

Comparison of little spotted kiwi (*Apteryx owenii*) from Kapiti and D'Urville Islands

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ABSTRACT

The Kapiti and D'Urville Islands populations of little spotted kiwi (*Apteryx owenii*) are the only two long-standing populations of this species that have survived the decline of kiwi in the 20th century. The populations were compared to determine their conservation status and to provide a basis for management decisions for the two surviving birds from D'Urville Island. Measurements, voice, ectoparasites, and genetic variation, as determined by allozyme electrophoresis, of birds from the two populations were analysed. Birds from the populations were found to be very similar with little genetic variation (0 loci for D'Urville Island birds and 3 loci for Kapiti Island birds).

The origin of the Kapiti Island population was believed to be from an introduction of birds to the island. However, searches of archives show that brown kiwi were introduced to Kapiti Island, but that there is no conclusive evidence to justify the belief little spotted kiwi were also introduced.

We recommend that management continues with the mixed Kapiti Island and D'Urville Island population on Long Island, and also that future excess progeny sourced from D'Urville Island stock should be transferred to another suitable island.

1. INTRODUCTION

The existing populations of little spotted kiwi (*Apteryx owenii*) originate from the two long-standing populations that survived the decline of this species in the twentieth century to near-extinction. The first population, on Kapiti Island, has probably more than 1000 birds (Jolly & Colbourne 1991; J.N. Jolly, unpubl. data) and is the source of recently established populations on three other islands. The second, on D'Urville Island, has probably dwindled to extinction. Two birds from D'Urville Island were transferred to Long Island, Queen Charlotte Sound (one female in 1982 and one male in 1987). They were provided with mates from Kapiti Island (two males in 1982, one female in 1989). The D'Urville Island female and one of the males from Kapiti Island had bred successfully by 1987 and reared at least one offspring (a male) to independence by 1987 (Jolly & Colbourne 1991). One of the males from Kapiti Island was removed from Long Island in 1989; and the number of kiwi on Long Island has steadily increased (Colbourne & Robertson 1997).

A better understanding of the relationship of the Kapiti and D'Urville Islands populations of little spotted kiwi is needed to determine their conservation status and to choose the appropriate management options for the birds on Long Island. Should they continue to be allowed to interbreed freely or should an attempt be made to breed back to the purer D'Urville Island stock? In the near future a decision may also be needed on whether to transfer excess progeny from the limited habitat on Long Island, either to establish a new founder population or to mix with birds removed from Kapiti Island.

The two islands are 75 km apart on opposite sides of Cook Strait. D'Urville Island is only 500 m from the nearest point of the South Island whereas Kapiti Island is 5 km from the south-west coast of the North Island. Exotic mammals present on D'Urville Island include stoats (*Mustela erminea*), pigs (*Sus scrofa*), red deer (*Cervus elaphus*), dogs (*Canis familiaris*), cats (*Felis catus*) and farm stock (Baldwin 1983), reflecting the island's closeness inshore, its size (15 000 ha) and its human habitation. In contrast, the value of Kapiti Island for conservation purposes was recognised last century (Buller 1888). Large populations of possums (*Trichosurus vulpecula*), feral goats (*Capra hircus*), sheep (*Ovis aries*) and rats (*Rattus norvegicus* and *R. exulans*) have been exterminated (Wilkinson & Wilkinson 1952; Cowan 1992; Empson & Miskelly 1999), and a variety of native birds introduced.

Among the species introduced to Kapiti Island were both North Island brown kiwi and South Island brown kiwi (*A. a. mantelli*, *A. a. australis*) (Turner 1913; Thomson & Turner 1917; Herbert & Daugherty, this volume). The origin of little spotted kiwi on Kapiti Island is less certain. Various authors have claimed that the population originated from an introduction of five birds in 1912 (Stidolph 1948; Wilkinson & Wilkinson 1952; Oliver 1955; Reid 1985; Atkinson 1990). None of these authors refer to primary sources. Wilkinson and Wilkinson (1952), who were nearest to contemporary to the event, expressed doubt as to which species of kiwi were introduced. Information on little spotted kiwi on D'Urville Island is sparse and refers only to their recent status (Baldwin 1983; Jolly 1987).

Two male little spotted kiwi from D'Urville Island, that were temporarily held in captivity, appeared larger than birds from Kapiti Island and prompted a suggestion that they should be considered separate subspecies (B.E. Reid & B. Rowe, pers. comm., 1980). In the present paper we report on a detailed comparison of birds from the two islands, using an analysis of measurements, allozyme electrophoresis of blood samples, and a limited comparison of their calls and ectoparasites. We also examine historical accounts to determine the likely origin of little spotted kiwi on both islands, and discuss appropriate options for management of the birds on Long Island.

2. METHODS

2.1 Allozymes

Allozyme electrophoresis measures Mendelian genetic variation at many loci. It has been a powerful technique for assessing population and species level differentiation (Allendorf et al. 1977; Richardson et al. 1986).

Blood samples were collected from two birds (one male, one female) from D'Urville Island and 30 birds from Kapiti Island. The method of allozyme electrophoresis followed Allendorf et al. (1977) and Daugherty et al. (1990).

2.2 Morphometrics

Three measures (exposed bill, tarsus, mid-toe) and weight were recorded from 4 adult birds (three male, one female) from D'Urville Island and 102 adult birds (56 male, 46 female) from Kapiti Island. Exposed bill was measured from the front edge of the cere to the tip of the bill. Tarsus was measured from the top of the joint of the femur and tibio-tarsus to the joint between tarsus and base of mid-toe (flexed). Mid-toe was measured from this joint to the base of the claw. All measurements were made with vernier calipers measuring to 0.05 mm or with a 2 kg Pesola spring balance weighing to the nearest 10 g.

2.3 Voice

The nature of calls was noted from listening stations in all four territories of D'Urville Island birds and throughout Kapiti Island. Calls of one female and one male from D'Urville Island and several males and females on Kapiti Island were recorded on both a Uher reel-to-reel recorder and a Sony three-head 'broadcast', cassette recorder. These calls were compared later by ear and by sonogram.

2.4 Ectoparasites

The taxonomic relationships of feather lice (Mallophaga) have proved useful in separating species of birds (Pilgrim & Palma 1982). We attempted to collect feather lice from all four D'Urville Island kiwi and from a sample of kiwi from Kapiti Island by spraying their plumage with 'Nuvan'TM. Identifications of parasites were made by Ricardo Palma (Mallophaga) and Dallas Bishop (feather mites/*Kiwialgae* spp.).

2.5 History of the populations

References to the presence and introductions of birds of Kapiti Island were sought in the annual reports of the relevant government departments (*Appendix to the Journal of the House of Representatives*), in departmental files, the ornithological literature, and the personal papers of: Richard Henry, Caretaker of Resolution Island 1894-1907 and of Kapiti Island 1908-11; W.R.B. Oliver, ornithologist; R.H.D. Stidolph, ornithologist; J.A. Thomson, Director of the Dominion Museum; E. Phillips Turner, Inspector of Reserves c.1910-20; and A.S. Wilkinson, Caretaker of Kapiti Island 1924-42.

References to kiwi on D'Urville Island were sought in local histories, particularly Baldwin (1983), published records, and personal papers of island residents.

3. RESULTS

3.1 Allozymes

Allozyme variation was identified at 29 loci. The two birds from D'Urville Island were homozygous at all loci. Variation was detected at only 3 loci in the Kapiti Island population, but in every instance the most common allele was that found in the D'Urville Island population. A single heterozygote was detected in the Kapiti Island population for loci *Ak-1* and *Hb-3* (frequency of variant = 0.018). At *Pgi-1*, a variant allele occurred in a frequency of 0.25, and the genotypes occurred in Hardy-Weinberg proportions.

3.2 Morphometrics

The mean weight of the three male kiwi from D'Urville Island (mean = 1443 g, $N = 3$) was significantly greater than the mean weight of Kapiti Island males (mean = 1135 g, $N = 51$), and the weight of the one female from D'Urville Island (1530 g) was near the upper end of the range of weights of Kapiti Island females (1125-1570 g, $N = 41$). However, the bill, tarsus and mid-toe lengths of males from the two islands were not significantly different, and only the mid-toe length of the female from D'Urville Island was near the (lower) limit of the range for Kapiti Island females (Table 1).

The three kiwi removed from D'Urville Island in 1980 were noted to be in 'excellent condition' (B.E. Reid, C. Roderick, pers. comm., 1980). Their well-spaced territories probably explain their better condition and greater weight compared with kiwi living at high density on Kapiti Island.

3.3 Voice

Calls were described during 270 hours of listening on Kapiti Island and 17 hours of listening at all four territories of kiwi on D'Urville Island. One male on D'Urville Island occasionally gave a call that was not heard on Kapiti Island (lower in pitch, soft and more drawn-out). Otherwise, the calls of the kiwi on both islands, including this bird, were essentially the same with only a minor difference in note being detectable by ear.

Sonograms of contact calls (the loud call of kiwi) show only minor differences in pattern and frequency (B.D. Bell, pers. comm., 1993) that may be consistent with differences between individuals.

3.4 Ectoparasites

Feather lice were not found on any of the four D'Urville Island birds. The same two species of feather mites (*Kiwialges palametricbus* and *K. phalagotrichus*) were found on birds from both islands (D. Bishop, pers. comm., 1987).

3.5 Archival history of the populations

Those authors that cite a source for their statements that little spotted kiwi were introduced to Kapiti Island refer either to an introduction of five kiwi in 1912 (Stidolph 1948; Reid 1985) or to Stidolph in their personal papers (Oliver 1955). That release was attributed to E. Phillips Turner, then Inspector of Reserves. However, Thomson and Turner (1917), in a report of the Advisory

TABLE 1. COMPARISON OF SIZE OF LITTLE SPOTTED KIWI FROM D'URVILLE AND KAPITI ISLANDS.

	WEIGHT (g)	BILL LENGTH (mm)	TARSUS LENGTH (mm)	MID-TOE LENGTH (mm)
Females				
D'Urville Island				
Number	1	1	1	1
Mean	1530	80.0	80.5	40.7
Kapiti Island				
Number	41	24	46	10
Mean ± S.D.	1351 ± 163.7	85.1 ± 4.0	79.7 ± 4.3	49.4 ± 3.64
Range	1125-1570	75.1-93.8	69.4-86.7	40.7-53.4
Males				
D'Urville Island				
Number	3	3	3	3
Mean ± S.D.	1443 ± 130.13	66.4 ± 1.88	75.7 ± 1.76	51.0 ± 2.84
Range	1310-1570	64.2-67.6	74.0-77.5	49.2-54.3
Kapiti Island				
Number	51	44	56	13
Mean ± S.D.	1135 ± 118.78	68.0 ± 2.13	74.1 ± 3.03	47.1 ± 3.97
Range	880-1360	63.5-71.5	65.6-78.5	38.5-50.0
T	2.58	0.76	0.54	1.02
P	0.02	n.s.	n.s.	n.s.

Committee on New Zealand Birds on the presence or absence of birds on the chief sanctuaries (including Kapiti Island), recorded that both North and South Island kiwi (*A. australis*) were liberated on Kapiti Island. They noted that their breeding status was not known. They did not record the liberation or presence of *A. owenii* on the island, but noted that either *A. australis* or *A. owenii* were seen in 1916. Turner (1913, 1915, 1929) also wrote that 'On 12th October, 1912, I liberated on Kapiti Island 5 kiwi and 3 kakapos which were procured from Jackson's Bay. (These would be South Island kiwi.)' The introduction of kiwi referred to by previous authors was clearly of South Island brown kiwi, not of little spotted kiwi.

There remains the possibility of other introductions not referred to by previous authors. Buller reported (Galbreath 1989) that attempts to preserve native birds by introducing them to offshore islands, a proposal given weight by the support of Lord Onslow, Governor of New Zealand, were yet to be put into practice in 1895. Thus planned liberations before that date would be unlikely. However, they soon followed with Henry's work in Dusky Sound and a liberation of weka on Kapiti Island itself in 1896. There followed a number of releases of birds on Kapiti Island that are all documented in the annual reports of either the Department of Lands and Survey or the Department of Tourism and Health Resorts in the *Appendix to the Journal of the House of Representatives*. North Island brown kiwi, for example, were released in 1915, 1931, 1935 and 1940. However, there are no references to the release of little spotted (little grey) kiwi.

Two reports of introductions of kiwi (species not identified) appear to be false. The first was recorded by Wilkinson and Wilkinson (1952) and attributed to

Richard Henry in July 1908. This was the month Henry arrived on Kapiti Island from Dusky Sound. Although details of his transfer, including arrangements for his luggage, equipment and boat, are recorded both in his correspondence and in departmental memoranda, there is no mention of any birds to be shipped to Kapiti Island. Nor is there a record of the liberation of kiwi in the annual report of his department, although this would have been the first liberation of kiwi on Kapiti Island. In addition, both Henry and his successor as caretaker of the island (J.L. Bennett) were asked to report on the liberation of rare birds on Kapiti Island in 1907, but a liberation of kiwi in 1908 was not mentioned (Henry 1909; Turner 1915).

The second doubtful record (Brook 1924) is of seven kiwi liberated in October 1923. However, the record is taken from the report of the same caretaker, J.L. Bennett, who reported (in error) that seven kiwi were liberated in October 1913. It appears that the date was transcribed incorrectly, particularly as Wilkinson, who took over as caretaker of the island in 1924 and recorded all introductions of birds, did not record this introduction (Wilkinson 1940; Wilkinson & Wilkinson 1952).

If little spotted kiwi were not introduced to Kapiti Island, there is the possibility that their presence was recorded before or at the time of the introductions of other birds. Buchanan (1876), Drew (Cowan 1907), Drummond (1908) and Girdlestone (1914) compiled bird lists during their visits to Kapiti Island, but none recorded kiwi. All of the lists were incomplete in omitting species, particularly the nocturnal species, recorded by others. Even 13 years after the first introduction of kiwi, Wilkinson (1925, 1949) commented that they were heard very rarely and were present at only three places on the island. It was only in 1929, after five years residence on the island, that Wilkinson was able to determine that both brown and little spotted kiwi were present. Little spotted kiwi were clearly present in very low numbers at this time, as would be expected with half the island cleared for grazing and feral goats, sheep and cattle (*Bos taurus*) roaming the whole island (Cockayne 1907).

The history of little spotted kiwi on D'Urville Island is much less well documented. There has not been any suggestion in the literature that kiwi were introduced to the island, and Webber (n.d.) recorded that kiwi were present in 1895. The population had dwindled to a few individuals by 1980.

4. DISCUSSION

All findings support the view that the two populations of little spotted kiwi are very closely related. Only the weights were significantly different, probably reflecting the excellent condition of the few surviving birds on D'Urville Island rather than any intrinsic difference.

The two populations were probably in reproductive contact during the last glaciation (10 000 years B.P.), when Cook Strait was bridged with forested land (Stevens 1980). Little spotted kiwi were present on the mainland adjacent to both islands last century (Buller 1888; Handly 1895; Sclater & Hochstetter 1861), and there is no physical reason why kiwi should not be present naturally on both islands.

Low genetic variation in the two D'Urville Island birds (homozygous at all loci) is expected in such a small population. However, variation that may have existed in the population could have been missed with the small sample of 29 loci from the total genome, and with samples from only two birds. Variation at only 3 loci in the 30 Kapiti Island birds tested is consistent with the characteristics of either a population that increased slowly from an introduction of a few birds, or with a long-isolated natural population reduced to a low level by a massive impact on its habitat.

As there is no record of an introduction of little spotted kiwi to Kapiti Island, but there are well-documented introductions of brown kiwi and other rare native birds, there is no justification for continuing with the assumption that little spotted kiwi were introduced to Kapiti Island.

5. RECOMMENDATIONS FOR MANAGEMENT OF BIRDS ON LONG ISLAND

The value of the existing mix of Kapiti Island and D'Urville Island birds on Long Island is that it could maximise in a single population the limited genetic variation that survives in the species. However, the suitable habitat on Long Island is very limited and could be fully occupied by kiwi in the near future.

Options for future management are:

- To breed back to a purer D'Urville Island strain by removing Kapiti Island birds from the island and encouraging population growth by creating space for the remaining birds.
- To allow the present mix to continue, to monitor the population, and to supply more Kapiti Island birds if necessary either to ensure survival of the population or to maximise its genetic variability.
- When the numbers on Long Island warrant, to transfer progeny either to a suitable island without kiwi or to an island with an existing founder population of Kapiti Island little spotted kiwi.

While it would be ideal to manage the two populations separately, it is probably wise to introduce a few Kapiti Island birds to the D'Urville Island population to ensure its survival, as was done on Long Island. This will inject new variation, but should have no adverse effects because the two populations are so similar. However, too many Kapiti Island birds will dilute D'Urville Island genes with the resulting loss of some genetic variation.

We recommend that progeny from Long Island be transferred to a suitable island without kiwi when the numbers of birds on Long Island are adequate. We also recommend that, once the extermination of weka is confirmed, Inner Chetwode Island be considered for a transfer of little spotted kiwi. The habitat appears suitable and it would fulfil the request of the local community to keep birds from D'Urville Island (or their progeny) within the Marlborough Sounds.

We also point out that a marker gene (*Pgi-1*) could be used to trace the breeding success of the D'Urville Island birds. If it were considered sufficiently important and practical to do this, we recommend that any birds taken from Kapiti Island for mating with D'Urville Island birds should be at least

heterozygous for the Kapiti Island marker gene *Pgi-1(b)*. This would involve blood sampling the bird on capture, and either holding the bird for a short period (1-2 days) while the sample is analysed in the laboratory, or equipping it with a transmitter for later re-capture.

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