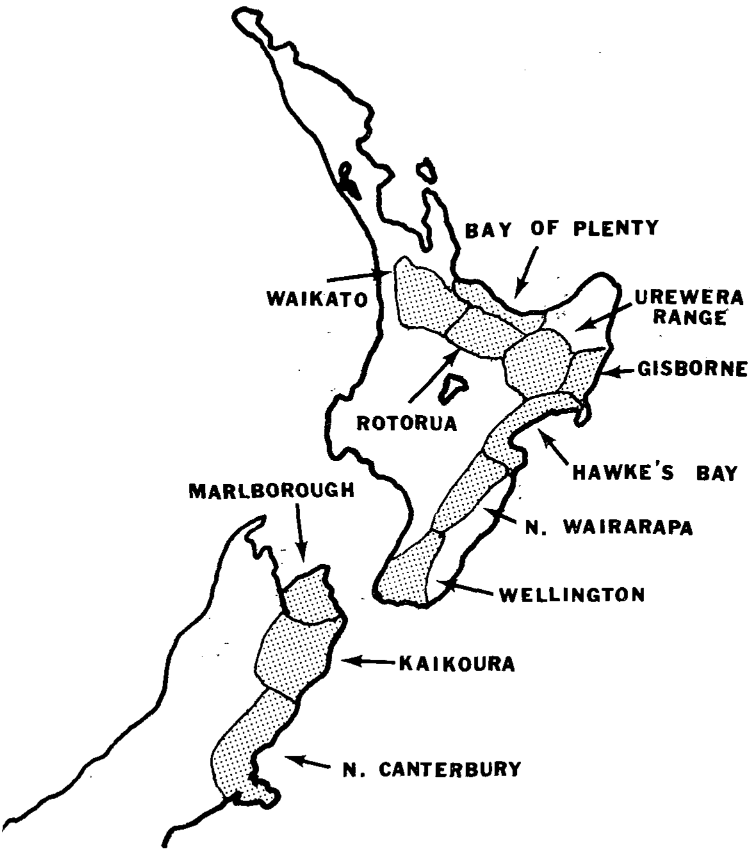

FIGURE 1 — Regions of census on North and South Islands.

covering 70 km on foot and 1932 km by automobile, we recorded the time spent, the kilometres covered, and our velocity in the various habitats. These habitat types were defined as:

Forest. 70-100% cover by woody vegetation taller than 3 m.

Shrub. 70-100% cover by woody vegetation less than 3 m tall.

Open Forest; Open Shrub. 30-70% cover by either trees or shrubs, the remainder usually pasture, occasionally marsh.

Sparse Forest; Sparse Shrub. 5-30% cover by either trees or shrubs.

Without Woody Vegetation. Less than 5% cover by woody vegetation. This was mostly dry pasture, occasionally wet pasture or marsh.

Coastal. Areas in close association with salt water.

Suburbs. Residential areas with much vegetation as well as buildings. Heavily urbanized areas were excluded from the survey.

The data recorded for each of the more than 300 perching kingfishers seen included habitat, perch site, and our speed of travel. Perch sites were classified as over or in trees or shrubs, over pasture or over open water.

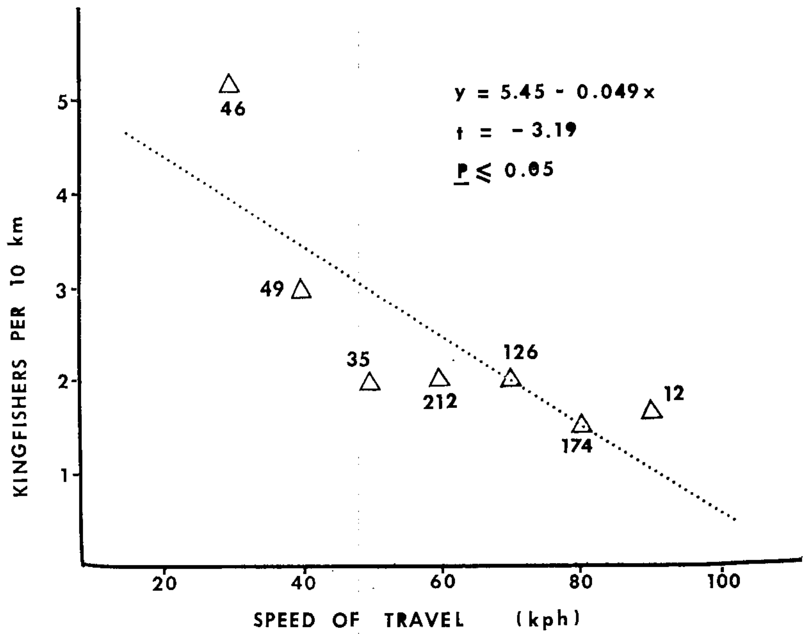

FIGURE 2 — Number of kingfishers observed per 10 km, Hawke's Bay and north. All observations are in areas containing some pasture. Number of km travelled at each speed is shown.

Since the number of kingfishers seen could depend on the speed of the observer, we devised a method to correct for observer speed. Using our data from the regions north of and including Hawke's Bay, we calculated a linear relationship between observer speed and number of kingfishers seen (Fig. 2). We limited this calculation to the northern regions to avoid confusion with geographic variations in abundance, and we excluded " Forest " and " Suburb " habitat types to avoid potential visibility problems in these habitats. Too few

Table 1 - Correction factor for number of kingfishers observed relative to the speed of travel

Speed (kph)	Correction factor
0	1.0000
2	1.0183
20	1.2193
30	1.3694
40	1.5617
50	1.8168
60	2.1715
70	2.6984
80	3.5628
90	5.2420

Table 2a - Number of kingfishers observed, Hawke's Bay and north of Hawke's Bay

Habitat types	Regions																				
	Waikato			Rotorua			Bay of Plenty			Urewera Range			Gisborne			Hawke's Bay			Total		
	No.1/	km2/	Cor.3/	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.
Forest				3	58	0.71				0	9	0.00	0	22	0.00	1	4	5.43	4	93	0.68
Shrub				3	11	3.98	4	34	2.55				1	2	17.81	1	1	0.00	8	48	3.46
Open forest	4	2	23.12	5	28	1.94				1	33	0.55	11	22	6.54	2	22	2.20	23	107	2.91
Open shrub	4	2	11.56	2	1	26.58				1	18	1.01	2	27	1.58	5	29	3.74	14	77	2.84
Sparse forest	3	25	1.30	2	18	1.35	3	2	15.27				65	109	11.81	29	99	6.63	102	253	8.03
Sparse shrub	1	1	18.17	8	6	17.14	16	56	6.70	9	33	5.95	12	32	8.45	0	4	0.00	46	132	7.30
No woody vegetation				3	2	21.50	14	13	22.59				12	15	21.59	5	10	10.85	34	40	19.23
Coastal							2	10	4.56							1	1	14.55	3	11	5.47
Suburbs	1	26	1.37				1	14	1.30				5	21	2.46	1	24	1.48	8	85	1.66
Total	13	56		26	124		40	129		11	93		108	250		44	194				
Corrected4/			2.78			2.71			6.59			2.50			8.62			5.12			
Not corrected4/			2.32			2.10			3.10			1.18			4.32			2.27			

1/ Number seen in each region/habitat type.

2/ Number of kilometres traveled in each region/habitat type.

3/ Number seen per 10 km, corrected for speed of travel (see text for details).

4/ #/10 km, not corrected for speed of travels.

Table 2b - Number of kingfishers observed, south of Hawke's Bay

Habitat types	Regions: N. Wairarapa			Wellington			Marlborough			Kaikoura			N. Canterbury			Total		
	No.1/	km 2/	Cor. 3/	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.
Forest				0	24	0.00	1	14	0.81	0	7	0.00				1	45	0.25
Shrub				0	27	0.00	1	4	4.13	0	20	0.00				1	51	0.32
Open forest	1	30	0.89	0	19	0.00	2	34	1.58	4	74	1.39	0	42	0.00	7	199	0.92
Open shrub				0	37	0.00	2	82	0.76	3	61	1.29	0	6	0.00	5	186	0.76
Sparse forest	7	132	0.38	2	38	1.35	2	49	1.10	1	115	0.31	5	117	0.74	17	451	0.62
Sparse shrub				0	4	0.00	1	8	3.37				0	3	0.00	1	15	1.80
No woody vegetation				0	1	0.00	10	67	5.32				2	49	0.44	12	117	3.23
Coastal				19	23	12.50	1	2	5.09	5	6	8.49				25	31	11.25
Suburbs	0	15	0.00	1	16	0.98	0	12	0.00	0	7	0.00	0	16	0.00	1	66	0.24
Total	8	177		22	189		20	272		13	290		7	233				
Corrected4/			0.43			1.88			2.17			0.92			0.46			
Not corrected4/			0.45			1.16			0.74			0.45			0.30			

1/ Number seen in each region/habitat type.

2/ Number of kilometres traveled in each region/habitat type.

3/ Number seen per 10 km, corrected for speed of travel (see text for details).

4/ #/10 km, not corrected for speed of travels.

observations were made below 25 kph to include them in this calculation. The number of kingfishers seen at 0 kph, found by extrapolating this line, is an estimate of the average number per 10 km for these habitats in these regions. More important for our calculations, the ratio of the value of the line at a particular speed to this value at 0 kph (the y-intercept), tells what fraction of the estimated actual population an observer sees at that speed. By multiplying our observed kingfisher densities by the inverse of this fraction (Table 1), we arrived at the estimated actual population, corrected for speed.

After correcting the observations for speed of travel, we summed them and divided by the distance travelled, giving the mean linear density of kingfishers for each habitat within each region (Table 2). Similarly, average densities for a given habitat (rows in Table 2) or region (columns in Table 2) were calculated by summing the speed-corrected numbers and dividing by the total distance travelled in that habitat or region.

Statistical tests were taken from Sokal & Rohlf (1969). They included the significance of linear correlation by the least squares method (p. 420 ff.), and of differences between proportions, using an arcsine transformation (p. 607 ff.).

RESULTS

Kingfisher densities declined as the latitude increased (Fig. 3). The highest densities were recorded in the Bay of Plenty, Gisborne and Hawke's Bay regions, and fewest in the Kaikoura and Canterbury Plains regions. A linear correlation of these data was significant ($P < 0.025$), although scattered ($r = 0.470$). A calculation without the correction for observer speed was similar in distribution and scatter ($r = 0.533$), and also significant ($P < 0.025$).

These data show the effect of altitude and distance from the coast. Waikato, Rotorua, Urewera Range, and N. Wairarapa are inland regions, partly above 200 m, and they fall below the regression line in Figure 3. The greatest concentration of kingfishers we encountered was 15 km inland from Gisborne at about 50 m elevation where, in one six km section of road, we sighted 35 kingfishers.

To incorporate Taylor's (1966) censuses from the Nelson area, we calculated his totals for altitudes above and below 120 m altitude and corrected these for speed (Table 3). His winter populations are slightly lower than our figures (Fig. 3), possibly because Taylor apparently observed alone. Note also the marked increase of kingfishers in the spring at higher elevations to levels we found during the winter only in the coastal areas of the North Island.

In general, we found the kingfishers preferred the more open habitats. By comparing the distribution of habitats available with the distribution of kingfishers among those habitats, we found that as the ground cover of woody vegetation increased, the number of

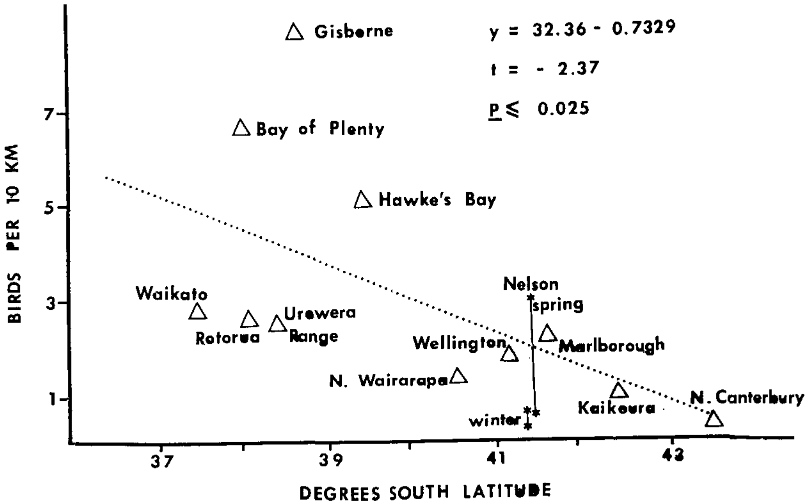

FIGURE 3 — Total number of kingfishers seen per 10 km in each geographical area plotted by latitude of centre of region. Taylor's (1966) data from Nelson are indicated by asterisks (*); the high elevation data from each season are above that of the low elevation observations.

kingfishers declined. The relative heights of the columns in Figure 4 show that this is most noticeable in the northern regions. This relation held for most habitat types whether the woody vegetation was trees or shrubs.

To determine if this decline was due to reduced visibility where trees were more abundant, we compared the kingfishers' perch sites in habitats having less than 5% trees with those having more than 5% trees. We found that, despite greater numbers of trees, impairing visibility, the percentage of birds we saw perched in trees, as opposed to more exposed (and visible) perches, differed by less than 3% (Table 4), not a significant difference ($P < 0.10$).

When data were combined for all habitats, the vast majority (89.8%) of birds were perched on fence posts and overhead wires. These sites were usually (94.0%) over areas clear of woody plants. This reflects the bird's visual, sit-and-wait hunting methods. South of Hawke's Bay 27.9% of the birds seen were perched over water, while to the north, far fewer (4.5%) used this habitat. This difference was very significant ($P < 0.001$).

DISCUSSION

We found most wintering kingfishers in one of two habitats. One was pastures, where the birds perched on fences or power and

Table 3 - Seasonal distribution of kingfishers in the Nelson region (recalculated from Taylor 1966)

Altitude		May-July	Sept-Nov
0 - 120 m	km traveled	458	631
	Number observed	14	15
	Corrected #/10 km *	0.66	0.52
120 - 460 m	km traveled	946	1366
	Number observed	14	151
	Corrected #/10 km *	0.34	3.10

* Data were corrected for speed of observer using an average speed of 60 kph.

Table 4 - Type of perch site of kingfishers and percent ( ) of total

	On trees	Isolated perches	Total
Habitat with less than 5% trees	13 (8.8)	135 (91.2)	148 (100.0)
Habitat with greater than 5% trees	18 (11.6)	137 (88.4)	155 (100.0)
Total	31 (10.2)	272 (89.8)	303 (100.0)

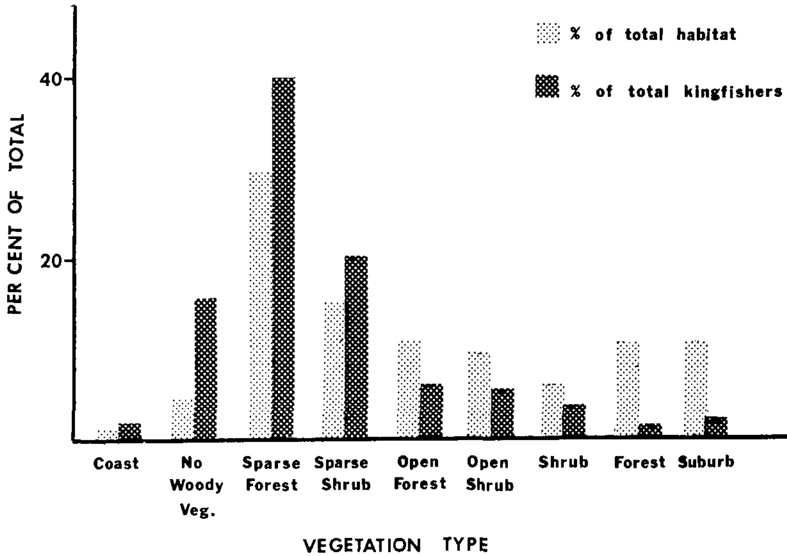

FIGURE 4 a — Comparison of percent available habitat and percent utilization by kingfishers, Hawke's Bay and north. Percent of total kingfishers data are corrected for speed.

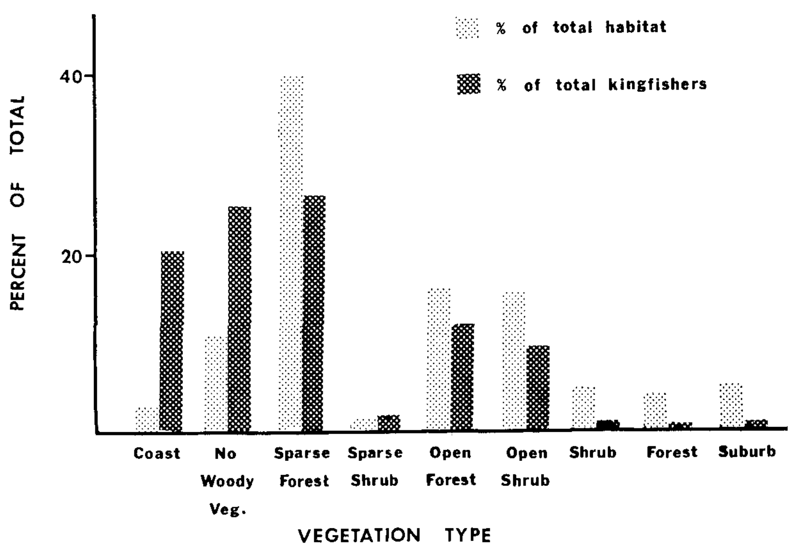

FIGURE 4 b — Comparison of percent available habitat and percent utilization by kingfishers, south of Hawke's Bay. Percent of total kingfishers data are corrected for speed.

telephone lines. Undoubtedly, kingfisher populations have benefited greatly from man's clearing the forests and erecting these structures. The second important habitat, especially in the south, was the coastal area. Hindwood & McGill (1958) noted the kingfisher's dependency on open water in Australia, where the few birds remaining near Sydney in winter were ". . . generally in mangroves . . . though at times they are also to be seen about the borders of tree-lined lagoons." Coastal regions may be preferred because of the more reliable food supply associated with open, shallow water, the more moderate climate, or both.

Sacred Kingfishers rarely winter as far south in Australia as they do in New Zealand. Confirming this, we encountered none in over 1000 km traversed between Sydney and Melbourne, 12-18 July 1975, including extensive field observations near Yarrawonga on the Murray River. The generally maritime climate of New Zealand may be enough milder than the Australian winter at similar latitudes to allow kingfishers to winter much farther south. On the other hand, the persistence of even reduced numbers of wintering kingfishers at higher altitudes in New Zealand, such as Taylor (1966) found above Nelson, suggests the New Zealand race may be hardier.

Hardy or not, the kingfisher can perform major movements between wintering and breeding grounds. In Australia this is a clear north-south migration. In New Zealand Taylor (1966) documented an altitudinal shift in population distribution. Although he did not mention it, his data also suggest a north-south movement of birds. While his low altitude population remains at 14-15 birds per 10 km through both seasons, the high altitude population increases tenfold in the summer. It is unlikely that all these incoming birds came from the nearby lowlands. They may have come from more northern centres of winter populations, such as we found in northern North Island.

It is interesting to speculate if Lesson (1826) had this in mind when he described the kingfisher in New Zealand as the Wandering Kingfisher (Fr: martin-pecheur errant) and gave it the specific name *vagans*.

ACKNOWLEDGMENTS

We are grateful to many poeple who made our field work in New Zealand an educational and enjoyable experience, especially P. C. Bull, D. Flack, J. A. Gibb, D. Horning and A. H. Whitaker. The majority of the analysis of the data contained in this paper was done while the senior author was on the faculty of Dickinson College, Carlisle, Pennsylvania. The paper benefited greatly from comments on it by B. M. Fitzgerald, J. A. Gibb and J. M. Scott.

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THE VANUA LEVU SILKTAIL (*Lamprolia victoriae kleinschmidti*): A PRELIMINARY LOOK AT ITS STATUS AND HABITS

By BARRIE D. HEATHER

ABSTRACT

This paper aims to bring together what is known of the Silktail *(Lamprolia)* of Fiji, in order to provide a base line for future study and particularly in order to consider the status of the little-known *L. v. kleinschmidti* of Vanua Levu.

The contribution of previous workers, especially Theodor Kleinschmidt, is examined which, together with recent work, strongly suggests that *L. v. kleinschmidti* is confined to the Natewa Peninsula of eastern Vanua Levu.

What little is known of *L. v. kleinschmidti* in the field is presented, largely by comparison with the better-known *L. v. victoriae* of Taveuni. Based largely on field observations by 1973 and 1975 parties of OSNZ members and other available material, particular attention is given to population strength, feeding, display, breeding and voice.

Discussion, largely speculative, considers the possible relationship of *Lamprolia* to the Paradisaeidae, and considers the implications of the distribution of the two forms. *L. v. kleinschmidti* seems more likely to be the relict population, from which *L. v. victoriae* has been recently derived.

INTRODUCTION

Lamprolia, the Silktail of Fiji, is as much a subject of taxonomic interest today as it was when first discovered in 1873. It has been lumped in with various groups from time to time, often more from convenience than conviction, but seems likely to remain of " uncertain family " and " one of the most puzzling birds of the world " (Mayr 1945). It may best be regarded as an isolated relict of a previous south-west Pacific avifauna, in a category similar to the wrens (Xenicidae), wattle-birds (Callaeatidae) and thrushes (Turnagridae) of New Zealand and to the even older Kagu *(Rhynochetos jubatus)* of New Caledonia. In the field one cannot fail to be impressed by its distinctiveness of manner and appearance and to be sceptical of its supposed relationship to warblers, chats, fairy wrens, babblers and so on.

The history of taxonomic argument over *Lamprolia* — a " record of scant information and voluminous conjecture " — has been admirably reviewed by Cottrell (1966). He also recounts his own brief experience

FIGURE 1 — Adult *L. v. victoriae*, Vunivasa, Taveuni, from colour slide by M. D. Dennison. Spangled head and wing coverts are partly visible. Note small size, shape of wing and tail, tail-rump pattern.

with *Lamprolia* on Taveuni and with Birds of Paradise and Riflebirds (Paradisaeidae) in New Guinea and Queensland and his positive feeling that there is some link between them. This feeling, which has been echoed from time to time in the literature, is easily shared when one sees *Lamprolia* in the field and alive in the hand.

Lamprolia has been described formally by Finsch (1873, 1876), Ramsay (1876), Sharpe (1883: 31-32) and less formally by Cottrell. It is a small (c. 13cm), insectivorous bird with long rounded wings and short rounded tail. The sexes are alike and the breeding is apparently monogamous. In the dim light of the forest it appears jet black with conspicuous white rump and tail, the tail bordered and tipped black. Its build, stance and feeding mannerisms are reminiscent of the Riflebirds *(Ptiloris)* of Queensland (Wood & Wetmore 1926, Cottrell 1966, Blackburn 1971). Its plumage is distinctly paradiseine. In sunlight or in the hand, the plumage is a shining velvety black glossed with purple in many areas. The rump and tail are a gleaming white, with the sheen and feel of silk, the tail feathers having a singularly loose structure. The black feathers of head, neck, throat, breast and wing coverts are scale-like, with tips of shining metallic blue, shifting to green or purple in some lights. As Finsch (1873: 734) first pointed out, similar feathers occur on the Birds of Paradise *Ptiloris* and *Manucodia,* to which Cottrell adds *Phonygammus* and *Paradigalla.* It is tempting to speculate that *Lamprolia* could be a relict of a primitive, unspecialised paradiseine avifauna.

Despite its antiquity *Lamprolia* has only two forms which, when one considers that insular divergence is a striking feature of Fijian birds, are remarkably alike and have therefore only recently diverged. *L. victoriae victoriae* Finsch occurs on Taveuni and *L. v. kleinschmidti* Ramsay occurs on the much larger neighbouring Vanua Levu (see Fig. 2). For a general map of the Fiji Islands, see Blackburn (1971). Taveuni has been more accessible than Vanua Levu from the old capital Levuka, on Ovalau and, since 1883, the present capital Suva, on Viti Levu and, although successive ornithologists have seen *L. v. victoriae,* little of value has been recorded about it. It still flourishes, however, in the extensive though steadily diminishing forest of Taveuni. *L. v. kleinschmidti* is almost one third smaller and has a narrower black tip to the tail. Nothing has been known about it beyond a few museum skins, a vague reputation for being hard to find and a tacit assumption that it occurs throughout Vanua Levu.

In early September 1973 a New Zealand ornithological party, after a week on Taveuni, spent a week near the extreme tip of the Natewa or Cakaudrove Peninsula on Vanua Levu. The choice of site was fortuitous, because of the generous offer of Dr Doug and Jean Corey to stay on their Kubulau estate (see Fig. 3). In the forest that is part of their estate *kleinschmidti* was quite readily found and some evident behavioural differences from *victoriae* were noted. No special study was made since it was assumed that its presence was typical of the whole island.

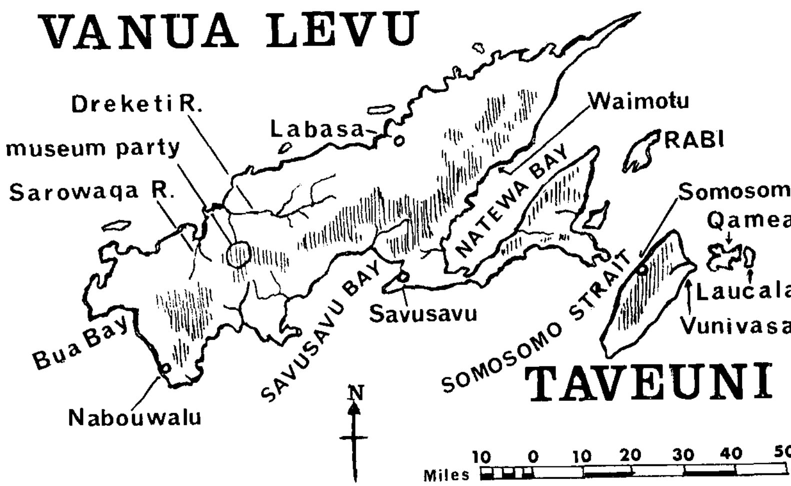

FIGURE 2

However in June/July 1974 a combined Fiji Museum-National Museum of NZ party collecting in the west-central high country of Vanua Levu found no Silktails, even though the habitat would have suited Taveuni birds (F. C. Kinsky & F. Clunie, pers. comm.). A party from New Zealand being organised for August/September 1975 therefore chose an intermediate site on the west coast of Natewa Bay directly opposite the Natewa Peninsula. Here a week was spent based on the Vunigarani estate of Mr David Browne and the adjoining Waimotu estate of Mrs Martha Smith (see Fig. 2). It was planned to study the Silktail closely before proceeding to Taveuni to begin a comparative study. There were no Silktails. Moreover, according to Mr Robin Mercer (pers. comm.) they are not known from the remaining forest at the base of the Natewa Peninsula, nor has he seen them from the track to Labasa from the Natewa Bay coast north of Tabia River. It seems likely, therefore, that the distribution of *kleinschmidti* is very restricted and may well be confined to the Natewa Peninsula.

A brief three days were spent back at Kubulau, which allowed some of the party to accumulate enough notes on *kleinschmidti* to make a first comparison with *victoriae* the following week on the Vunivasa estate of Colonel and Mrs Kolb, on the wet north-east side of Taveuni.

A general report on the 1973 and 1975 parties is in preparation.

Not wishing to neglect earlier work, I have looked into the history of collecting on Vanua Levu, hoping to discover exact localities where collectors have found *kleinschmidti* and where they have not, and to bring together what is known of *Lamprolia* in general. The results, despite considerable research, are meagre but interesting. Some indirect information may remain to be gleaned from labels and archives in museums but, short of finding the lost field notes of Kleinschmidt for 1875, little of substance can be expected.

As the forests of Fiji are being extensively modified or removed and as there has been little local interest since the first flush of collecting a century ago, *Lamprolia* deserves urgent study, with as a first priority the distribution and habitat tolerances of *kleinschmidti*. This paper aims to bring together what little is known of *Lamprolia* up to the present, and to suggest hypotheses, in order to provide a starting point for further studies.

PAST COLLECTORS ON VANUA LEVU

TITIAN R. PEALE

Peale, the first naturalist in Vanua Levu, was artist and zoologist with the U.S. Exploring Expedition of 1832-42. Although the expedition surveyed the coastline of Vanua Levu in 1840, the reputation of the Fijians was such that the explorers rarely ventured ashore, certainly not far inland except in the north-west where the Fijians were more tolerant because of the sandalwood and beche-de-mer trade. It appears that Peale scarcely stepped off the ship for, in the narrative, only once is Peale mentioned (Wilkes 1845: 215) as returning from a " jaunt " inland from Sandalwood Bay (Bua Bay on modern maps). His field notes (Cassin 1858) suggest that he collected in safe, open country, collecting such open-country species as the Grey-backed White-eye *(Zosterops lateralis)* and the Red-headed Parrot Finch *(Erythrura cyanovirens)*.

Dr EDUARD GRAFFE

The first in Fiji of the explorers and scientific collectors appointed to the south-west Pacific by the Hamburg trading firm of Johann Cesar Godeffroy. Graffe collected in Ovalau and Viti Levu but the nine species listed by Finsch & Hartlaub (1867) from Vanua Levu refer to Peale's skins. Graffe worked also in Samoa, Tonga, the Wallis and Phoenix Islands.

THE *" CHALLENGER "* EXPEDITION

H.M.S. *Challenger,* during its 1873-76 voyage of deep-sea exploration, visited Fiji briefly in 1875 but before *kleinschmidti* had been discovered. It was at Matuko, east of Kadavu on 24 July, Kadavu on 25 July and Levuka from 28 July to 1 August: 82 birds were collected and are described in the Report (Finsch 1881). Finsch was travelling himself in the Pacific between 1879 and 1882 but I have found nothing to suggest he visited Fiji.

EDGAR LAYARD

Layard brought to Fiji an enthusiasm for birds beyond that of a mere collector and he provided the only published field notes of merit from the period. During 1874 and 1875 he was British Consul and, after Fiji was ceded to the Crown, administrator of the government, resident in Levuka, tied to a routine of administration and official visits round the islands, with little opportunity or physical strength to explore or collect himself. He had to rely mainly on the collecting and observations of others, including his butler on Ovalau, Storck and Abbott on the Rewa River, Viti Levu, Liardet on Taveuni, Holmes, Swayne and Tempest on Vanua Levu and his son Leopold on the Rewa River, on Taveuni and Vanua Levu. He did manage some collecting time on Wakaya and also on Kadavu at the time the *Challenger* was there and, when the first resident Governor took over from him late in 1875, six weeks at Gila in northern Taveuni where he collected many specimens of *victoriae* now in museums around the world.

He did not visit Vanua Levu or see *kleinschmidti* alive himself but received several skins in exchange from Kleinschmidt. In Levuka his relationship with Kleinschmidt developed from " Mr Kleinsmidt [sic], a gentleman in Levuka much addicted to natural history " (1875a) to " my friend Kleinschmidt " (1878), with whom he exchanged skins and ornithological gossip.

The first hint of the existence of *kleinschmidti* came from Layard on Taveuni (1876a: 148) — " a gentleman, on whose observations I do not place much confidence, has assured my son that he has seen it [= *Lamprolia*] on the neighbouring islands [sic] of Vanua Levu." Its discovery was announced as a hasty insertion in his next paper (1876b: 154-5) that " Mr Klinesmith has just discovered a new *Lamprolia* near Savu-Savu Bay, on Vanua Levu, which resembles *L. victoriae* but is about a third smaller, and the head is entirely covered with the brilliant blue feathers. He has named it *L. minor*." " Near Savu-Savu Bay " (see Fig. 2), therefore, has become the type locality but it is so vague that we learn little of where Kleinschmidt had been, except that it was somewhere on the long southern side of the island. Layard was not familiar with the southern side and may have thought this prominent bay sufficient to indicate the area of collection. The two Layard skins in the British Museum, the only ones I know of, have on their labels merely ' Savu Savu. Kleinsmith Co.' [= collector]. When Kleinschmidt visited the hot springs on the site of the present township of Savu Savu in May 1876 (Kleinschmidt 1879), it was clearly his first visit there and six months later than his only collection of *kleinschmidti* in November 1875, and in the meantime he had been elsewhere — certainly on Leluvia, near Ovalau on 12 March (Anon, 1876: 165) and on Viti Levu on 21-27 March (Anon. 1876:166; Nehrkorn 1879: 399). Therefore Savu Savu on Layard's labels cannot be considered a precise locality.

In his last paper from Fiji (1876c), Layard gave a summary table of all species collected in Fiji and an explanatory note on where collecting had been done. On Vanua Levu his knowledge was limited to the western end around Bua Bay where Holmes, Swayne and Tempest as well as Leopold Layard had collected for him. The species concerned show that true forest had been included. Leopold had " spent a month at the eastern end of the island," which may vaguely mean somewhere between Labasa and Natewa Bay but I can find no further reference. Kleinschmidt had " worked the southern side," and if this was as thorough as it sounds (and Kleinschmidt was a thorough explorer), it is interesting that the Silktail had been found once only. It is implied (p. 387) that the interior of Vanua Levu had not been worked, which could suggest that Kleinschmidt had not been into the high country behind Savu Savu Bay.

THEODOR KLEINSCHMIDT

Kleinschmidt, whose name gave Layard so much spelling trouble, would be the dominant figure of Fijian ornithology and prominent in ethnology were his notes, reports and letters not lost to us. From 1873 to 1878 he travelled widely in Fiji, avidly collecting, sketching and painting, noting, sending his collections of birds, insects and ethnological material mainly to the Godeffroy Museum in Hamburg. His tragic death in 1881 before he could bring together his material for publication, the financial collapse of J. C. Godeffroy & Son in 1881, followed by the auctioning of the contents of the Godeffroy Museum in 1885 meant that much of his collections was dispersed and his writings lost. Consequently his work has remained almost completely forgotten, although it seems that interest is reviving (Tischner 1961). There is no direct material left in the Kleinschmidt family archives (Dr A. Kleinschmidt, pers. comm.).

Kleinschmidt was a naturalist of the old style, largely self-taught, combining a sound wide knowledge of natural history, artistic talent and an understanding of correct collecting techniques. His life and qualities have been reviewed by Schmeltz (1881) and Tischner (1961). After boyhood in Kassel, Germany, and a period at sea, he spent twelve years in St. Louis, USA, where his fortunes fluctuated in a series of business ventures. He came to Fiji via Melbourne in 1873 at the age of 39 but his fortunes in Levuka did not prosper in the economic conditions there. To his delight he was in 1875 offered a post as explorer-collector (Reisende, Naturforscher und Sammler) for the Godeffroy Museum. He worked enthusiastically in Fiji until late 1878 when he moved to islands off the Rabaul coast of New Britain. Here he was murdered by islanders two years later in reprisal for the bad manners of an Englishman in a land claim. This was reported with strong pro-European bias in *The Fiji Times* of 27 August 1881.

Kleinschmidt must have started exploring very soon after his arrival, for in his first year he discovered *Lamprolia* on Taveuni and sent two skins to Finsch, who described, named and published the genus and the species *victoriae* the same year (Finsch 1873). J. G. Keuleman's beautiful woodcut does not show the true body shape and stance of the bird. Finsch's type specimen still exists in the Hamburg Zoological Museum (W. Meise, pers. comm.), although a little damaged — the museum was badly bombed in 1943.

We do not know how often or exactly where Kleinschmidt went to southern Vanua Levu, except for his visit to the Savu Savu hot springs. It seems that he collected *kleinschmidti* only once, on the occasion when he discovered it. The first mention of his discovery was by Layard who gave the vague locality of " near Savu-Savu Bay " and whose two exchange skins add nothing. A skin must have been sent to or at least seen by E. Pierson Ramsay in Sydney for he gave the first formal description of it, with the locality " Vanua Levu," and named it *L. klinesmithi* (Ramsay 1876). This skin seems to have been part of the Macleay collection but is not in the Macleay Museum, Sydney, today even though two of Layard's *victoriae* skins are (G. Phipps, pers. comm.).

Ramsay's publication preceded Layard's by several months, even though Layard had written his first, so that Kleinschmidt's appropriate choice of name, *minor*, although used by taxonomists until 1930, has been superseded by *klinesmithi*. I prefer to follow Mayr (1945) by using the more desirable spelling *kleinschmidti*. Ramsay's habitat summary, " confined to the mountains, in scrubs," is absurd but he does quote remarks by Kleinschmidt that they " live in the interior part of the country, and only in certain spots in the high but damp ranges; in dry and rocky parts they are not seen at all," and that " they are scarce and extremely hard to find." This could refer to high country behind Savu Savu Bay or on the Natewa Peninsula.

This habitat description is echoed by Kleinschmidt in his note that accompanied his first three skins to the Godeffroy Museum (Finsch 1876). " The bird is not quite as brilliant as the large one but is nevertheless a most elegant creature which lives in the deepest bush, in damper places, seems in general to keep to its chosen area (sein Revier) for in the same forest it does not occur at all in other equally high but dry places only two or three miles from its area." He then gives the only behaviour note we have until 1973: " It hovers, like a *Myzomela* honeyeater or a humming-bird around the numerous lianas that creep up the tall trunks, seems to snap up certain insects there, then settles for an instant on a thin twig in the undergrowth." The bird so delights him that he can scarcely bear to shoot it. " The natives call it ' sassa.' Although I offered every reward, I could not get an egg from them since the bird and thus its nest are rare."

Finsch, commenting on these three specimens, will not accept that they deserve specific rank and thus foreshadows the modern view that, based on morphology, the two Silktails are subspecies. His comment begins: " The last consignment includes three further specimens from Somosomo on Taveuni," which, were Vanua Levu not mentioned in his table, could suggest that Finsch thought they had been collected on Taveuni. That others may have believed this is shown by Richmond, former Associate Curator of Birds, U.S. National Museum (undated): " Finsch says it occurs on the coast of Somo Somo Strait, on Vanua Levu; not from Somo Somo on Taveuni." The source of this remark is probably the *Kleine Mittheilungen* (Anon. 1876), which appears not to be written by Finsch, in his absence in Siberia, and includes comments from Hartlaub and extracts from Kleinschmidt's letters. The text says: " Up to now found by Mr Kleinschmidt only on the coast of Somo Somo Strait on Vanua Levu, not at Somo Somo on Taveuni, as wrongly printed on p. 6 above."

It is therefore clear that Kleinschmidt found the Silktail somewhere on the east side of Natewa Peninsula, a locality that accords with recent findings.

Existing Kleinschmidt skins provide no help on where he collected them although they tell us when. Apart from Layard's two, I know of four skins from the Godeffroy Museum and there are probably others in other European museums. Two in the Hamburg Zoological Museum have no information on their labels; one in the British Museum has " Van. Lev. Mitt. Nov. 75 " [= mid November 1875]; one in the Merseyside County Museums, Liverpool and one in the American Museum of Natural History have Vanua Levu and Nov. 1875. One in the Museum Heineanum, Halberstadt, is wrongly labelled " Kadavu " and is of obscure origin since it has a Finsch label and has been through the hands of a dealer, Dr Eugen Rey, who was in business in Leipzig between 1874 and 1890 (K. Handtke, pers. comm.).

The type status of the various skins has still to be decided.

A further lead to Kleinschmidt's locality comes from Tischner (1961: 671, Plate I). In one of three folders of Kleinschmidt drawings and handscript dating from late 1876 onwards, found in the Hamburg Ethnological Museum, is a drawing of the tatooing on a Fijian woman. On the drawing Kleinschmidt has written the locality " Cakaudrove, Vanua Levu " and the date " October 1875." This is just before he collected *kleinschmidti* in mid November. Cakaudrove was the tribal area encompassing the shores of Natewa Bay, Savu Savu Bay, Natewa Peninsula, Rabi, Kioa and Taveuni. The headquarters was and still is Somosomo on Taveuni.

Kleinschmidt seems to have travelled to and from from Somosomo during and after November for, after his collection of *kleinschmidti* in mid November, we know he found a pair of *Petroica* on Taveuni on 21 November and his first Orange Dove nest on 28 November on Kioa Island (Anon. 1876: 166-7; 172). There was an egg of Peale's Pigeon in the Godeffroy Museum with the note " Somo-Somo Straits, part of Vanua Levu, end November 1875 (Nehrkorn 1879) and there is mention, without date, of a Pacific Swallow nest found " on the cliff coast of Vanua Levu . . . near Kioa I " (Anon. 1876: 166). Finally, there were December skins of Fiji Shrikebill from Taveuni (Anon. 1876: 170).

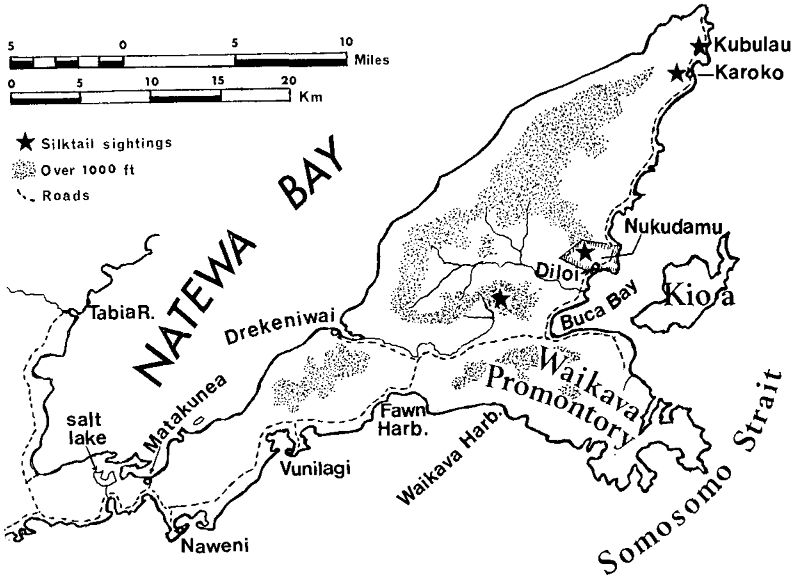

FIGURE 3 — Natewa Peninsula.

There is little doubt that *kleinschmidti* was found in mid November 1875 in the high country of Natewa Peninsula, within range of Taveuni and Kioa, that is in the Buca Bay area. This locality falls within the area of recent sightings.

CASEY A. WOOD

Wood was in Fiji during 1923 and 1924 (Wood & Wetmore 1925, 1926) and made an extensive collection of 259 skins which were commented on by Dr Alexander Wetmore and are still housed in the National Museum of Natural History, Smithsonian Institution (George E. Watson, pers. comm.). He did not visit Vanua Levu himself but was helped by the artist W. J. Belcher and by the government architect in Suva, A. H. Martin and his son Gordon, who made collections and sketches on the north side around Labasa (30 Sept), around the Dreketi and Sarawoga Rivers (2-3 Oct) and Nabouwalu in the south-west corner (4 Oct). Some forest species were collected which could, however, have been taken from forest margins. Four *victoriae* skins were collected on Taveuni by the Martins on 19-23 November 1923; two males (one immature) and two females, according to Wood. Dr George E. Watson (pers. comm.) describes them as one male and one female immature, one female sub-adult and one male adult.

ROLLO BECK and JOSE CORREIA

The Whitney South Sea Expedition of the American Museum of Natural History was working the islands and islets around Vanua

Levu in December 1924. Beck and Correia were the collectors and chanced to land on Vanua Levu once. Their unpublished journals are held by the museum in typescript.

After sailing up the eastern side of Taveuni in November, landing briefly opposite Qamea with little collecting success, they went to Qamea and then in a sweep to the islets north and north-west of Taveuni and back down to Rabi and Kioa. On 7 December, a Sunday, the ship " crossed the channel " from Kioa to " the small harbour of the mainland, Vanua Levu " (Correia: 194), " three miles to Vanua Levu side of the strait " (Beck: 108) where they rested for the day. On 8 December 1924, according to Correia who stayed aboard with a swollen foot, Beck went ashore with one of the crew from 6.30 a.m. to 4.30 p.m. " One new species of flycatcher was found on this island " (Correia). " Went ashore at the place of Mr Fisher who owns Kioa Island and a large plantation here on Vanua Levu. Found the little black flycatchers scarce " (Beck). There are no field notes. Five *L. v. kleinschmidti,* including an immature, were collected by Beck and are in the American Museum of Natural History (LeCroy pers. comm.).

The following day they left Vanua Levu for the Yanuca group and from 11-18 December were on Taveuni where Correia noted the contrast: " The small black bird which we first saw on Vanua Levu was very common on Taviuni " (Correia: 196).

The office of the Registrar of Titles, Suva, has informed me that the property of William Fisher was the Nukudamu Estate of 2078 acres (831 ha.). Nukudamu extends from the coast, where it encloses the settlement of Diloi, inland to include a major spur from the main range of Natewa Peninsula, with Koroitakala (1504'; 458.5m) its highest point (see Fig. 3). If forest is still on the property the Silktail is probably there also, as Nukudamu is between the two localities where the Silktail was found in 1973.

FIELD OBSERVATIONS

No apology is made for the rather casual nature of these observations. In both 1973 and 1975 the parties were on ornithological holiday, at their own expense, and there was plenty to do without an intensive study programme. Nevertheless, enough material has accumulated for a start to be made, although it is conceded that it is risky to generalise or draw conclusions about Fijian birds from brief encounters.

Notes on the Silktail have been contributed by: (a) 1973 party: Mrs B. Brown, P. Child, B. D. Heather, Mrs S. M. Reed, R. B. Sibson, C. Smuts-Kennedy; (b) 1975 party: Mrs B. Brown, W. F. Cash, P. Child, M. D. Dennison, B. D. Heather, Miss C. M. Heather, P. Latham, G. A. Woodward.

POPULATION STRENGTH

Taveuni: It is generally agreed that *L. v. victoriae* has a strong population wherever forest remains.

On the western slopes the forest has been cleared up to about 1500′ (457m) and one must camp at this height to be among a natural balance of forest birds. Coconut plantations extend about half way up from the coast, with grassed clearings above, relieved only by isolated trees or cattle-trampled remnants of forest in the gullies. The 1973 party was camped at about 1500′ (457m) above the Waitevala Estate of Burns Philp at Waiyevo, 4km south of Somosomo (see Fig. 2). This was several ridges north of the two sites used by the 1970 parties (Blackburn 1971).

In the forest about the camp the Silktail was readily found wherever one went, in groups of from two to five. They were seen at times even in patches of scrub on partially cleared land, but only in patches continuous with the forest. During two trips to the summit ridge, PC and CS-K saw Silktail throughout, right to the crater lake at 3000′ (915m). F. Clunie (pers. comm.) has also found them high on the upper ridges. Moreover he found the Silktail common in forest, since cleared, some 200m a.s.l. above Tutu, near Waiyevo, so that there is no doubt that the Silktail formerly existed as low down on the western side as rainforest extended.

On the eastern slopes, which are very steep, wet and difficult of access, the forest extends unmodified to the shore, except for the gentler slopes of the northern and southern ends of the island which have been cleared. The 1975 party was camped near the coast on Vunivasa Estate (see Fig. 2), which extends from the shore at Vurevure Bay and its northern headland, back to the steep gorge of the Waibula River. This estate has been cleared completely except for one ridge of partly modified forest, with vine-covered scrub in the gullies. This ridge held a thriving Silktail population. Groups of from two to five were frequent and were seen at times even in low scrub where the vegetation ended at 100m a.s.l. It can be expected that the Silktail occurs in wet eastern forest where it still extends to sea level but this difficult area has yet to be studied.

Vanua Levu: By contrast, both the 1973 and 1975 parties found *L. v. kleinschmidti* at Kubulau (see Fig. 3) thinly distributed, and only in the unmodified forest. The remnant of forest on the Kubulau property, dominated by Fiji kauri *(Agathis vitiensis)* and casuarina *(Casuarina nodiflora)*, held two, perhaps three pairs of Silktails which ranged widely in the area. This forest extends almost to sea level but the final 100m, which is cut off by the road, is too dry for most forest species.

Two other ridges a little south of Kubulau, behind and south of the village of Karoko (see Fig. 3), were visited briefly by PC in 1975. *Agathis* was not present but he saw three pairs of Silktails, one with a juvenile, on one ridge and one pair on the other.

A one-day visit was made in 1973 by PC, BDH and J. Brown to a cut-over but regenerating forest at about 1000′ (305m) about 9km inland from the road junction in Buca Bay (see Fig. 3). Much time was taken getting there and an extensive search was impossible but, although much of the forest was dry, one Silktail was seen in a damp gully near the top of the ridge. Mr Robin Mercer (pers. comm.) saw one bird in the same general area, known as Navonu, in 1972. This is the only *kleinschmidti* he has seen. He has not seen it in the Drekeniwai area.

Study is needed to show whether *kleinschmidti* tolerates selective milling enough to survive until damp forest has regenerated. Study is also needed over a much wider area of Natewa Peninsula to show if the density of *kleinschmidti* is always as low as it is reputed to be and why. Habitat use and habitat tolerances different from those of *L. v. victoriae* may be involved.

FEEDING

Both parties were impressed by the difference between the two Silktails in their levels of feeding in the forest.

Leopold Layard reported that *victoriae* was a bird mainly of the lower understorey. " It creeps about in the low growth of the thick saplings and among the pendant thin lianas and vines in the very thick forest. . . Occasionally they descend to the ground and peck among the fallen leaves. . . He only saw one upon a tall tree " (Layard 1875b). His father added later (1876a) that " it rarely, if ever, ascends trees of any altitude, always keeping to the undergrowth." Kleinschmidt (Anon, 1876) wrote that " the bird lives in the undergrowth of the tall, wet luxuriant forests of Taviuni, seldom higher than 20 to 30 feet from the ground. It even seems to go often to the ground. . ."

Our own impression of *victoriae,* particularly its use of the ground, was neatly expressed by Blackburn (1971): " It is a bird of the fairly open understorey, and not seen higher than about 20 feet, but more often on the ground, or within a few feet of it."

On Vanua Levu, by contrast, *kleinschmidti* consistently fed higher, coming to ground rarely and briefly, despite ample litter. As our comparison was made with only the few birds available at Kubulau, the difference may only be a local one, because of habitat differences. However, until a wider study of *kleinschmidti* can be made, the difference is given tentatively.

To help sort out the habitat niches of the two Silktails, a modified version of Atkinson's feeding levels and stations was tried out (Atkinson 1966). The method is appropriate as by temperament the birds are disturbed by only the most clumsy of observers, and as the birds remain below the top canopy and thus can be followed without bias toward lower stations. It is recommended that the method be continued in future studies. The results are given tentatively until a wider range of individuals in a wider range of habitats can be recorded.

FEEDING LEVELS

A comparison of the levels of forest being used by the two Silktails at the time of our visit is shown in Table 1. Despite the small sample, the difference we were aware of is clearly shown. Whereas 77.2% of observations of *victoriae* were at lower understorey or ground level, 87.2% of observations of *kleinschmidti* were at upper understorey level. The table is compiled from notes kept by WFC, MDD, BDH, PL and GAW.

TABLE 1 COMPARISON OF SILKTAIL FEEDING LEVELS SEPTEMBER 1975

FEEDING LEVELS	No. of observations		% of total no.	
	TAVEUNI	VANUA LEVU	TAVEUNI	VANUA LEVU
Canopy	0	5	0	3.6
Upper understorey	29	123	22.8	87.2
Lower understorey	41	12	32.3	8.5
Ground storey	57	1	44.9	0.7
Total	127	141	100	100

That *victoriae* also can use the upper understorey is shown by an individual seen on a part of the Vunivasa ridge where sub-storeys had been cleared and the bird moved frequently between the ground and the upper understorey. F. Clunie (pers. comm.) has seen *victoriae* in an area where the ground was barren, covered with scoriaceous rock, feeding in the upper understorey on vines and dead leaves; on normal ground nearby, more typical feeding methods were in progress. High level feeding of *victoriae*, however, seems to be unusual, whereas at Kubulau *kleinschmidti* fed high even though the ground was far from barren.

FEEDING STATIONS

The feeding stations grouped from all levels are compared in Table 2. Both Silktails gave a high proportion of attention to gleaning through dead leaves, whether attached to vines or shrubs, or accumulated in forks from above. Whereas *victoriae* also moved frequently to the ground, *kleinschmidti* gave much more attention to live parts of plants.

TABLE 2 COMPARISON OF SILKTAIL FEEDING STATIONS -- CONDENSED

FEEDING STATIONS	No. of observations TAVEUNI	No. of observations VANUA LEVU	% of total no. TAVEUNI	% of total no. VANUA LEVU
Dead plant parts	69	66	54.3	46.8
Live plant parts	23	59	18.1	41.9
Bark epiphytes	0	3	0	2.1
Aerial	2	12	1.6	8.5
Ground surface	33	1	26.0	0.7
Total	127	141	100	100

We were unable to keep accurately the *time* spent at stations as, when off the ground, birds shifted station too rapidly. A table of timed observations (cf. Atkinson 1966) would have shown more clearly the high proportion of time *victoriae* spent on or close to the ground.

The same figures broken down to the specific stations are shown in Table 3. It is not intended that too much should be read into the detailed percentages, in such a limited sample, but merely to show the range of stations used by both birds. Stations on the list but not used by the birds were: tufted epiphytes, soil probing, stones on ground, buds, flowers, fruits. Cottrell (1966) and Clunie (pers. comm.) have seen some feeding on stones and logs on the ground.

FOOD AND FEEDING METHODS

The restless gleaning of *Lamprolia,* with continuous and rapid shifts of station, has been described by Layard (1876a), Kleinschmidt (Anon. 1876) and Cottrell (1966). All parts of a plant may be thoroughly searched, with particular attention to vines and clusters of dead leaves. L. Layard recorded small beetles only from stomach contents and Kleinschmidt found "almost entirely remains of various black beetles with dark green and brownish gloss."

TABLE 3 COMPARISON OF SILKTAIL FEEDING STATIONS -- IN DETAIL

FEEDING STATIONS	No. of observations TAVEUNI	No. of observations VANUA LEVU	% of total no. TAVEUNI	% of total no. VANUA LEVU
Dead Plant Parts				
Foliage	60	34	47.1	24.1
Twigs	1	2	0.8	1.4
Branches	1	1	0.8	0.7
Trunks	2	1	1.6	0.7
Vine foliage	5	27	3.9	17.0
Vine stems	0.	4	0	2.8
Live Plant Parts				
Foliage	14	12	11.0	8.5
Twigs				
Branches	0	5	0	3.6
Limbs	0	4	0	2.8
Trunks	3	7	2.4	5.0
Holes & crevices	2	2	1.6	1.4
Vine foliage	3	6	2.4	4.3
Vine stems	1	23	0.8	16.3
Ground Stations				
Litter	28	1	22.0	0.7
Bare soil - picking	3	0	2.4	0
Logs	1	0	0.8	0
Surface roots	1	0	0.8	0
Sundry				
Aerial feeding	2	12	1.6	8.5
Bark epiphytes	0	3	0	2.2
Total	127	141	100	100

L. Layard's observation of a bird digging into an ants' (probably termites') nest has not been repeated although this source could be used for feeding nestlings. Clunie has seen a bird peck open a termite tunnel on a tree trunk, and capture several termites before dashing on to catch up with the other four birds of its group.

A characteristic of *kleinschmidti* noted by WFC, PC, BDH and RBS was its feeding on lianas that clambered up tall trunks. Searching industriously, a bird would steadily work its way in a spiral up a liana to about 20m above ground, would then float back down like a gliding butterfly or a falling black leaf, to three metres and then start again. F. Clunie and F. C. Kinsky (pers. comm.) have seen similar behaviour from *victoriae,* though not to such height, particularly when working through trunk epiphytes. Clunie has noted that individuals from a party of five he was following would rip and drop lichens and leafy liverworts from branches in their search.

Aerial feeding was seen on several occasions, done in opportunist manner during normal gleaning. At Kubulau one bird made a swift three-swirl spiral in mid-air in the lower understorey. On other occasions the birds would hover briefly at a dead leaf or at bark lichens. Twice at Vunivasa a bird was seen hovering at a spider web, once spending two minutes leaping from the ground to hover snapping at a low web.

A bird was seen boulder-hopping in a Taveuni stream bed in 1973 by W. Ringer and RBS saw one drying its feathers and preening after bathing in the same stream. At Vunivasa WFC saw a bird drink from the water in a large dead leaf on the ground, dipping and tipping back the head three times; then later stepping in, shaking its wings and wetting its under parts.

Ground feeding on Taveuni was very common. From one to five birds might be found working over the ground, tossing aside leaf litter with abrupt flicks of the bill, then picking at the ground beneath. Clunie (pers. comm.) saw a bird take a small pale worm and then found only small pale nematodes in the litter. During ground feeding, the partly fanned tail would flick prominently like signal flashes, a habit noted also by Cottrell (1966: 261). This tail-flicking was not used to disturb food from the ground in the manner of fantails and other aerial feeders, and was not used while feeding at other levels.

In all its feeding activity, in our experience, *Lamprolia* is silent, except that when two or more birds are together a quiet twittering may be heard. In Clunie's experience, this twittering among a group is typical.

Loose associations of Slaty Flycatcher *(Mayrornis lessoni),* Spotted Fantail *(Rhipidura spilodera)* and Fiji Shrikebill *(Clytorhynchus vitiensis)* are often encountered below the top canopy, sometimes accompanied by a Fan-tailed Cuckoo *(Cacomantis pyrrhophanus).* Juvenile and female Golden Whistler *(Pachycephala pectoralis)* often feed at or near ground level and on Taveuni the Blue-crested Broadbill *(Myiagra azureocapilla)* is often present. Often the Silktail will be in the same area but, apart from a general presence, they cannot be said to feed together. Once a ground-feeding Silktail ignored a noisy encounter between a Shrikebill and Slaty Flycatchers, but another was disturbed, as were Slaty Flycatchers, by the loud trumpeting of a Musk Parrot *(Prosopeia tabuensis)* in the canopy overhead.

COMPETITION

There is no evidence available to suggest that either competition from other species or predation markedly affects the Silktail. If the higher feeding levels of *kleinschmidti* at Kubulau are typical, it is more likely to be sharing habitat resources with other sub-canopy specialists than is *victoriae* with its low-level feeding tendency. The Fiji Warbler *(Vitia ruficapilla)* and the Shrikebill are possible competitors to be considered. The Mongoose on Vanua Levu is not known to have an important effect on other than ground-nesting rails, in the present state of knowledge.

DISPLAY

Despite the richness of plumage, particularly about the head, no special display of this plumage has been seen. No courtship has been seen, however, and, although A. Habraken saw copulation on the ground once at Vunivasa, which was preceded by no formality, there was much disturbance at the time by people and Blue-crested Broadbills and copulation may have been a displacement reaction.

We have seen two types of aggressive display. In the first, the wings and tail are fanned in unison slowly out and in, horizontally. This is reminiscent of flight take-off movements and may be derived from them. This display was seen by BDH and MDD at Kubulau when a Silktail joined some noisy Slaty Flycatchers in the upper understorey to display at a Barn Owl *(Tyto alba)* which we had disturbed. At Vunivasa WFC saw a Silktail display about a metre up a tree-fern trunk, facing away from him at something he could not see. No sound was made. Also at Vunivasa, during some three hours of watching a pair of Blue-crested Broadbills which were feeding a newly-fledged chick in the same area as Silktails were feeding a juvenile, I saw this display twice only. Once the female Broadbill dived at a Silktail, which dropped to the ground and displayed briefly. Once the male Broadbill briefly pursued a Silktail which afterwards displayed from a safe distance. Also in the area was the usual understorey mixture of female Golden Whistler, Fiji Shrikebill and Slaty Flycatcher, and occupied nests of Spotted Fantail, Ground Dove *(Gallicolumba stairii)* and Orange Dove *(Ptilinopus victor)* but little attention was paid by one species to the others. That the Silktail can be aggressive is shown by Clunie (pers. comm.) who has twice seen a single *victoriae* dash at a male Blue-crested Broadbill perched on a vine, almost colliding with it and pursuing it in silence for several metres;

and two birds, feeding on the ground, chase a Kingfisher *(Halcyon chloris)* in silence for thirty metres.

In the second type of display, the nape feathers are raised and the whole body is agitated; the tail is flipped up and down and the wings are held out in a drooped position and flapped vigorously up and down; this is accompanied by a harsh scolding cry. I have caused this display three times out of many attempts by making a harsh noise with the lips: twice at Waitevala in 1973 when one bird only from parties of three and five reacted instantly and at length while the rest showed no interest; and at Kubulau in 1975 when unknowing we were within two metres of a nest. Layard (1876a: 149) noted on Taveuni that " it chattered defiance at us if near its nest," and at Waitevala in 1973 CS-K first suspected he was near the nest he later found when one and then two birds became very agitated and displayed all round him. Generally, however, birds leave and approach the nest silently, flying low. Although we spent much time at two nests, and also at nest-building and the feeding of a juvenile, no further displays were seen.

BREEDING

BREEDING SEASON

Published material is meagre and our observations add little. *Taveuni:* Layard (1876a) in late July/early August 1875 found the forest above Gila " full of young birds. The nests had chiefly fully fledged young ones; and only one had a single fresh egg." How many birds were involved is not clear but Layard must have struck a good patch of localised breeding for, were July a regular breeding season, one would expect at least an abundance of juveniles in August. From 25 August to 10 September 1970 the New Zealand parties above Somosomo saw no sign of breeding (Blackburn 1971); from 22 to 26 August 1973 above Somosomo one nest with egg was found but birds were otherwise in parties of from three to five, in adult plumage; from 9 to 13 September 1975 at Vunivasa one juvenile was seen and one nest being built but all other birds seemed not breeding.

On the other hand, Clunie (pers. comm.) in early June 1973 above Tutu, south of Somosomo, found three nests with egg or young, one being built and one apparently destroyed by a predator. Yet groups of five and six birds were also common.

Of the three birds collected by Martin for Casey Wood on 19 and 23 November 1923 two were immature and one sub-adult (George E. Watson, pers. comm.). A nest with egg collected by Kleinschmidt on 11 December on Taveuni is described by Nehrkorn (1879), and three nests with one egg each and one nest with no egg were found by Correia on 11-17 December 1924 at about 2000′ (610m) above Somosomo (LeCroy, pers. comm.).

Vanua Levu: At Kubulau from 28 August to 5 September 1973 no breeding was seen, and yet from 4 to 7 September 1975 one nest with egg and one juvenile were seen. In November 1875 Kleinschmidt could get no nests but on 24 December 1924 Beck collected a juvenile going into adult plumage. The four adults Beck collected had small gonads (LeCroy, pers. comm.).

As with many Fijian birds, there seems to be no precise breeding season. Nesting may well be found at any time of year but there is a possibility that pockets of particularly intensive breeding by various species may occur through some form of interspecific stimulation, or some other localised habitat factor. Whether individual *Lamprolia* breed more than once a year has been suspected but not yet shown.

TERRITORY

Whether *Lamprolia* is territorial is not clear. Neither boundary disputes nor signs of aggression between individuals have been recorded. Whether the Silktail's " song " has a territorial function is not known. On Vanua Levu, at Kubulau, birds seemed to be paired and keep well apart, except on one occasion when three birds were together on a vine. However the population pressure seems low.

On Taveuni, although more than one bird has seldom been seen near a nest, numbers close by vary between two and six. Even where the juvenile at Vunivasa was being fed actively, one or two extra birds were often present without apparent friction. Colour marking (dye on the white tail) was begun at Vunivasa but too late to show whether birds were in pairs or in loose groups. The nature of groups and pairs is puzzling and needs study.

NEST AND EGG

The nest of *Lamprolia* is a deep cup slung between the members of a horizontal forked twig at their point of junction (see Fig. 4). The site selected has an umbrella of one or more large leaves immediately above. The nest is placed in a broad-leafed plant of the lower understorey, so that it may be at a height of from one to three metres from the ground. The nesting habitat seems to be places where beneath the top canopy there is a glade of understorey broad-leafed plants between two and three metres high. On the steep slopes of Taveuni this is often on or near ridge tops, but the Kubulau nest was in such a glade in a broad flat gully, close to a sharp drop to a stream.

While the nest is roughly circular (see Fig. 4), it can *look* triangular or almost rectangular from side view because the binding to the twig members gives a shelfed appearance reminiscent of a stretcher. The lip of the nest however is at the level of the twig.

The most remarkable feature of *Lamprolia* nests is the varied form of their lining and external decoration. The nests we have seen agree with the description of Nehrkorn (1879) in being built of

FIGURE 4 — Nest of *L. v. kleinschmidti,* Kubulau, Vanua Levu, from colour slide by M. D. Dennison. Main stem of twig concealed by shadow at left. Note loose external structure, blotched egg, large loose feathers just beside egg.

thin dry fibres and shredded dead leaves, without external decoration and with a few feathers placed loosely at the bottom of the cup. The three Vunivasa nests and the Kubulau nest, because of their dead-matter construction, had a distinctive straw-coloured appearance which seemed conspicuous, but they were easily overlooked because bundles of straw-coloured dead leaves fallen from above were commonplace in the forks of the understorey plants. The Waitevala nest of 1973 on the other hand was black in appearance, as was the Kleinschmidt nest described by Nehrkorn. In this area the bundles of dead leaves caught in forks were black and the nest, presumably made from the materials at hand, was not easily noticed. Although the nest structure was not examined closely I do not recall that it was built externally of black fibres, as Nehrkorn describes, but rather of black shredded leaves.

TABLE 4 — DIMENSIONS OF LAMPROLIA NESTS

External		*Internal*		*Measurer*
Width	*Depth*	*Width*	*Depth*	
		L. v. kleinschmidti		
80	60	40	40	Heather
		L. v. victoriae		
100	62	52	35	Nehrkorn
85-70	50	50-45	35	Heather
80	60-55	45	35	Heather
(c. 80)	(50)	(c. 50)	(30)	Heather
76		52		LeCroy
80		46		LeCroy
85		45		LeCroy
87		48		LeCroy

( ) = uncompleted nest

A nest lining of feathers is unusual in Fiji birds, for obvious climatic reasons. It is known only for the Pacific Swallow *(Hirundo tahitica)* and from a record by Blackburn (pers. comm.) of a Blue-crested Broadbill nest with in the cup a few scarlet feathers of the Collared Lory *(Phigys solitarius)*. A token use of feathers in this undecorated type of Silktail nest is interesting. Nehrkorn notes " a few " feathers; my notes from a glance into the Waitevala nest merely say " a few black and white feathers," perhaps of the Island Thrush *(Turdus poliocephalus)* which was present in the area; and from the Kubulau nest " about eight feathers, two or three large ones in the bottom and smaller ones scattered round the wall." PL noted them to be pigeon feathers. In the two abandoned nests at Vunivasa the feathers were a small indistinguishable mess in the bottom.

The second type of nest is strikingly different in appearance, although the same in basic structure. The inside is completely lined with feathers and the outside so decorated with moss-like liverwort as to look totally green. Layard seems to have seen this type: " composed of fibres and the macerated strands of a species of flag, and lined with feathers," among which he detected the yellow breast feathers of the male Golden Whistler in particular and feathers of Peale's Pigeon *(Ducula latrans)*. Of the four nests collected by Correia on 11-17 December 1924, all at about 2000′ (610m), three are built of " green moss and fine grass, lined with feathers," with a second lining of fine grass (perhaps shredded vine leaves) under the feather lining; and the fourth " bulky, of dry grass," lined with fine grass but no feathers (LeCroy, pers. comm.). Clunie has recent examples of both types, yet to be described. The two types of nest seem unrelated to season, altitude or available materials. They and the use of a feather lining raise interesting questions.

By contrast with the neat, tight cups of broadbills, flycatchers and fantails, the Silktail nest seems large, thick-walled and loosely built. External dimensions (see Table 4) probably vary with the angle of the fork and in any case cannot be measured accurately. The walls of the two Vunivasa nests measured made up roughly 44% of the diameter in one case and between 36% and 41% in the other, and in the Kubulau nest roughly 50%. By Nehrkorn's measurement, Kleinschmidt's nest had walls 48% of the diameter.

Despite the bulk of the nest, and it will be noted that the *kleinschmidti* nest was no smaller externally than the *victoriae* nests, the cup seems too deep and narrow for the bird which adopts a characteristically scissored sitting posture (see Fig. 5) in which the back is out of sight below the rim and the tail, wings and head project upwards, the backward tilt of the head forcing the nape feathers out to give a thick-necked appearance.

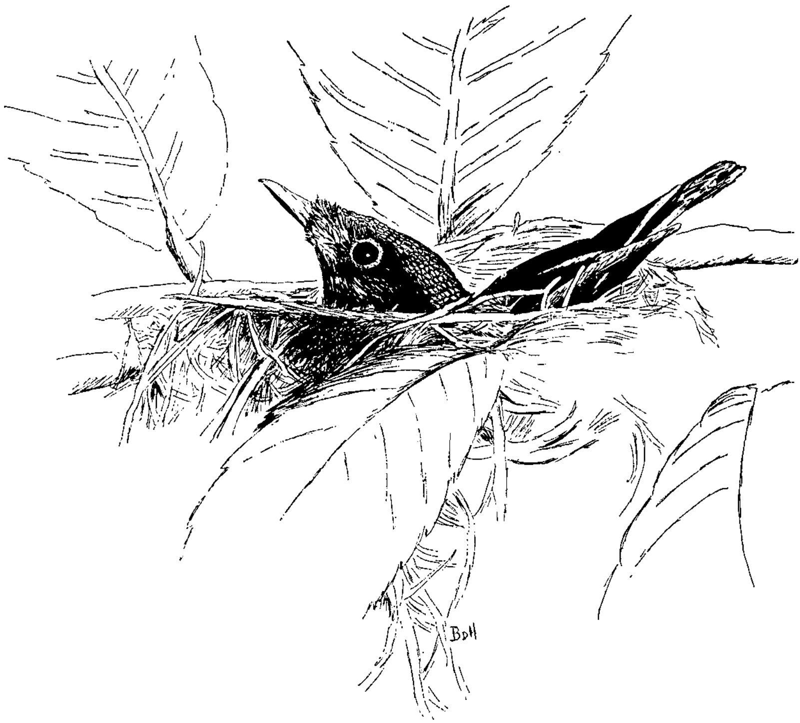

FIGURE 5 — Characteristic incubating posture of *Lamprolia,* based on colour slide of *L. v. kleinschmidti* by J. Brown. Twig apex at left.

Three *victoriae* eggs described after Layard, Nehrkorn and Cat. Brit. Mus. by M. Schonwetter (in MS, *Handbuch der Oologie,* Band II: 651. Berlin) give a range of 24.0-25.1 x 16.5-18.9 (W. Meise, pers. comm.). Two *victoriae* eggs measured by Clunie were 21.5 x 16.5 and 23.2 x 17.0, and the three Correia eggs measured by Mrs LeCroy were 24.1 x 16.2; 23.0 x 16.2; 23.3 x 17.4. Thus the range for all eight eggs is 21.5-25.1 x 16.2-18.9.

The *kleinschmidti* egg measured 16.6 x 14.8, proportionately shorter and broader than the *victoriae* eggs.

The eggs of the two subspecies are alike, an attractive " pinkish white ground, unglossed, covered evenly with larger and smaller blurred lilac-red and pale purple spots " (Cottrell 1966). Clunie (pers. comm.) has seen them more varied, with the pink ground so delicate as to be almost white, and with fewer, smaller spots mainly round the wide end. Two of Correia's eggs are described as " quite pink " and slightly pinkish," both with fine splotches all over (LeCroy, pers. comm.).

All observers agree that the clutch is invariably one. Clutches of one or two are quite frequent with Fiji birds and may, as Lack (1971) has suggested for tropical island birds in general, be related to the absence of a seasonal flush of food supply with which large families may be raised. A year-round moderate food supply in a uniform climate should reduce the rate of mortality, which would also favour a small clutch. The high population level of *victoriae* supports this view.

NEST-BUILDING

In one glade of understorey broadleaves on the Vunivasa ridge was a group of three *L. v. victoriae* nests and a fourth that was begun, two-thirds built and abandoned while we were there. One nest was old, judging by its texture and the litter inside. One was very recent, with feathers and broken, unfaded eggshell sufficient for a complete egg in a sticky mass in the bottom. One was very recent but clean and empty except for a small wet patch of feathers in the bottom. PL saw a single bird begin the fourth nest, which it continued to build with bursts of activity followed by long spells of absence. Only one bird was seen in this area. It was not seen near the empty nests and when the final nest was abandoned it was not seen there again. Perhaps only one bird builds, or these were practice nests but, in view of the broken egg, there may have been a tragedy.

The nest was begun by gathering a small bundle shredded from dead vine leaves lodged in the crown of a shrub. This bundle was laid across the apex of the horizontal fork. The bird then collected spider web, hovering to do so, and the shredded leaf was securely bound to the twig by the web. This was continued for short periods of from five to fifteen minutes, interrupted by absences of thirty minutes or more.

The following day, the bird was watched by CMH for 80 minutes, during which 32 visits were made to the nest, about 23 minutes being spent working at the nest and about 57 collecting material. Times were kept to the nearest half-minute. Time building: ½ to 2½ mins; average 0.8. Time collecting: ½ to 8½ mins; average 1.9. Shredded vine leaf was brought 15 times, spider web 7, rootlet 2, unidentified from the ground 1, nothing 9. Twice, leaf and web were brought together.

As far as was seen, leaf was shredded by tugging and tearing at clumps of dead vine leaves lodged in forks or attached to fine vines. Web was collected by hovering at it or through it and gathering it in the beak and on the face.

The nest was built as a hammock slung from the members of the fork and from the apex, with the sides nearest the fork and apex therefore developing first and the side facing away from the apex remaining open. The bird worked either by standing on the rim or by sitting in the nest, facing the apex, from where it could still reach round the outside as well as working the inside. Its main activities at this stage were to tuck shredded leaf into the outside, apparently at random, on any part of the sides, less often on the top, occasionally over one or both twigs. Web seemed also to be laid randomly. One spell of 13 minutes was spent gathering big bundles of finely shredded leaf and a rootlet and packing it inside. The inside was worked partly by tucking, partly by trampling with the feet and pushing with the breast.

Surprisingly little rootlet and fibrous material was brought but this may be used more at a later stage, chiefly for the inner lining.

BEHAVIOUR AT THE NEST

With the two nests concerned, the state of incubation of the egg in each was unknown.

In 1973 the Waitevala nest was largely left alone but during a late-morning watch of 134 minutes by SMR the bird left the nest seven times, for periods of between 2 and 10 mins, average 8.5 mins. The bird remained silent, always approached the nest from below and, while sitting, frequently turned the head from side to side.

At the *kleinschmidti* nest various observers spent much of one day using a hide, or watching from four or five metres away. In the morning when MDD and BDH were there from 6.53 a.m. to 10.11 a.m., the bird was on the nest for five spells of from 6 to 13 mins, average 10.0, and off the nest for six spells of from 9 to 15 mins, average 11.7. When we first arrived it was raining and the bird was sitting. It stayed sitting for 18 mins until the rain had stopped and the bush had stopped dripping heavily. Twice more during the time there were heavy showers and the bird returned promptly, curtailing its absence once to 4 mins. Times of disturbance are omitted.

When MDD and GAW continued from 10.27 a.m. to 1.38 p.m., the bird was on the nest for six spells of from 5 to 22 mins, average 11.0 and off the nest for seven spells of from 10 to 18 mins, average 13.4.

Fig. 6 shows the fairly regular rhythm of times off and on the nest. The average time off corresponds closely to the median of 8.5 mins given by Nice (1962: 221) for ten passerine species in which only one sex incubates. However, the average time on the nest is much lower than the median of 30 mins for the eight temperate-zone passerines, and much closer to the 12 and 17 mins averages of the two tropical American species quoted.

In the first period of observation, MDD noted that there was no movement by the bird on the nest. It did not preen, garden, turn the egg or even fuss round the nest as many species do. GAW later noted that the bird often moved its head from side to side, seeming particularly nervous when other species were nearby. During two hours in the afternoon, WFC noted that, during an unusually long 30 minute spell, the egg was turned twice, with a 16 min. interval. He

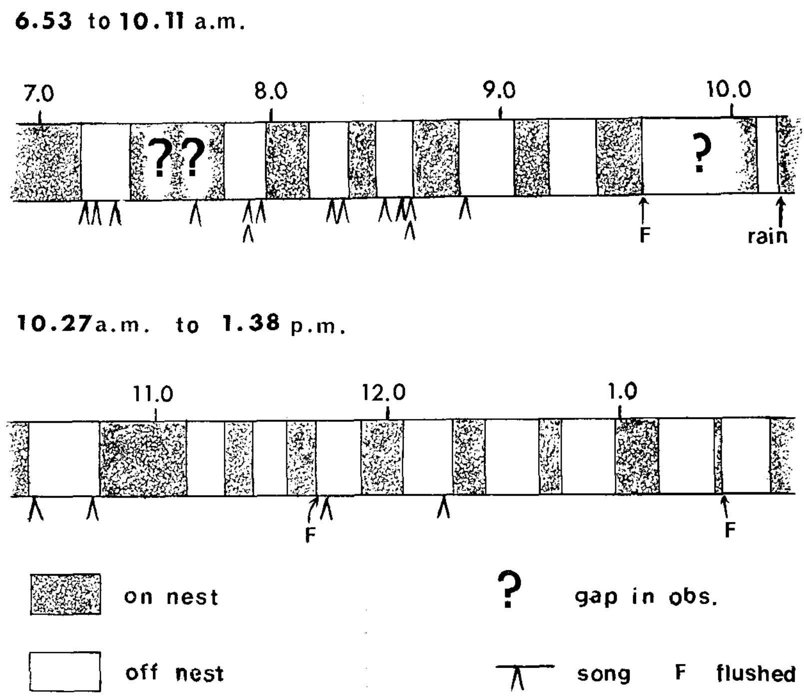

FIGURE 6 — Nest-attentiveness of Vanua Levu Silktail, 7/9/75.

estimated that the bird was on and off the nest for about ten minutes on the average.

The peculiar sitting posture of *Lamprolia* (Fig. 5) has already been described. It always sat facing the apex of the fork, regardless of its direction of approach to the nest.

Its arrival at and departure from the nest were silent and, except when rain suddenly began, unhurried and almost always at the level of or from below the nest. During the morning the bird went from the nest directly up the valley, an area where the morning sun would first strike the canopy, and returned from that direction. In the afternoon it moved to and from the opposite direction, up the side of a ridge where two birds had been seen together the afternoon before the nest was found and where the afternoon sun was on the canopy. Silktail song was heard from the same directions and nowhere else while the bird was away. Song was not heard whenever the bird was sitting.

Change-over at the nest did not take place. The only time two birds were seen near the nest was just before its discovery by P. and R. Latham, when the sitting bird was made by my lip noises to give the scolding display. A second bird, which remained silent, appeared promptly, watched for a while and then left, moving straight up to and away through the upper understorey.

The function of song was puzzling. During the morning sessions up to 1.40 pm, 18 calls were heard, 14 during the first two hours and the last at 12.15 (see Fig. 6). The impression was that the sitting bird sang, for calls were heard only during its absence, and most often just before or just after being on the nest. Three examples, in which minutes refer to time of calls and 20m is a guessed distance, will show this:

(1) Left nest. 1 min later, 20m up valley. 3 min later, closer. 6 min later, very close. 3 min later, on nest.
(2) Left nest. 8 min later, 20m up valley. 1 min later very close, preceded by scolding cry. 2 min later, on nest.
(3) Left nest. 2 min later, 20m up valley. 5 min later, same. 1 min later, same. ½ min later, close. ½ min later, on nest.

The bird seemed to fly straight up the valley to feed and later to move gradually back to the nest. Which bird really sang and why, and why song virtually ceased later in the morning cannot be discussed profitably.

As a comparison, a bird followed by MDD and BDH for 1½ hours in another part of the Kubulau forest called six times, without apparent purpose and barely interrupting its feeding in the upper understorey. A second bird did appear briefly twice but the calls seemed to be unrelated to its presence.

Whether both birds incubate remains an open question until a pair can be colour-marked. One would expect both to incubate in a monomorphic species but the fact that change-over was not seen at or near the nest suggests that only one bird was sitting, as also do the regular absences of the sitting bird. The climate enables eggs to be left for short spells but other sub-canopy species whose nests we have watched have not been seen to desert the eggs in this way. The eager gleaning of the Silktail for food implies a need for constant food intake and short spells on and off the nest may be a compromise between feeding and incubating needs.

JUVENILES

The appearance of the juvenile *L. v. victoriae* has been described by Finsch (1876) and Sharpe (1883) from skins of unknown age. Grey-black, without much gloss (Finsch); far less spangled, especially underneath (Sharpe). Bill, especially below, light grey or brownish (Finsch). Wood describes his immature male merely as " somewhat duller " and having restricted white on the tail. Watson (pers. comm.) describes Wood's sub-adult female and two immatures as less velvety on the back and with the blue on head and nape not pronounced. The immature male has the widest black tail-tip of all skins (13mm).

Kleinschmidt, in a letter to the Godeffroy Museum (Anon. 1876), says: " The young bird shows the metallic sheen on the head when in the nest; only its velvety plumage is not quite as intensively black or as glossy in others parts as in the adult. When fledged and caring for itself, a juvenile can be recognised by its yellow gape, its lighter beak (chiefly the lower mandible is spotted with yellowish or light brownish areas) and its plumage which is duller, less glossy and dark slate-grey rather than black. The white satin feathers of tail and rump appear in first plumage with full sheen. Legs and bill are shining black in the adult. Because of the many dark grey specimens I have killed, I think that adult plumage is first developed at first breeding when the birds are a year old." The last statement is unproven.

The immature female of *L. v. kleinschmidti* collected by Beck has " less iridescence and the overall colour is more greyish black; the tail feathers are more pointed " (LeCroy, pers. comm.).

In the field where the light is often poor, details are hard to see. The juvenile *kleinschmidti* seen from six metres by PC on the hillside behind Karoko village was full-sized but with tail very short and white with thick-looking black tip. It looked dull black, without sheen, charcoal below and slightly grey under the throat, and with faint teal-blue on the crown. He saw it fed twice at a three-minute interval by one parent and then a half-minute later by the other parent. Twice it flitted a metre to another branch, once pecked vaguely at a leaf but did not try to feed itself. Although the parents twittered considerably, the chick was silent.

The juvenile *victoriae* seen for several days at Vunivasa was full-sized, including tail with fully developed white and black areas. Iridescence, gloss, blue or grey were not visible; in the understorey light it looked just dull black.

This juvenile for the most part was silent but at times uttered a modest ' cheep-cheep ' call. It made a brief tail-wing fanning display at me once but otherwise it and the adults ignored my presence. Once it chanced to land beside the small Blue-crested Broadbill fledgling in the area and was quietly driven off by the male Broadbill. Four Silktails were in the area, at least two of which were feeding the juvenile. The adults collected food in no special way for it, mainly from clumps of dead leaves, sometimes on the ground or hovering at spider webs. The juvenile made no attempt to feed itself, apart from moving vaguely from place to place and occasionally pecking casually at a leaf. It merely passively and silently accepted food, showing its yellow gape, sometimes preening briefly or sitting hunched up whenever the adults were absent, as on one occasion when the adults disappeared to where Slaty Flycatchers were making alarm calls. Once the juvenile moved to the ground and was fed there three times. Food was given as soon as collected, so that intervals of about a half-minute were frequent.

It is interesting that the white of the tail develops clearly in the first juvenile plumage, whereas more decorative plumage appears only gradually. The white of the tail flickers prominently when *victoriae* feeds on the ground and when both subspecies take off for sustained flight. Presumably therefore the main role of the white is for species recognition or for escape movements, that is, for social rather then sexual display.

VOICE

The Silktail is for the most part silent, although groups frequently twitter quietly while feeding. There is no alarm call when birds are suddenly disturbed. The scolding cry described seems to be used at times of extreme stress but too inconsistently to be understood. Clunie (pers. comm.) has heard one of a feeding pair give a loud, very clear whistle and one of another feeding pair give frequently a different whistling call, and also a type of trilling whistle.

The standard call or song of *Lamprolia,* probably the " stridulous cry " of Layard (1876a), can easily be missed among the various louder voices of the Fiji forest. It is unimpressive, hesitant, seldom uttered more than once at a time and does not carry far in the forest. It seems to be spontaneous, uttered during the course of other activities and from no special perch. *L. v. kleinschmidti* called much more readily and often at Kubulau than did *victoriae* at Waitevala and Vunivasa, a difference which, if real, may reflect the difference in feeding levels and ease of social contact at these levels.

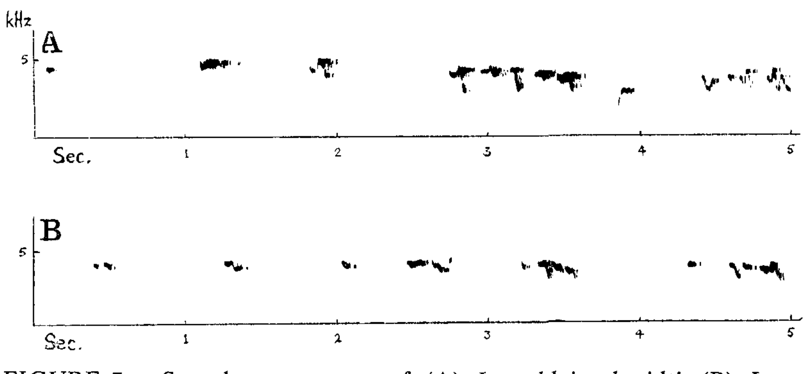

FIGURE 7 — Sound spectrograms of (A) *L. v. kleinschmidti,* (B) *L. v. victoriae.* From tapes of Mrs Beth Brown, prepared by courtesy of Dr P. F. Jenkins and University of Auckland.

Sound spectrograms made from tapes of both subspecies recorded with great patience by Mrs Beth Brown are shown in Fig. 7. Both are given consistently and are sufficiently stereotyped to be probably innate. While they are basically very alike, there are differences which may be no more than dialectal but which may equally be sufficient to deter interbreeding if the two forms were sympatric.

The song can be divided into two sections, an initial three notes, widely spaced and slightly descending in pitch; and a final section of two elaborations of the same note in *kleinschmidti* and three less detailed elaborations in *victoriae,* descending in pitch rather more sharply. The two songs are alike in duration (c. 5 seconds), tonal quality (lack of harmonics) and frequency range. Differences are clear also. In *kleinschmidti* the first note is very faint but the second and third are of greater volume and richness than those of *victoriae;* the first elaboration is much richer in frequencies and loudness than in *victoriae* and the final elaboration is a very weak version of the preceding one.

SOME POINTS OF MORPHOLOGY

I do not wish to attempt a full discussion of *Lamprolia's* morphology, a task for taxonomists with a range of skins at hand. However, several aspects may be worth looking for in the field.

It is well known that *L. v. kleinschmidti* is about one third smaller than *L. v. victoriae,* for which reason Kleinschmidt chose unsuccessfully to call it *minor* (Layard 1876b, Finsch 1876, Anon. 1876). This is apparent in the field when one moves from one island to the other.

The following dimensions, which omit feathers obviously damaged or in moult, are the best available to me for *kleinschmidti,* by different hands and not strictly comparable: bill from base, average of nine birds 14.8mm, range 13 to 16; wing, average of twelve birds 68.8, range 64.5 to 72; tail, average of eleven birds 42.2, range 40 to 44; tarsus, average of nine birds 19.0, range 18 to 20.

The series of nine skins of *victoriae* collected on Taveuni by Kinsky and Clunie, housed in the National Museum of New Zealand, Wellington (NMNZ 17966-17977), give the following fresh measurements: bill from base, average 13.9, range 12.8 to 15.3; wing, average 83.2, range 79.0 to 84.5; tail, average 47.2, range 45.0 to 49.0; tarsus, average 24.2, range 23.4 to 25.3 (F. C. Kinsky, pers. comm.).

The black terminal tail tip is often given as a field character. The following widths, taken parallel to and beside the rachis of the central feather, show a degree of overlap. *L. v. kleinschmidti,* from twelve birds in Halberstadt, Hamburg, London and New York: average 4.6mm, range 1 to 9. *L. v. victoriae,* from thirteen birds in Halberstadt, Hamburg, Sydney and Washington: average 9.5, range 7 to 13. The band width does not correlate with sex or age. The New York (ex-Godeffroy) skin with a width of 1.0mm is exceptional, but the black tapers from 3mm on the vanes to 1mm in the centre.

First brought up by a discussion between Salvadori (1877) and Layard (1878) was the matter of an inverted V on the nape of *Lamprolia* when viewed from behind which at first was thought to distinguish the subspecies, or male from female. This V of dull-coloured feathers, with little or no iridescence, is clearly visible on some skins of both subspecies, of either sex, both adult and juvenile. On other skins the whole nape is iridescent. There may be a difference in feather micro-structure between nape and crown, emphasised by the quality of skin preparation in some cases. The matter may have no meaning but could be looked for in the field.

DISCUSSION

DISTRIBUTION

It is interesting and not entirely futile to speculate on the strange distribution of *Lamprolia* which is confined to Taveuni and, it seems, to that part of Vanua Levu closest to Taveuni, although there is no apparent reason why it should not flourish in the rainforests of Viti Levu, Kadavu and the whole of Vanua Levu.

Strange distribution patterns are a feature of other Fijian birds. From purely geographical logic one might expect *Lamprolia* to be distributed similarly to the quite unrelated Orange Dove *(Ptilinopus victor)* which occurs throughout Taveuni and Vanua Levu and the adjacent islands of Qamea and Laucala, Rabi and Kioa (see Fig. 2). The forest of these adjacent islands is dry, however, which adds weight to the view that dry conditions are a barrier to the survival and spread of *Lamprolia.* Similarly, the isthmus at the base of Natewa Peninsula, nowadays without forest, may never have held truly damp rainforest so that *kleinschmidti* may long have been isolated within the peninsula, on an ecological island. The isthmus is narrow — barely 1 km at its narrowest point — low-lying and largely cut across by a salt-water lake.

Mayr (1932: 16-17) distinguishes a subspecies *ambigua* of the Golden Whistler *(Pachycephala pectoralis)* which is confined to Rabi, Kioa and eastern Cakaudrove (= Natewa) Peninsula. *P. pectoralis* is much more dispersive and habitat tolerant than *Lamprolia;* the existence of *P. p. ambigua* supports the view that forest birds on the peninsula and its neighbouring islands may be ecologically isolated.

The general trend in Fijian birds is to divergence among the islands, often in seemingly minor ways, such as in details of plumage, body size, song and habitat preference, but more distinctively in older genera. Despite the undoubtedly great antiquity and obscure origin of *Lamprolia,* the two forms show a degree of divergence not much greater than many other Fijian birds and thus their divergence is recent. Present indications are that the two forms are strong subspecies and it is possible that, when *kleinschmidti* is better known, the subspecific status may need to be reconsidered.

Fleming (1962), by a kind of " educated guessing," has ranked the endemic families of New Zealand passerines as survivors of immigrant stocks that colonised New Zealand early in the Tertiary. If evolution on different archipelagos has occurred at the same rate, *Lamprolia,* an endemic family of one species, survives from an earlier array of birds which may have colonised Fiji in the early Tertiary.

Presumably once part of a range of related forms whose diversity was well beyond that of modern Fijian birds, *Lamprolia* may have survived because its small size and relatively unspecialised habits have enabled it to adjust to changing conditions and competition from new immigrant stocks.

On analogy with subspeciation in New Zealand (Fleming 1962), there has been ample time since the late Pleistocene or later for the two Silktails to have diverged to the limited extent they have. Which of the two is the relict form and which the recently derived form is a further matter for speculation.

If one assumes that the much stronger population on Taveuni is the relict population, then dispersal to Vanua Levu probably occurred in the late Pleistocene or soon thereafter. Somosomo Strait, which separates Taveuni and the nearest point of the Waikava Promontory on Vanua Levu by some 8 km (5 miles), is a dispersal barrier partly overcome by the prevailing south-easterly winds but which has been crossed at some time by most other Fijian birds. If one must seek an easier route, the strait could have been as narrow as 1 km ($\frac{5}{8}$ mile) with the lower sea levels at the time of the last major glaciation, some 15000 years ago, but there would have been no direct land bridge (P. Rodda, pers. comm.).

However, since an immigrant form is not likely to establish permanently unless it can occupy a vacant ecological niche or dominate competitors for an occupied niche and therefore flourish, it seems unlikely that *kleinschmidti,* which does not seem to meet these criteria, should be the derived form. Whereas Natewa Peninsula, consisting largely of sedimentary deposits and submarine volcanics, apparently has a long history of uplift, Taveuni is mostly very young, with, except in the extreme east, its original volcanic topography little eroded (P. Rodda, pers. comm.). It seems more plausible that *victoriae* should be the derived form, finding on Taveuni an abundance of the wet forest conditions it seems to favour and in these conditions exploiting a largely vacant niche by developing strong terrestrial and low-level components in its feeding habits. This habitat shift may explain *victoriae's* increase in body size associated with terrestrial life, as has occurred, for example, with *Petroica australis* in New Zealand (Fleming 1950) and with *P. rodinogaster* in Tasmania (Keast 1971).

Should pockets of *kleinschmidti* be found elsewhere on Vanua Levu, this could support the view that *kleinschmidti* is the relict form, dying out from the west, surviving in isolation on Natewa Peninsula, and flourishing as the better adapted *victoriae* in the favourably wet conditions of Taveuni.

Whatever the background, the full distribution and habitat tolerances of *kleinschmidti* should be an early priority for study while stands of unmodified forest remain. One wonders whether higher densities will be found, whether in damper, higher country the birds are litter feeders and whether the feeding behaviour seen at Kubulau in September differs at other times of year.

RELATIONSHIPS

As there is no clear evidence of relationship of *Lamprolia* to other bird groups, it is surprising that relationship to the Paradisaeidae seems to have been dismissed rather hastily, apparently on the grounds that *Lamprolia* does not show some of the primary characteristics of modern Birds of Paradise (for example, see Bock 1963). The Paradisaeidae are a rapidly evolving group whose origins also are obscure. In the presence of congeneric species, recognition plumage-patterns are of high selective value, especially in sexual selection, and this has led to extremes of extravagance and specialisation among the Paradisaeidae (Gilliard 1969). However, one would not expect an ancient isolate like *Lamprolia* to exhibit the specialisations of plumage or of skull structure (Bock 1963) of modern Birds of Paradise.

If one starts by assuming relationship, it can be argued that *Lamprolia* may be closer to the early progenitors of the Paradisaeidae, showing a generalised skull structure, monogamy, monomorphism and unspecialised insectivorous diet, all of which have been suggested for the paradiseine precursor (Gilliard 1969). There is precedent among Birds of Paradise for most of the features of *Lamprolia,* quite apart from the obvious similarity of feather structure, including general build and stance of body, feeding mannerisms, litter feeding, type of nest, egg colouring, flicking white tail, monogamy, sexual monomorphism, even small size (Gilliard 1969). Indeed one is struck while reading works such as Gilliard's that differences between *Lamprolia* and a hypothetical primitive paradiseine are often less than differences among the Birds of Paradise themselves. The problem is hampered by lack of knowledge of the Paradisaeidae in the field, particularly the behaviour of females and juveniles; and by lack of knowledge of *Lamprolia* itself.

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BODY MASS CHANGES AND ENERGETICS OF THE KIWI'S EGG CYCLE*

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ABSTRACT

The disproportionately large kiwi egg and its formation were studied by following the increase in body mass of a hen through an egg cycle. Indirect calorimetry of the hen and bomb calorimetry of a kiwi egg were used with body mass data to estimate the rate of energy expenditure, the peak energy demand during egg production and the extent of fasting at laying time. The energy content of whole fresh egg was 11.55 Kj per g. The yolk, containing 91% of the energy of the kiwi egg, was completed during the first 7½ days of the cycle, adding 174 to 203% to her standard metabolic budget.

INTRODUCTION

The kiwis have attained the extreme in the proportion of egg size to adult body size (Huxley 1927), approximately 1:5 for the Brown Kiwi, *Apteryx australis* (cf Reid 1971a). This is of considerable interest both mechanically and energetically. Such a large egg apparently precludes significant overlap in production of consecutive eggs, so that changes in body mass between eggs can be more clearly attributed to specific stages in egg formation.

The kiwis are thus important, both as interesting birds in their own rights, and because of their broader implications for constraints upon evolution and function in class Aves. In his review of reproduction energetics, Rickleffs (1974) cited water contents of kiwi yolk and albumen from Reid (1971b), but apparently overlooked the significance of the unusually large, energy-rich yolk, 61% of egg contents (Reid 1971a). Compounded with the absolute size of the kiwi egg, this suggests an energy content that is very large in proportion to the bird's metabolic rate. Reid (1971b) estimated this energy content, but calorimetric data were not available for the kiwi egg, so he used published values for caloric content of typical bird yolk and albumen. Discussing the effect of egg-laying on adult weight, Rickleffs (1974) did not consider the possible extreme in this respect, represented by the kiwis.

We report here the changes in body mass of a female Brown Kiwi during the cycle between two consecutive egg-layings, and the energy content of a Brown Kiwi egg. This information is related to the metabolism of female Brown Kiwis, and may suggest advantages

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of kiwis for the study of basic avian reproduction, further justifying the propagation and protection of these unique birds.

MATERIALS AND METHODS

A North Island Brown Kiwi hen *(A. australis mantelli)*, 2 years of age, was obtained in 1974 from the Mt Bruce Native Bird Reserve and paired with a 14 month old male. These are the youngest ages for which kiwis are known to breed. She laid 4 eggs in 1974, 6 in 1975, and has laid 7 in the 1976-77 season. She was weighed at two day intervals, from the time that the first egg was laid in 1976 until the laying of the second egg, on a pan balance readable to $\frac{1}{8}$ oz. (Lyssese infant model). Mass and other values have been converted to S.I. units following Mechtly 1969. Mass was measured at approximately the same time, between 1700 and 1800 hr.

The bird and her mate were maintained and weighed in a 250 m^2 outdoor aviary of the Otorohanga Zoological Society, Otorohanga, North Island. Natural foraging was supplemented by a diet of raw ox heart double-cut in julienne strips mixed with cooked rolled oats, wheat germ, soya oil and nutritional premix (No. 178, Tasman Vaccine Laboratories). Breeding has occurred in both artificial burrows and burrows dug by the birds. Further details of the programmes have been submitted to the Wildlife Division, Department of Internal Affairs (Rowe, unpubl. ms).

Standard metabolic rates were determined as oxygen consumption, employing a paramagnetic oxygen analyser (Servomex OA 272) with read-out on a potentiometric recorder (Esterline Angus " Mini-Servo ") and a digital multi-meter (Hewlett-Packard 3465A). Air was passed through the metabolic chamber (20.7 1. rectangular tin or 134 1. refrigerator compartment) with a diaphragm pump (Charles Austen Mk II) and measured with a calibrated rotameter (Matheson 603) traceable to U.S. National Bureau of Standards (USNBS). Oxygen volumes were corrected to standard temperature and pressure, dry, and used to estimate metabolic energy requirements using routinely accepted assumptions of a respiratory quotient (CO^2/O^2) of 0.8, at which 1 ml of oxygen consumed would be equivalent to 20.1 joules or 4.8 calories of energy released (Calder 1974). Temperatures in an underground metabolic bunker or within the refrigerator were monitored with thermocouples and electronic thermometer (Bailey Instruments BAT-4), calibration traceable to USNBS.

So as not to disrupt the breeding programme or make unauthorized sacrifice of an egg, an infertile egg of slightly smaller size (357 vs 432 g) was separated into yolk and albumen and submitted for bomb calorimetry to the Laboratory of Animal Nutrition at the Ruakura Agricultural Research Centre. The mass of this egg had decreased 9.71 g between laying and calorimetry. Carbon loss was estimated from four determinations of oxygen uptake spaced over a 35 day period in controlled environments and subtracted from mass decrease to estimate water loss by evaporation, assumed to have come from the albumen and therefore added to albumen mass for calculating energy content per unit fresh mass.

RESULTS

The first egg, in her third year of laying at Otorohanga, was laid by this bird on the night of 16 June 1976. Weighings commenced at 1730 hr, 17 June. Her body mass increased 0.397 kg in the next 17 days, then stabilized for a week (Figure 1). After laying the second egg, her mass had decreased 0.51 kg. The egg weighed 0.432 kg, so 0.078 kg was lost from the body of the hen during the two days centred around laying.

The standard metabolic rate of this hen measured in a later egg cycle (No. 6), 5.18 W (Watts: = 4.46 kcal/hr) at 2.19 kg (day 12) and 4.54 W (3.91 kcal/hr) at 2.22 kg body mass (day 15 of a 23-day cycle). She was lighter by 8-9% in this cycle, and the egg was, in similar proportion, 7% lighter. The increase in body mass between days 6 and 18 during egg cycle 7 was the same as in cycle 2 studied in more detail, though the absolute or basal mass of the bird was running lower, possibly reflecting a seasonal mass cycle.

The egg yolk of another Brown Kiwi egg had an energy content of 18.16 kilojoules/g wet (4.34 kcal/g). The albumen yielded 3.15 kilojoules/g wet (0.75 kcal/g). The yolk contributed 63% of the extrapolated fresh mass of the contents (assuming water loss was from the albumen), and the albumen 37%. The energetic density of the whole fresh egg, including the 25.5 shell and membranes was therefore 11.55 kilojoules/g (2.76 kcal/g). This value applied to the mass of the egg analysed by Reid (1971b) gives an energy content of 1202 kcal, which is remarkably similar to his 1100 kcal estimate.

DISCUSSION

With information on body mass changes of the hen, composition and energy content of the kiwi egg, and published knowledge of function of the female reproductive tract in birds, it is possible to piece together significant information on the energetics of egg-formation, a proportionately great energy demand for the female kiwi.

The mean interval between eggs of this female in 3 years of laying 17 eggs at Otorohanga has been 33.2 days ± 14.3 (1 s.d.) with a range of 24 days (twice) to 75 days. One half of the intervals were 24 to 27 days long. Kinsky (1971) has summarized published time intervals between eggs of the Brown Kiwi of 11 to 57 days with a mean of 33 days also. He reported that successive ovulations occur alternately from two ovaries, and that maximum development of a second ovum continues only to a diameter of 40 to 50 mm. Calculated as a sphere this is a volume of 33.5 to 65.5 cm^3, which, at the specific gravity of yolk from the domestic hen's egg, 1.035 g cm^3 (Romanoff & Romanoff 1949), would weigh 34.7 to 67.7 g.

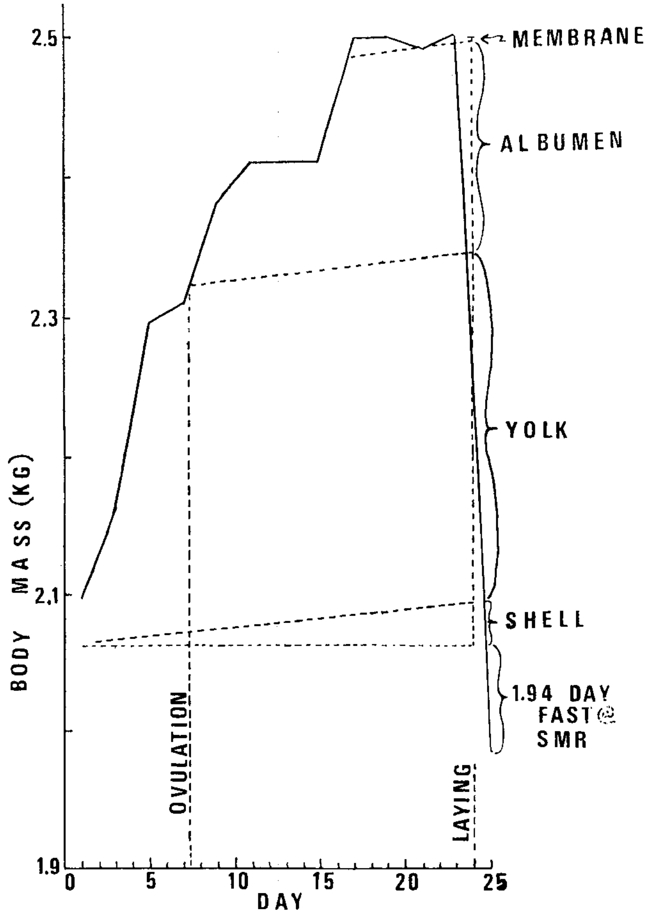

FIGURE 1 — The body mass changes of a female North Island Brown Kiwi between layings of successive eggs (day 0 and day 24) is shown by the solid line. The vertical line on day 24 shows the mass of the second egg, subdivided by brackets according to the composition of kiwi eggs (Reid 1971b and this study). We assume that the shell material is accumulated linearly through the egg cycle. Since the yolk is formed prior to ovulation, the increment due to yolk mass can be ascribed (3rd dashed line from bottom) to female mass change and at date of ovulation estimated thereby. At ovulation, 91% of the energy content of the egg has been incorporated. The contribution of albumen follows (4th from bottom). The difference between decrease in female associated with egg-laying and mass of egg laid probably represents fasting or reduced food intake at this time of obvious discomfort, and is equivalent to the energy requirement of 1.94 days at the standard (basal) 3 rate.

Welty (1975: 301) gave a table of intervals between eggs for various kinds of birds. The listing of the kiwi as 5 days is obviously incorrect, and assuming that the other data are correct, the kiwi exceeds significantly all other birds, the longest interval of which is represented by the megapodes in a 4 to 8 day category. Note that egg mass as per cent of adult mass, divided by interval between eggs, makes the kiwi more comparable to other birds.

The interval during which the hen's mass was monitored in the present study was 24 days. A maximum of 2.495 kg was maintained essentially stable between days 17 and 24. The egg weighed 0.432 kg, which subtracted from maximum body mass gives a value 0.035 kg below the mass at the start of the interval. We assume from this failure to " break even " on the one egg that the maximum mass of a second ovum calculated above from Kinsky (1971) would be related to the shortest intervals of 11 to 19 days between eggs. Thus we will neglect the minor contribution of egg 3 to the hen's mass changes between layings of eggs 1 and 2.

The yolk of a bird's egg is formed within the ovary, with the albumen added in the magnum of the oviduct and finally the shell membranes and the shell in the isthmus and the uterus respectively (Welty 1975).

The dry shell of a Brown Kiwi's egg contributes 5.3% of the total mass, the shell membranes 0.9%, the yolk 57.4% (61.1% of contents), and the albumen 36.5% (calculated from Reid 1971b). The infertile egg of this analysis had proportionately slightly more yolk (63.3% of contents), but we will use Reid's values, because the egg he analysed was so similar in size to the egg laid in the cycle reported here (434.6 g vs. 432 g). This egg would have had an estimated 23 g shell, 4 g membranes, 248 g yolk, and 157 g of albumen.

The shell of a domestic hen's egg is mostly calcium carbonate, the calcium for which is obtained from the diet over the entire cycle and an additional amount is reabsorbed from her bones (Welty 1975; Peaker 1975). In the kiwi, the mass of these bones is greater, being solid, amounting to 130 g to 168 g or about 6 times the mass of an eggshell (calculated from Reid & Williams 1975). While the shell is formed last, the mass of material involved is absorbed earlier and transferred internally (note the essentially unchanging body mass in the last week before laying). Thus we have assumed (Fig. 1) that this component of the mass increase is distributed linearly through the interval. To the bottom sloped line we add the 248 g yolk, which increment, parallel to the incremental increase in eventual shell material, intercepts the hen's mass curve during day 7 of the cycle.

This has profound implications. The yolk must have been completed by 7½ days into the cycle. The yolk contains 6.3 times as much energy per gram as the albumen, and there is 1.6 to 1.7 times as much yolk as albumen. The product of yolk size and energy content thus is 91% of the energy content of the egg. If this was acquired and deposited only in the one interval, 600.4 kilojoules (143.5 kcal) of energy would have to be stored per day, a power requirement of 6.95 watts. Rickleffs (1974, Table 12) assumes that the energy content of an egg must be multiplied by 1.33 to cover the cost of synthesis, so the power requirement of egg formation becomes 9.24 W.

On the other hand, the 35 g difference between her maximum mass less the egg (2.063 kg) and her starting mass for this cycle (2.098 kg) could represent yolk formed at the end of the previous cycle. This mass is similar to that estimated above for a 40 mm ovum, and at 18.16 kilojoules/g represents 636 kilojoules of energy which could be subtracted to give a lower value (4503 − 636 = 3867 kilojoules), or 516 kilojoules/day to complete the yolk during days 1-7½ of the cycle. This is equivalent to a 5.97 W incorporation or 7.94 W synthesis cost rate.

These estimated rates of synthesis of 7.94 to 9.24 W give a possible range, the magnitude of which can be appreciated by comparison to the standard metabolic rate of this hen, 4.55 W, or of 3 hens averaged, 4.27 W, which represents minimum maintenance cost. In addition to her maintenance, she must process energy at a rate of an additional 174 to 203% while forming yolk during the first week of a new egg cycle. Such a requirement should be reflected in the ecology and feeding behaviour of female kiwis. If intake and stored reserves are inadequate, egg-formation would, obviously, be inhibited.

Note that in the 48 hour period between weighings when the egg was laid, the decrease in mass exceeded the mass of the egg by 78 g. This could be the result of fasting during the period of discomfort just before laying and the observed behaviour of kiwi hens to remain with the egg for a period after laying, when they would be unable to feed.

King (1974) gave a figure of 2.09 kcal (= 8.74 kilojoules) metabolized per gram of body weight loss during fasting. Applying this factor to the loss in mass beyond egg mass, we have 690.8 kilojoules, which if " burned " at the standard metabolic rate of this bird would last 1.94 days, a reasonable approximation to the fasting period.

In conclusion, we feel that the combination of body mass changes, egg mass, and egg calorimetry can provide useful insight into the energetics of reproduction in kiwis.

ACKNOWLEDGEMENTS

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Affairs, have provided valuable suggestions and encouragement in matters of kiwi biology and care, and in the preparation of this manuscript. Marvin Bernstein, New Mexico State University, very kindly calibrated the rotameter.

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SHORT NOTES

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VARIATION IN HATCHING TO FLYING PERIOD OF NEW ZEALAND DOTTEREL CHICKS

NORTH ROAD, CLEVEDON

10/10/76, nest 2 eggs.
15/10/76, 3 eggs.
14/11/76, 3 very small chicks, estimated to be 2 days old at most.
10/12/76, 3 chicks, all flying well.

It may be presumed that the third egg was laid on the 11/10/76 and that incubation began in 12/10/76. If the chicks were actually two days old when found on 14/11/76 the hatching to flying period was approximately 32 days.

MAXINE E. McKENZIE

POLLEN ISLAND, UPPER WAITEMATA HARBOUR

3/11/74, nest 3 eggs.
4/12/74, 1 chick present, banded BG-51425. It could flutter only short distances so this could be taken as its flying date. The eggs were not chipped on the afternoon of 3/11/74. In other cases in this paper hatching has taken up to three days so if in this case it took place on 4, 5 or 6/11/74 the hatching to flying period would be 28, 29 or 30 days.

SYLVIA M. REED

MATAITAI, CLEVEDON

13/10/49, nest 3 eggs, 1 chipped.
14/10/49, 2 chicks had hatched.
15/10/49, third egg hatched but chick died.
19/11/49, 1 chick missing. The other, when chased, fluttered c 10 m, just clear of the ground, then froze and allowed itself to be picked up.
24/11/49, flew low and straight several times for up to 90 m at a time. Assumed to have first flown on 20/11/49 or 21/11/49 at 37 or 38 days.
Ref. Notornis 4: 24.

H. R. McKENZIE

MATAITAI, CLEVEDON

1/11/50, nest 3 eggs.
28/11/50, 2 tiny live chicks seen and 1 dead.
26/12/50, chicks banded, D5901 and D5902 at 28 or 29 days of age.
3, 6, 10, 13/1/51, not flying. Colour bands read.
17/1/51, D5901 flying, but not readily, at 51 or 52 days.

NOTORNIS 24: 136-143 (1977)

17/1/51, D5092 could flutter a few yards in weak flight in either 51 or 52 days from hatching.
Ref. Notornis 5: 16, 17.
(This long period could not have been due to weakness as D5092 was caught and rebanded by Sylvia M. Reed 26 years later).

H. R. McKENZIE

MATAITAI, CLEVEDON

25/12/50, nest 3 eggs.
13/1/51, 2 eggs chipping, 1 whole. The whole one later proved to have a large dead chick in it.
15/1/51, 1 chick 4 m from nest. 1 egg with cracks and two small holes in it.
16/1/51, 2 chicks gone from nest.
7/2/51, banded surviving chick, D5903. It was 46 days old when banded and showed no signs of flying. It was strong and healthy and could run as fast as the others had done but was not seen again on further visits. It was certainly not injured when banded. It was thought that a dog which prowled the flats may have killed it. This bird would probably have flown in about 50 days.
Ref. Notornis 5: 16, 17.

H. R. McKENZIE

Summary: Hence we have approximate periods of hatching to flying of 28-30, 32, 37-38, 50 and 51-52 days.

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SEA BIRD OBSERVATIONS OFF THE WEST COAST OF THE SOUTH ISLAND, NEW ZEALAND, OCTOBER-NOVEMBER 1975

From 29 October until 1 November 1975 I was a fisheries observer on board the deep-sea trawler *Shinkai Maru* which was engaged in exploratory fishing for the Japan Marine Fishery Resource Research Centre (JAMARC) off Greymouth, around 42°15′S and 170°40′ E, approximately 45 km from shore, mostly at depths between 200 and 500 m. Air temperatures ranged between 14.8 and 15.5°C, sea surface temperatures between 13.9 and 14.0°C, barometric pressure between 1007.0 and 1022.8 mb, and winds were mostly from the westerly quarter with speeds between force 3 and 7 (Beaufort scale).

During daytime the vessel was followed by 1000-1500 birds which fed on frequently discarded fish offal. This aggregation of birds consisted of the following ten species:

Royal Albatross	*Diomedea epomophora*
Wandering Albatross	*Diomedea exulans*
White-capped Mollymawk	*Diomedea cauta cauta*

Salvin's Mollymawk	*Diomedea cauta salvini*
Black-browed Mollymawk	*Diomedea melanophris*
Giant Petrel	*Macronectes giganteus*
Cape Pigeon	*Daption capensis*
Westland Black Petrel	*Procellaria westlandica*
Sooty Shearwater	*Puffinus griseus*
Black-backed Gull	*Larus dominicanus*

Within this group there were usually about 500 Westland Black Petrels, 300 White-capped Mollymawks, 200 Sooty Shearwaters, 50 Cape Pigeons and 20 Salvin's Mollymawks. The remaining five species were seen infrequently.

The Westland Black Petrels came so close to the ship that it was easy to obtain photographs which clearly show the identification characters discussed by Bartle (1974, *Notornis* 21 (2): 135-166, and 1975, *Notornis* 22 (4): 345-346): the large, pale, dark-tipped bill and angular flight silhouette with short neck and long narrow wings (Figs 1 and 2). The dark colour of the feet was visible when the birds alighted on the water (Fig. 3).

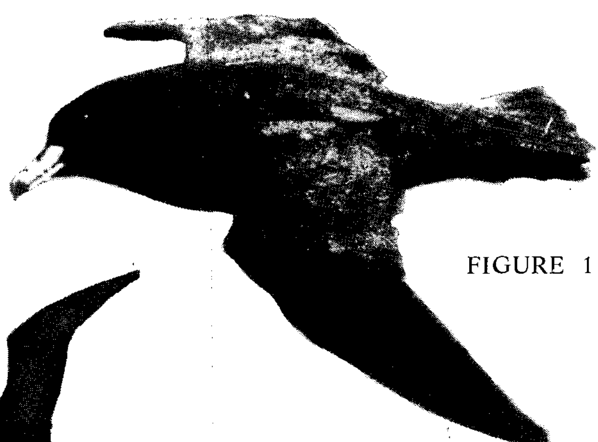

FIGURE 1

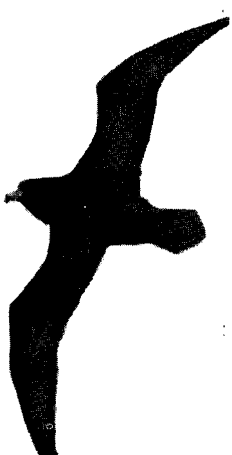

FIGURE 2

FIGURES 1 - 3 — Westland Black Petrel *(Procellaria westlandica)* off the west coast of the South Island, New Zealand, October-November 1975.

Photos: C. M. Vooren

While these observations were made, two other large deep-sea trawlers were fishing nearby, and both were followed by bird flocks similar in composition and size to the one around the *Shinkai Maru.* Apparently the habit of feeding on offal from trawlers, first observed in the Westland Black Petrel in the early 1950s (Bartle 1974), is now firmly established in this species. According to the description of the breeding cycle of the Westland Black Petrel given by Jackson (1958, *Notornis* 7 (8): 230-233), the chicks are still in the burrows at the time when the present observations were made. The birds seen around the trawlers were therefore breeding adults and/or unemployed birds.

Grey-backed Storm Petrels *(Garrodia nereis)* were frequently observed but did not follow the ship. At any time of the day, single individuals could be seen at a rate of roughly 1 bird per 10 minutes observation.

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N.Z. FALCONS TAKING POULTRY

Records of New Zealand Falcons *(Falco novaeseelandiae)* taking poultry are too numerous to mention and because of this habit the Falcon was frequently shot out of hand. The birds involved were usually the inexperienced juvenile females in their first autumn.

Two specimens which had attacked poultry were sent to me last winter; both had been previously banded by me in Marlborough. The first bird, an adult female banded 4 November 1975, was recovered in an exhausted condition after attacking a domestic duck in a water-hole. It was collected by a Raptor Association member, Greg Dunn, but died a few hours later. Examination of the bird showed no fat reserves and an 8 mm deep spike hole in the back of the skull penetrating at an angle, but missing the brain by about 1 mm. Festering indicated that the wound had been caused probably 1-2 weeks before death. The only object I could imagine which could cause such an injury without staying embedded was barbed wire. I have frequently seen trained Falcons in this study flying between barbed wire strands or through pig-netting, fortunately without injury. However, I know of a trained Goshawk *(Accipiter gentilis)* in Britain which had the top of its skull completely torn off by flying under barbed wire.

The second specimen, banded as a juvenile female on 27 December 1975, attacked and was killed on a domestic hen on 25 April 1976. Examination of the Falcon showed a deep cut across the front of one foot. The cut was inflamed, rendering the foot swollen and useless. The only thing I could think of which could cause such a clean straight cut were telephone wires. In this area there were only 2 wires, and the poles were spaced about 100 m apart, making the wires virtually invisible against a background of broken scrubby terrain. I observed a Falcon using one of the poles as a hunting perch and also saw a Grey Duck *(Anas superciliosa)* strike the wire in full flight. The duck was on the ground for about 5 minutes but flew off as I approached. On another occasion I saw an Australasian Harrier *(Circus approximans)* strike power wires, but as it was only flying slowly it recovered before it hit the ground.

The pesticide levels in these two Falcons were not as high as in some other specimens (details to be published later), but Ratcliffe (*Bird Study* 1972: 117-147) considered that low pesticide levels in Peregrines *(Falco peregrinus)* may cause unco-ordination, resulting in mis-timed stoops.

As these are the only two Falcons taking poultry which I have examined, there is obviously no case to assume that all N.Z. Falcons taking poultry are in some way incapacitated, but it is a sobering reflection that the probable causes of these injuries were man-made hazards.

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JUVENILE CHATHAM ISLAND SHAG OBSERVED OFFERING NEST MATERIAL TO A BREEDING ADULT

On 22 November 1973 I observed a small breeding colony of Chatham Island Shags *(Leucocarbo carunculatus onslowi)* from 12.15 to 3.15 p.m. on the main Chatham Island at Cape Fournier near Owenga.

The clifftop colony comprised a tight knit group of 60+ nests with another group of 20 nests some 50m distant. There was a distinct difference in the stage of development between both groups in the colony. The larger group contained many nests with 1-4 large, downy chicks, some with flight feathers. There were also some nests with smaller young and the odd nest still contained eggs. In the smaller sub-colony further along the clifftop most of the nests still contained eggs, although in one nest there were chicks with the egg tooth still visible. One or two juveniles from the previous year were also present around the colony.

The plumage of the juveniles was brownish on the head, back and wings with grey-white on the underside in comparison to the black and white of adults. The caruncles of juveniles were also less developed.

While observing birds in the smaller group, one of the juveniles appeared from the larger group, proceeded past the smaller group and disappeared further around the cliff. This juvenile re-appeared later with a beakfull of dried plant material and walked back to the larger nesting group. As it approached the perimeter of the group some of the adults on nests near the edge of the group threatened with necks stretched forward, bills open and uttering a quiet gutteral noise. The juvenile shag walked up to one of these displaying adults sitting tight on a nest at the edge of the colony and placed the material in the adult's opened bill. The material was then incorporated into the nest while the juvenile stood nearby.

Nesting adults threatened in a similar manner to that already described when a human intruder passed close to the colony, and on a similar, though more localised scale, when an intruding bird passed close to an occupied nest.

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FLUCTUATIONS IN WHITEHEAD POPULATION

The numbers of the Whitehead *(Mohoua albicilla)* recorded in the Mount Holdsworth area of the Tararua Range have shown considerable variation during the past fifty years, suggesting a cycle of decline or a periodic abandonment of habitat. The Whitehead is not confined to forest areas as it occurs also in some places in scrub lands far from extensive bush.

During the twenty years up to 1939 the Whitehead was recorded on every visit to the Mount Holdsworth area. In that period 25 excursions were made to this region, especially to Donnelly's Flat but also occasionally to the Mountain House and to the summit. Invariably the Whitehead was present.

In the 1940-1949 decade, on 6 of the 18 visits no Whiteheads were recorded, the first nil return occurring in 1940. In the 1950-1959 period 11 out of 14 visits failed to find the bird; all those that were recorded were in 1950. In 1960-1972 on 9 out of 14 visits the bird was missing, the first records of its reappearance being in 1969, with three records since then up to 1972. Thus, in the period 1951 to 1968 inclusive no records of the Whitehead were forthcoming in an area which prior to 1940 never failed to disclose the presence of this species on every visit. The area traversed was the same throughout.

One visit of some significance was that of 5 March 1950 when a tramp was made to Totara Flats via Holdsworth and back. Not a single Whitehead was recorded during the whole trip when a record was kept of all birds seen or heard. All the usual bush species including the Kaka *(Nestor meridionalis)* were recorded except the Whitehead and Parakeet (*Cyanoramphus* spp.).

It should be noted that in the period of no records in the Mount Holdsworth area the Whitehead was present in the Kiriwhakapapa Valley to the north in 1955, 1966 and 1967 and also in the more isolated Mount Bruce Bush, where the Bird Reserve is now located, in 1951, 1967-1969. Elsewhere, in the eastern portion of the Wairarapa-East Coast district I have recorded the presence of this species in several localities (Stidolph 1971, *The Birds around us,* Masterton: 104-105) during the same period.

It would appear that the Whitehead is subject either to cyclic fluctuations in population or that it forsakes certain areas for a period. In the latter part of last century Sir Walter Buller lamented the rarity of the once common Whitehead, which, however, some years later, 1920-1940, from my own observations was well distributed and numerous in bush districts in the Wellington province, even including small isolated bush areas well away from the main forests. It could well be that Buller's (1905, *Supplement to the Birds of N.Z.,* II: 129) comments were made in a period of decline, since when the population had expanded again up to 1940, when another recession began, as in subsequent years, apart from the Holdsworth area, I have failed to find this bird in some Wellington district areas where it was recorded earlier.

It may be pertinent to mention that surprisingly large numbers were found on a visit to cut-over bush at Erua in the Waimarino district on 17 October 1947. In a walk along an old logging track from National Park to Erua and back no less than 31 Whiteheads were recorded, as compared with 40 Bellbirds *(Anthornis melanura)*, 31 Grey Warblers *(Gerygone igata)*, 14 Riflemen *(Acanthisitta chloris)*, 12 Tomtits *(Petroica m. toitoi)* and three Robins *(P. a. longipes)*. In the bush all the millable trees had been removed and the bush had been well opened up. It is noteworthy that this date is within the breeding season.

That the Whitehead is not confined to forests is indicated by its presence also in second growth and remnant beech in the Wairarapa-East Coast district, miles away from any extensive bush area. Moreover, on 1 March 1953, Ray Wilkinson (who for years resided on Kapiti Island Bird Sanctuary) at Hatepe, Lake Taupo, saw 50 Whiteheads in manuka and kowhai near the lake shore and he estimated that there would be 200 in the area, as the birds were distributed all through it.

On Kapiti Island, in my experience, a favourite breeding area of the Whitehead was, at that time, in the shrubby fringe of the bush at and around Rangatira, interspersed, as it was up to the end of 1942, when my intimate knowledge of the island ceased, with grassy areas where shrubs such as manuka, tauhinu, kaikomako, kohuhu and small-leaved Coprosma were chosen as nest sites.

Areas of scrub and second growth tend to be neglected ornithologically and it may be that the Whitehead is to be found in these areas more than is generally recognised.

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REVIEWS

Wishbones for Wetmore: Olson, Storrs L. (Editor) 1976: Collected Papers in Avian Paleontology Honoring the 90th Birthday of Alexander Wetmore. *Smithsonian Contributions to Paleobiology* 27, 211 pp., illus.

This *festschrift* for America's greatest ornithologist contains eighteen research papers on fossil birds. They are prefaced by a portrait and by appreciations by S. Dillon Ripley (Secretary of the Smithsonian Institution), Delacour (" one of the few ornithologists of our generation still alive ") and the editor, whose article appraises the current status of the study of fossil birds and Wetmore's great and sustained contribution thereto, and are followed by a list of his 155 papers on the subject and an index of fossil birds named in them. Comment here is largely devoted to papers of universal interest and to one of special relevance to New Zealand.

J. H. Orstrom discusses hypothetical anatomical stages in flight evolution from *Archaeopteryx*, which he believes could not fly (despite its well developed flight feathers, emphasized by Bernard Tucker (1938) in a scholarly paper, not cited by Orstrom, in *Evolution. Essays . . . presented to Professor E. S. Goodrich*, ed. G. R. de Beer, Oxford). Consistently (and in contrast to de Beer's interpretation of 1954 in his British Museum monograph *"Archaeopteryx lithographica,"* 68 pp. London) Orstrom maintains there is no evidence for an ossified sternum in *Archaeopteryx*, implying that it was cartilaginous, probably not carinate, and perhaps membranous. The skeletal characters of *Archaeopteryx* are interpreted as placing " the hands and their activities directly in front of and *above* the animal " suggesting climbing and prey-catching. Orstrom argues that there is no compelling evidence for *Archaeopteryx* being arboreal, the anatomy appearing adapted for ground-dwelling activities, a return to the views of Nopsca (1907, *Proc. zool. Soc. Lond.*: 233) which allowed P. R. Lowe (1928, *Proc. zool. Soc. Lond.*: 185) to suppose the Ratites to be primitively flightless terrestrial and cursorial birds. Orstrom supposes *Archaeopteryx* was insectivorous (" almost certain "), grasping its prey " in the hands or snaring them beneath the forelimb plumage." " The original advantage behind the enlargement of the contour feathers of the forelimb was to enhance insect-catching skills " (but if so why should the whole Class Aves have abandoned this forelimb function after flight was learned ?). Thus the " remiges " of *Archaeopteryx*, " diastataxic " as in flying birds (according to H. Steiner 1918, *Z. Naturw.* 55: 221) are explained as serving quite a different function, before flight was accomplished. There is still much food for thought in *Archaeopteryx*, some meat left on this chicken.

P. D. Gingerich (" Evolutionary Significance of the Mesozoic Toothed Birds ") has confirmed that the Upper Cretaceous *Hesperornis* had toothed jaws and a palaeognathus palate, a condition shared with ratites and certain dinosaurs, and was thus intermediate between dinosaurs and typical birds. He thus rejects Cracraft's view (1974, *Ibis*

116) that the palaeognathous palate is a derived state. Features uniting Ratites and tinamous are primitive, suggesting that they are either survivors of an early radiation of birds or a more recent " artificial group in which primitive characters have reappeared secondarily through neoteny."

L. D. Martin & J. J. Tate Jr. describe in detail " The skeleton of *Babtornis advenus,*" a large loon-like diving bird related to its contemporary *Hesperornis* in the Late Cretaceous. Both are " very primitive birds, which in some characters appear to be little modified from *Archaeopteryx.*" Pierce Brodkorb describes a Cretaceous bird apparently ancestral to the Coraciformes and Piciformes. E. N. Kurochkin (Akademia Nauk, Moscow) surveys the Paleogene birds of Asia, which now amount to 350 satisfactory postcranial specimens. There are also papers of less interest to New Zealand on a Paleocene owl (Rich & Bohaska), the Eocene Piciform *Neanis* (A. Fiduccia) and other North American Piciformes (Fiduccia & Martin), Oligocene Coraciiformes (Olson), an Eogene *Aegialornis* and Miocene swifts (C. T. Collins), a Miocene osprey (S. L. Warter), a flightless auk from the Miocene of California (H. Howard), Pleistocene Grebes (R. W. Stover), a late Pleistocene fauna from Ecuador (K. E. Campbell), giant Pleistocene predators from Cuba (O. Arredondo) and the extinct flightless duck of California (G. V. Morejohn).

A REVISION OF THE MOAS

Of direct relevance to New Zealand is " The Species of Moas (Aves: Dinornithidae)" by Joel Cracraft, who reviews the species-level systematics of the moas after analysing intraspecific variability among the specimens in the Britsih Museum, American Museum of Natural History, Field Museum of Natural History, and Canterbury, Otago and National Museums in New Zealand; supplemented by data from Auckland Museum specimens obtained from Archey's monograph (1941, *Auck. Inst. Bull.* 1). All species recognised by Oliver (1949, *Dom. Mus. Bull.* 15) were examined except for *Pachyornis murihiku, Anomalopteryx antiquus, Megalapteryx hectori* and *M. benhami,* but apart from *M. benhami* these are probably invalid. Dimensions of hindlimb bones were analysed both by standard univariate procedures and by several multivariate statistical techniques to determine variability patterns in relation to species distinctness and sexual dimorphism.

As a basis for comparison Cracraft studied the variability of a Kiwi, *Apteryx australis* (sample from Castle Rocks Cave), and of four moas believed to be " good " species: *Megalapteryx didinus, Anomalopteryx didiformis, Dinornis torosus* and *Pachyornis elephantopus.* Coefficients of variation are generally greater than found for the Emu. He believes temporal variation relatively unimportant but geographic variation important, partly inter-island (NorthIsland/South Island) but also suggests there is intra-island variation due to post-glacial contact and sympatry of isolates differentiated morphologically in separate forest refugia; " some of the variation observed may be the result of recent character displacement in size following this contact."

As a result of these investigations, Cracraft classifies the moas as follows (N, North Island; S, South Island; NS, both islands): *Anomalopteryx didiformis* (NS), *A. oweni* (N); *Megalapteryx didinus*

(S), *M. benhami* (S); *Pachyornis mappini* (N), *P. elephantopus* (S); *Euryapteryx geranoides* (NS), *E. curtus* (N); *Emeus crassus* (N?, S); *Dinornis struthoides* (N, S?); *D. novaezelandiae* (NS), *D. giganteus* (NS), *D. torosus* (S). When this is compared with R. J. Scarlett's rationalisation of moa classification (1972, " Bones for the New Zealand Archaeologist," *Canterbury Mus. Bull.* 4) based on much practical experience without the help of a computer we find, not surprisingly, that Scarlett anticipated most of the conclusions (e.g. in *Anomalopteryx, Megalapteryx, Emeus* and in his treatment of *P. elephantopus, Dinornis struthoides* and *D. torosus*. Scarlett's more tentative suggestions for other species of *Pachyornis* and *Euryapteryx* also approached Cracraft's while his acceptance of North/South Island species pairs in *Dinornis (giganteus/maximus* and *novaezelandiae/robustus)* is only nomenclaturally different from Cracraft's recognition of North/South size differences within *D. giganteus* and *D. novaezelandiae.*

Even among flying birds, North and South Island populations generally differ subspecifically after about 10 000 years of isolation by Cook Strait, in plumage as well as size, though often with wide overlap. The apparently clear separation of *Dinornis torosus* and *D. struthoides* is comparable with that of *Mohoua albicilla* and *M. ochrocephala,* whereas the overlapping *dimensions* of *Dinornis giganteus* and *D. maximus* and of *D. novaezelandiae* and *D. robustus* are more like the subspecies of *Petroica* or *Philesturnus.* We can only guess whether these Moas (like *Apteryx australis*) differed in plumage as well as dimensions, but at least their degree of differentiation at Cook Strait was comparable with that of less mobile members of the Passeres.

Cracraft's paper makes a long overdue contribution to the treatment of Dinornithiformes as living populations. It will doubtless provoke further work and thought, for it is not quite the last word. Thank goodness !

C. A. F.

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Birds of Paradise — The World's Glamour Birds. *B.H.P. Journal* 2: 76.

An interesting contribution to the literature of these fabulous birds is a short article by W. S. Peckover. It is beautifully illustrated by his own colour photographs and two splendid paintings by Bill Cooper.

Those birds which have the brightest colours and gaudy display plumage are usually promiscuous breeders. A group of males display in a chosen tree and one is selected by a watching female. After mating she will be chased off to undertake nesting activities alone while he will continue his display with the other males " awaiting the arrival of the next adult female who has selected their display tree for her quick time mate."

Of the 43 species, five are black, male and female almost alike and these follow " normal " breeding patterns, with a pair bond lasting at least one season, and the male assists with nest building, brooding and feeding the offspring. " Ornithologists now believe that pairing for breeding is a recent development while promiscurity is the 'old' way of living in the Bird of Paradise family."

Although huge numbers of birds are taken by natives by traditional means — shotgun shooting being heavily penalised — the native landowners protect the display trees which are used season after season. They " practice sensible conservation methods allowing at least one fully plumed male to survive at each display tree. So even the Lesser and Raggiana Birds of Paradise, the ones that are the most used in headdresses, are not endangered by traditional style hunters " (the chief threat is the replacement of the forest by agricultural land).

The article appears in the undated " *B.H.P. Journal*, 2.76," pages 35-41. The reviewer's copy was received in January 1977 from the Public Affairs Department of Broken Hill Proprietory Company Ltd., 140 William Street, Melbourn, Australia 3000. Copies may be obtained by writing to the editor.

J. M. C.

ABOUT OUR AUTHORS

ROBERT ("BOB") ST.PAUL came to New Zealand with his family from England when less than a year old and spent his school years at Moumoukai Valley in the Hunua Ranges. A sturdy youth, he left school very early and in 1912 went bushfalling and pitsawing, working from Awanui in the north, Wanganui in the west, National Park in the south and all about the King Country and western Urewera. After being a bush boss for a long time he went postsplitting independently. He is a brother of J. W. and E. St.Paul, whose names have appeared often in *Notornis*. Dr Gilbert Archey (later Sir Gilbert) met him at Tihoi, recognised his ornithological potential and enlisted him as a member of the Ornithological Society of New Zealand, getting him to send his daily bird notes to R. B. Sibson, who, when he went overseas handed him over to H. R. McKenzie, who put him on to monthly detailed charts. These charts were faithfully compiled and are a mine of information. In 1961 his health failed and he went to live at Waikino, still keeping a close interest in birds. His files are eventually to be deposited in the OSNZ library.

BRIAN GILL completed a B.Sc. (Hons.) degree in Zoology at Massey University in 1975, and is currently studying breeding of the Grey Warbler and Shining Cuckoo at Kowhai Bush (Kaikoura) for a Ph.D. at Canterbury University. Apart from bird-counts, he has also worked on the Whistling Frog (1973, *Proc. N.Z. Ecol. Soc.* 20: 31-4), and on skinks (1976, *N.Z. Jl Zool.* 3: 141-57) in the coastal Manawatu.

C. JOHN RALPH, a member of the OSNZ for several years, has recently joined the U.S. Forest Service as a Research Ecologist, studying forest birds in Hawaii, especially endangered species. These studies include censusing, banding, food habits, breeding biology and energy budgets to help determine the factors limiting their populations, Much of his research in the past has focused on migration, but he has studied breeding and wintering birds as well. He was co-founder of the Point Reyes Bird Observatory in California and the Ashby Bird Observatory in Massachusetts, and served as the Director at Point Reyes for four years. After receiving his doctorate, he taught animal behaviour and ecology in Pennsylvania for three years before being offered the position in Hawaii. The kingfisher study was occasioned by a visit to various research centres and workers in New Zealand. While driving between areas, he took the opportunity to make notes on the species.

CAROL PEARSON RALPH first turned her attention seriously to birds during a year in Argentina with her parents, both field biologists. This interest later took her to the Point Reyes Bird Observatory, where she joined C. John Ralph in studying breeding sparrows. During her graduate studies at Cornell University, she studied and published on birds in Colombia and Peru; then, for her doctoral dissertation she turned to a colourful insect, the Large Milkweed Bug, and its special relationship with its host plant. As a collaborator with the U.S. Forest Service and U.S. Fish and Wildlife Service, she currently is expanding her entomological interests by identifying the insects important as food for the Hawaiian forest birds.

WILLIAM CALDER III says that he was introduced to birds by a boyhood companion, now Prof. L. Hugh Moore, and members of the Atlanta Bird Club. He did graduate research in bird physiology at Washington State University (Zebra Finch) and at Duke (Roadrunner). He co-authored " Caloric and thermal relationships of birds " with Dr James R. King (Vol. 4, *Avian Biology,* D. S. Farner & J. R. King eds.). Professor Calder is in New Zealand on sabbatical leave from the University of Arizona for his study of kiwis. He says that he is " frantically trying to see as much of kiwi country as I can before continuing on to labs in Australia and a symposium on bird and egg respiration in Germany " and returning home.

BARRY ROWE is a pharmacist in retail business in Otorohanga. He has been closely associated with the planning, building and subsequent operation of the Nocturnal Kiwi House and allied units at Otorohanga, and is currently curator of the kiwis there, including all three species. He writes: " I believe in the principle of the aviculture of our native species as a means of propagation of the rare species in particular and of developing an understanding of all species."