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## DISTRIBUTION, POPULATION CHANGES AND MANAGEMENT OF BROWN KIWI IN HAWKE'S BAY

**Summary:** Historical and recent records indicate that kiwi are less numerous and widespread in Hawke's Bay than they used to be. The birds are still scattered throughout the ranges to the west and north of the region, usually at densities of about one bird per 100 ha. Kiwi have now almost completely disappeared from their former lowland habitats. The decline of kiwi in Hawke's Bay may have started before European settlement, but has been particularly rapid in the last 70 years. Repeat surveys of three populations between 1984 and 1990-91 indicate that the decline is continuing. The main cause is thought to be predation by cats and stoats on chicks and the accidental destruction of adults by possum hunters. Feral dogs may have been important earlier this century. Kiwi will not now survive in Hawke's Bay unless they are actively managed. We give several reasons why a population should be maintained within the region, despite the costs and effort of doing so, and identify the birds at Lake Waikaremoana in Urewera National Park as being the best ones to target.

**Keywords:** Brown kiwi; ratite; *Apteryx australis mantelli*; distribution; abundance; population changes; Hawke's Bay.

### Introduction

The brown kiwi (*Apteryx australis* Shaw and Nodder) is the most numerous, widespread and best known of New Zealand's three species of kiwi. It currently comprises three sub-species (one on each of the main islands) which differ slightly from one another in plumage and mean size. The smallest of the sub-species, *Apteryx australis mantelli* Bartlett, is restricted to the top two-thirds of the North Island, north of a line extending from southern Hawke's Bay to Wanganui (Bull, Gaze and Robertson, 1985). Within this general area, there are two large populations centred on Taranaki and Northland, and a cluster of smaller, disjunct groups scattered throughout the Bay of Plenty, the Coromandel Peninsula, and the mountain ranges along the east coast.

The North Island brown kiwi is not endangered, but is thought to be vulnerable (Williams and Given, 1981). The birds seem to be plentiful in Northland, and attain densities there (in both native and exotic forests) which are generally at least two times greater than those elsewhere in the North Island (Colbourne and Kleinpaste, 1983). Little is known of their status and population trends in other districts, except that the birds may be declining in Hawke's Bay (McLennan, 1988).

The New Zealand atlas of bird distribution lists about ten records of brown kiwi in Hawke's Bay, mainly from the southern Urewera and Kaweka Ranges (Bull *et al.*, 1985). Our first aim is to update this information with new records, and to establish where the southern limit of their range presently is. Sub-fossil and midden remains

show that *A. mantelli* formerly lived in both the Tararua Ranges and the Wairarapa (Reid and Williams, 1975; Millener, 1981). It is not known why they disappeared from these areas, and whether their range is still contracting northwards. The information here should serve as a baseline against which further change can be measured.

Our second aim is to consider the future of kiwi in Hawke's Bay by addressing whether it is necessary to actively manage the birds to ensure their longterm survival, whether it is worth trying to save populations within the region, and what needs to be done to promote population growth.

### Methods

#### Surveys

Four surveys for kiwi were undertaken in Hawke's Bay between 1982 and 1992. Most lowland patches of forest within the district, including exotic plantings, were surveyed by staff of the (then) Ecology Division, D.S.I.R., between November 1982 and April 1984. The eastern flanks of the Kaweka Range were surveyed by staff of the (then) Forest Service between July and September 1984 (Speedy, 1985); and members of the (then) Fauna Survey Unit of the Wildlife Service surveyed much of lowland Hawke's Bay in 1984. Staff of the Department of Conservation and volunteers surveyed the western flanks of the Kaweka Range in May 1992.

The surveys were undertaken mainly on calm nights, usually in the first two hours of darkness. On most occasions, observers positioned themselves at dusk on hill tops and promontories, away from streams and rivers or other sources of noise. In the first hour of darkness, each observer counted the number of kiwi calls they heard, noting for each the sex and estimated location of the bird. The procedure was much the same for the second hour, except that taped or simulated kiwi calls were broadcast from time to time to try and elicit responses from birds which might have otherwise remained silent.

Most small patches of forest (~50 ha) were visited once, whereas larger patches were surveyed over several nights.

#### Other sources of information

Records of kiwi in Hawke's Bay were provided by farmers and outdoor enthusiasts, who had either seen or heard birds on their property or had encountered them in their travels. We also obtained some records from Department of Conservation and Forest Service files.

Appendix 1 lists the records and the people who provided them.

#### Population studies

Population changes were determined in three areas by surveying them in 1984 and again in 1990-91. The initial size of two of these populations (at White Pine Bush, 39°17'S, 176°53'E and Haliburton's Bush, 39°59'S 176°51'E) was determined precisely by catching and tagging kiwi until no new ones were found. The birds at Haliburton's Bush were also radio-tracked for two years to determine their ranges (McLennan, Rudge and Potter, 1987). The third population, in a 1650 ha patch of dense scrub at Waitere (39°04'S, 176°46'E) was indexed by counting calls during 106 hours of listening on 28 nights from January to April, 1984.

The population in Haliburton's Bush (700 ha) was re-surveyed on 23 nights from July to December 1989, then again on one night in August 1991. A total of some 70 hours was spent listening for natural calls, and playing taped calls in each of the known territories. A similar procedure was used in White Pine Bush, except that the area was so small (19 ha) that it could be adequately covered in just one night.

The population at Waitere was also re-surveyed twice - in May 1990, then again in March, 1991. In each of these re-surveys, kiwi calls were counted in five or six different parts of the block in the first two hours of darkness on four consecutive nights. The survey positions were the same as those used in 1984.

## Results

### Distribution in Northern Hawke's Bay

We defined Northern Hawke's Bay as the land lying east of the Huiarau Range between the Hangaroa River (in the north) and the Napier-Taupo highway (in the south). It comprises some 480 000 ha, and includes the eastern half of Urewera National Park, the Waiiau River catchment, and the lower Mohaka River and its tributaries. We obtained 72 records of kiwi in the area, of which 48 were of birds seen or heard since 1970 (Fig. 1).

The recent records (post 1970) show that brown kiwi are distributed widely throughout the forests along the western edge of Northern Hawke's Bay. They are present in the catchments of the three main rivers draining east from the Huiarau Range (the Mohaka, Waiiau and Wairoa), and in most of their major tributaries. They also appear to be spread throughout Urewera National Park, although most of the records from there are of birds seen at night on State Highway 38, along the northern shores of Lake Waikaremoana.

About half of the recent records came from rough farmland in steep hill country within a few kilometres of the western ranges. Ironically, most of them were provided by scrub-cutters, who discovered eggs and birds as they felled the vegetation. They are now of historical interest only. For other records of birds seen on back country roads (e.g., Cricklewood Road), the kiwi involved had almost certainly been displaced from neighbouring areas by land clearance. Another on Highway 2, just north of Wairoa, involved an injured bird which had probably been dumped from a passing car.

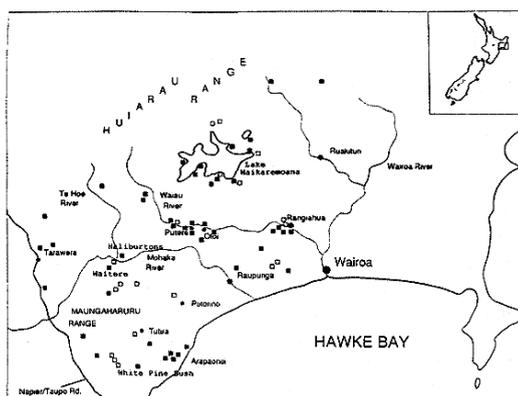


Figure 1: Distribution of brown kiwi in Northern Hawke's Bay. Open squares indicate records dating from before 1970; dark squares indicate those obtained from 1970 onwards.

Surveys indicate that few kiwi live in remnant patches of native vegetation in rural areas of Northern Hawke's Bay. Some survive in scrub at Rangiahua, Putere, Raupunga and Waitere; and in bush in the Tangoio, Aropaoanui and Te Hoe valleys. Most of these isolated populations contain fewer than eight birds, and some contain just one individual or one pair.

**Distribution in Southern Hawke's Bay**

We defined Southern Hawke's Bay as that land extending south from the Napier-Taupo highway to a line running west from Paoanui Point through Waipukurau to the central Ruahine Range. The Rangitikei River was the western boundary. It comprises some 720 000 ha, and includes the Kaweka and Ahimanawa Ranges, and the northern and central parts of the Ruahine Range.

We obtained 66 recent records of kiwi in Southern Hawke's Bay, mainly from the north-eastern flanks of the Kaweka Range, around Middle Hill, Kaweka flats, and the Makino River (Fig. 2). There were few records from both the southern and western flanks of the Kaweka Range, despite comprehensive surveys in both areas.

Kiwi have been recorded at least nine times in the Ruahine Range during the last decade. All were recorded at the northern end, on both the eastern and western sides. The record from the Kawhataui River (No. 63 in Appendix 1, Section D) is the southernmost for brown kiwi in the North Island. Kiwi were heard in Ruahine Corner in the 1970's, and their footprints were seen in the ashes of a scrub fire at Ngamatea in the early 1980s.

There are only two recent records of kiwi in remnant patches of forest in rural areas of Southern

Hawke's Bay. One kiwi has lived for a number of years in a small patch of scrub at Mt Cameron in the Tutaekuri Valley, some 15 kilometres downstream from its nearest known neighbour. The other record is from Gwavas, south of Hastings, where 16 birds from Nonhland and Rotorua were liberated in late 1980 and early 1981. At least four were still there in April 1984 (D.S.I.R. survey), but there was no sign of them after December 1986 (M. Hudson, *pers. comm.*).

**Kiwi in exotic forests in Hawke's Bay**

There are seven large exotic forests in the Hawke's Bay region, covering some 64 000 ha. Six of these forests replaced scrub and bush then occupied by kiwi, and four of them still have small populations of the birds living within 500 m of their borders. Despite this, only Esk State Forest has a resident population of kiwi. These birds are few in number and confined to one small area, but have persisted there for at least 20 years. Some of the other exotic forests have kiwi living in native vegetation within them (Te Awahohonu) or adjacent to them (Kaweka), but not actually among the pines themselves (Table 1). Records of kiwi sign also show that the birds sometimes feed along fire-breaks and forestry roads in Kaweka State Forest, especially those bordered on one side by native vegetation.

**Kiwi in scenic reserves**

In 1984, the 17 largest scenic reserves in rural areas of Hawke's Bay were surveyed specifically for kiwi. Appendix 2 lists the ones that were visited, and the time that was spent listening in them.

Kiwi were found in just two of them: a single female in White Pine Bush, just north of Napier, and two males in the water-supply reserve at Raupunga. Another reserve, at Waitere, was formally gazetted after kiwi were found in the area in 1984.

Other records show that at least four more reserves definitely contained kiwi in recent times, some as little as ten years ago. These include Boundary Stream Reserve, Bellbird Bush Reserve, Hanree Reserve, and Te Waka Bush. We did not record kiwi in Esk State

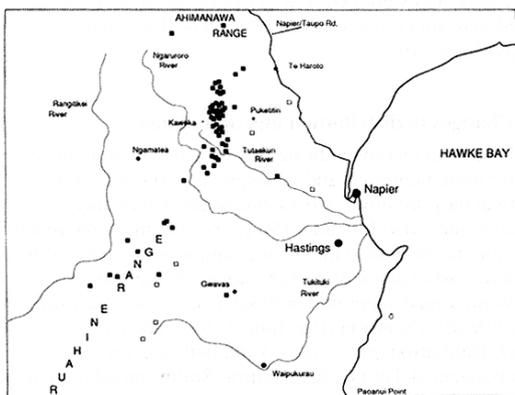


Figure 2: Distribution of brown kiwi in Southern Hawke's Bay. Conventions as in Figure 1.

Table 1: Results of kiwi surveys in five exotic forests in Hawke's Bay.

Forest	No. of sampling nights	No. of sampling sites	Hours spent listening	No. heard
Mohaka	3	6	8.0	0
Esk	1	2	3.5	0
Te Awamohunu	4	8	13.0	3
Patunamu	4	10	13.0	0
Kaweka	12	10	29.5	2

Forest Kiwi Reserve during our survey in 1984, but a possum trapper heard a male calling there in June, 1989.

### Population changes

All three reference populations declined between 1984 and 1991. At Waitere, mean call rates in 1990 and 1991 were about one every 4.5 hours, compared to one every 1.4 hours seven years ago (Table 2). This reduction is significant (Students  $t = 2.52$ , d.f. = 44,  $P = 0.02$ ) and suggests a decline of about 68%, assuming a direct relationship between call rate and the number of birds on the ground.

At Haliburton's Bush, three pairs and two unpaired females lived there between 1984 and 1986. In late 1989, only one of the original pairs was still present, and no calls were heard from either of the two unpaired females. Some 22 months later, no calls were heard at all.

The single female at White Pine Bush also disappeared between 1984 and 1991.

## Discussion

### Distribution and abundance of kiwi

Kiwi are now almost entirely confined to the ranges along the western edge of Hawke's Bay, where they are widespread but sparsely distributed. Speedy (1985) heard just 21 birds during his comprehensive survey of the eastern flanks of the Kaweka Range, and estimated that the average density there was less than one kiwi per 100 ha. McLennan *et al.* (1987) recorded a similar density (R per 770 ha) in a recently isolated remnant of forest near the southern boundary of Urewera National Park. These densities are exceptionally low by national standards, and are about one-fortieth of those in some forests of Northland (Colbourne and Kleinpaste, 1983; Potter, 1990; R. Pierce, *pers. comm.*). They do, however, seem to be typical for all of the forests along the western perimeter of central and southern Hawke's Bay, including those on both sides of the Kaimanawa Ranges. Anecdotal reports from possum trappers suggest that the birds may be more numerous in Urewera National Park, especially in the north-western

comer, where the forest is dominated by tawa (*Beilschmiedia tawa* (Cunn.) Kirk) rather than beech (*Nothofagus* spp.).

Kiwi have not persisted in lowland areas of Hawke's Bay, despite Guthrie-Smith's prediction (in 1921) that they had a lasting refuge there in the numerous bush-clad gorges. Indeed, his bold statement that "there he (the kiwi) is safe, should the whole of the rest of New Zealand be turned into cabbage gardens cultivated by Chinese", has proved to be one of his rare errors of judgement (Guthrie-Smith, 1953). The last vestiges of the lowland population now number about ten birds. The only known breeding pair survives in the Aropaoanui Valley; they were probably the parents of a juvenile which was found in 1985 wandering among sheep in open paddocks near Lake Tutira, a few kilometres west of Aropaoanui.

The loss of native vegetation in lowland areas has been offset to some extent by the establishment of exotic forests, consisting mainly of *Pinus radiata* D. Don. Despite their structural simplicity and acidic litter, such forests seem to be highly suitable for kiwi, particularly the older ones with a well-developed canopy and an understorey of shrubs. In Northland, for example, kiwi living within exotic forests achieve similar body weights, productivity and densities to those in nearby indigenous forests (M. Taborsky, *pers. comm.*; Colbourne and Kleinpaste, 1983; Potter, 1989). Those in Hawke's Bay have not been colonised, probably because there are few juveniles around to do so.

Kiwi are still present in the Ruahine Range, but in extremely low numbers and only at its northern end. This is now the southern limit of their distribution on the eastern side of the North Island. The birds were present in the catchment of the Tuki Tuki River, some 18 km south of their present distribution, in the late 1960s, and were believed to extend as far south as the Manawatu Gorge as recently as 1974 (Reid and Williams, 1975).

### Changes in distribution and abundance

Historical records indicate that brown kiwi were once far more numerous and widespread in Hawke's Bay than they are now. Most lowland areas probably contained kiwi less than 150 years ago, and some much more recently than this. For example, some parts of the now vast expanse of pasture alongside the Napier-Wairoa road supported both kiwi and weka (*Gallirallus australis* (Sparrrman)) as little as 65 years ago (J. Haliburton, *pers. comm.*) and both species were abundant at Tutira when Guthrie-Smith settled there in 1882.

Of greater interest is the suggestion that kiwi are failing in mature, native forest, both in Hawke's Bay

Table 2: Mean call rates of brown kiwi at Waitere in 1984, 1990 and 1991.

	No. of hours spent listening	Mean call rate per hour $\pm$ S.E.
Autumn 1984	106.5	0.69 $\pm$ 0.17
May 1990	52.0	0.33 $\pm$ 0.08
March 1991	56.0	0.13 $\pm$ 0.04

and in its surrounding districts. The evidence for this is anecdotal, but persuasive. Buller (1888) mentions finding exceptionally high densities of kiwi in the forests of East Cape, on the slopes of Mt Hikurangi. They exceeded those in the Pirongia ranges, in the Waikato, where in a single week Buller and his Maori hunters found 40 kiwi and nine eggs. Buller also refers to a collection of 300 kiwi skins, including a number of albinos, which were taken from the Kaimanawa Range in the late 1800s (Buller, 1877; Oliver, 1955). It is extremely doubtful if 20 kiwi could be caught in the whole of the Kaimanawa Range today; indeed, there have been only four records of kiwi in the Kaimanawa Range during the past four years (C. Speedy, *pers. comm.*).

In Hawke's Bay itself, a number of people have noticed substantial declines in kiwi numbers in their own lifetimes - in the Esk Valley (J. King, *pers. comm.*), in the Maungaharuru Range (M. Heays, *pers. comm.*), in the eastern flanks of the Kaweka Ranges (R. Whittle, *pers. comm.*), in the forests at the confluence of the Mohaka and Te Hoe Rivers (M. Haliburton, *pers. comm.*), and in the forests of Urewera National Park (R. Ward and others, *pers. comm.*).

The unavoidable conclusion is that only remnants of a once larger and more widely distributed population of kiwi now inhabit the forests of Hawke's Bay. Their former densities are unknown. If, however, they were half those currently in Waipoua and other forests of Northland, the birds must have declined by some 95% to reach their present average of about one individual per 100 ha. This may be an overestimate, but the true figure is undoubtedly high. R. Whittle (*pers. comm.*) estimates the population in the eastern Kaweka Ranges has dropped by 75% since the 1930s, while in some other areas the birds have disappeared altogether.

#### Why are kiwi failing in Hawke's Bay?

Several factors are probably involved in the failure of kiwi in Hawke's Bay. Land clearance and habitat fragmentation are the obvious and immediate causes of their demise in most lowland areas. This, however, probably just accelerated a process that was already taking place, because the birds have also declined in areas which have retained a cover of native vegetation.

Brown kiwi apparently disappeared from the Tararua Ranges before Europeans arrived with their assortment of mammalian herbivores and carnivores. It is unlikely that these birds were hunted to extinction by Maori and their dogs, because little spotted kiwi (*A. owenii* Gould) persisted there (albeit in low numbers) at least until the 1880s (Buller, 1888). The range of brown kiwi has therefore been retracting northwards for some time, and it is now difficult to tell whether the original

(and unknown) causes are still operating.

The numerical decline has, however, been especially rapid in Hawke's Bay in the last 70 years, suggesting that some of the more recent changes associated with European settlement are at least partly responsible. Mammalian predators are prime suspects, with good reason. Brown kiwi are flightless, they nest on the ground, they have low reproductive rates, their eggs take an exceedingly long time (75-90 days) to hatch, and their chicks begin an independent life when they are less than one-seventh the weight of an average adult (Reid and Williams, 1975).

Of the introduced carnivores, feral dogs are probably the greatest threat to kiwi. Single animals can decimate otherwise viable populations of kiwi in a matter of months, as Taborsky (1988) observed recently in Waitangi State Forest in Northland. Feral dogs are now rare in Hawke's Bay, but they were numerous in Urewera National Park up until the mid 1960s (M. Smith, *pers. comm.*) and were widespread throughout Hawke's Bay earlier this century.

Recent radio-tracking studies (McLennan *et al.* 1987; Potter, 1989) suggest that adult brown kiwi survive well in the presence of rats (*Rattus* spp.), stoats (*Mustela erminea* L), cats (*Felis catus* L) and feral pigs (*Sus scrofa* L), but that chicks may not. McLennan (1988) recorded no recruitment in his study population in Hawke's Bay in two years, although the birds there bred with considerable success. He suspected that predators, chiefly cats, killed the juveniles before they grew large enough to defend themselves.

What is not clear, however, is why cats and stoats appear to have so little impact on kiwi in some other parts of New Zealand. The birds in Northland, for example, also live with these predators, yet, for whatever reasons (predator abundance, availability of alternative prey, openness of vegetation, etc.) still seem to be able to produce enough young to replace themselves. The brown kiwi on Stewart Island also breed successfully in the presence of cats (R. Colbourne, *pers. comm.*), but the chicks there, unlike their northern counterparts, are protected by their parents for some months (and possibly years) after they leave the nest.

None of the introduced herbivores affect kiwi directly, except possums (*Trichosurus vulpecula* Kerr) which occasionally eat eggs (McLennan, 1988) and take over kiwi burrows (Morrin, 1989). The indirect effects of browsers on kiwi have never been studied, but may be substantial. Browsers probably make forests more accessible to predators by reducing ground cover and developing pathways. The trampling by deer and goats may reduce the abundance of soil invertebrates, the main food of kiwi. Some kiwi are killed every year by the dogs that people take into forests to hunt pigs, while others fall victim to poison baits and traps, set to catch

possums.

Possum hunting is probably the most significant cause of death in adult kiwi, and the reason why the birds are declining in many areas. In some populations in Hawke's Bay, and elsewhere, as many as 38% of the birds have lost parts of their feet or toes, presumably to gin traps (McLennan, 1988; McLennan and McCann, unpublished; Colbourne, *pers. comm.*). The ones that lose the tip of their bill or receive other fatal injuries do not survive to be counted, so actual injury rates are probably considerably higher than those indicated by the number of maimed birds. Reid's (1987) view - that possum hunters actually benefit kiwi because their catches also include large numbers of cats and stoats - must be doubted (McLennan, 1987). It is perhaps significant that the densest concentrations of kiwi now extant in the North Island are in Northland, where possums have arrived only recently, and possum hunters have not been active for long.

In undisturbed and benign situations, such as on offshore islands or in captivity, some kiwi live for at least 30 years (Reid and Williams, 1975). This means that adults can breed either intermittently or unsuccessfully for a number of years before their populations begin to decline. However, when the adults themselves die prematurely, and few of their young survive to replace them, the effects at the population level are both immediate and disastrous. This is the predicament the kiwi of Hawke's Bay find themselves in today.

#### **The future management of kiwi in Hawke's Bay**

Kiwi will not now be saved in Hawke's Bay simply by preserving their habitat, although this is still an essential thing to do. In fact, the birds in Urewera National Park are no safer in the long term than those living in scrub on private land. The birds now require active management, wherever they are, if they are to have any chance of persisting for more than a few decades.

There have been no previous attempts to reverse a decline in kiwi numbers on the mainland, and all sorts of technical and ethical questions remain unanswered - including whether it is worth trying to save them in Hawke's Bay at all. We believe that it is worth attempting to save the kiwi in Hawke's Bay for three reasons. First, recent studies reveal unusually high levels of genetic variation among brown kiwi, indicating that the appropriate unit for conservation is each population (Baker *et al.*, in prep.). Second, the success or otherwise of any conservation programme ultimately depends on public support. Efforts to maintain representative fauna within regions, rather than just in those areas where they might survive longest, involves many more people and spreads the risk of failure over several sites. Third, much needs to be learnt about the

relative costs of effort required to ensure survival of populations of differing size and in different habitats. The experience gained in Hawke's Bay would contribute substantially to this process and have nationwide application.

We specifically propose that an attempt should be made at Lake Waikaremoana in Urewera National Park. The area enjoys legal protection, is part of the largest patch of forest now extant in the North Island, and contains several rare bird species, including kiwi, which might benefit from predator control and habitat enhancement. Furthermore, the lake itself restricts mammal movements, so some peninsulas could effectively be converted into mainland "islands" by erecting mammal-proof fences. The effects of mammal control on juvenile kiwi survival and recruitment within these areas could then be compared directly with kiwi outside the areas of mammal control.

The costs of managing a mainland population of kiwi are undoubtedly high and the pay-offs are as yet uncertain. For all that, we suggest the costs of not doing anything are even greater.

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Appendix 1: Records of North Island brown kiwi in Hawke's Bay. All grid references preceded by N refer to New Zealand Mapping Services map series NZMS 1, while those preceded by U refer to NZMS 260 maps. Abbreviations: DOC = Department of Conservation; DSIR = Department of Scientific and Industrial Research; FSU = Fauna Survey Unit of Wildlife Service; F = female; L&S = Lands and Survey; M = male; NZFS = New Zealand Forest Service; SF = State Forest; sq. = square; SH = state highway.

Record No.	Location	Grid Reference	Date	Source	Comment
<b>Section A: Northern Hawke's Bay, pre 1970</b>					
1	Hopurahine, Lake Waikaremoana	N96: c. 440 430:	?-1-58	DOC files, Wairoa	Adult, caught on SH38
2	Ruakituri Valley	N96: not recorded	26-9-57	<i>Ibid</i>	Caught in gin trap
3	Waikaremoana	N96: 459 431	19-1-58	<i>Ibid</i>	Caught on SH Huiarau summit
4	Ruakituri Valley	N96: not recorded	17-4-58	<i>Ibid</i>	Caught in gin trap
5	Waikaremoana	N105: c. 595 299	9-12-58	<i>Ibid</i>	Caught on SH 38
6	Rangiahua	N105: sq. 47 40	10-4-61	<i>Ibid</i>	Killed by pig dogs
7	Hopurahine, Lake Waikaremoana	N96: not recorded	27-7-62	<i>Ibid</i>	Killed on SH 38
8	Waihua Valley	N115: sq. 46 39	6-6-65	<i>Ibid</i>	Caught in gin trap
9	Waihua Valley	N115: sq. 46 39	4-6-65	<i>Ibid</i>	Caught in gin trap
10	Putere	N105: not recorded	1-8-63	<i>Ibid</i>	Adult female
11	Rangiahua	N105: sq. 47 40	1-8-67	<i>Ibid</i>	Killed by dog
12	Waikari Gorge, Mohaka Forest	N115: sq. 43 39	9-2-66	M. Benjamin, NZFS, Napier	Adult, caught, released
13	Ferndale block, Putere	N105: sq. 44 40	1950-60	K. Hawkins, DOC, Wairoa	Numerous sightings, calls
14	Lake Kaitawa, Waikaremoana	N105: 554 227	1949-53	R. Ward, Howard Cr., Taradale	Numerous calls
15	Panekiri Range, Waikaremoana	N105: sqs. 50 24 and 49 24	1949-53	<i>Ibid</i>	Numerous calls, sightings
16	Kotemaori Waitahaha Stm.	N115: c. 480 870	1925	J. Haliburton, Te Wae Wae Station, Willowflat	Kiwi, weka present; two kiwi nests found during bush clearance
17	Mohaka River Te Hoe confluence	N114: c. 255 945	1910-30	M. Haliburton, Te Wae Wae Station, Willowflat	Kiwi numerous in scrub and bush
18	Boundary Stream Scenic reserve	N114: c. 240 860	1969	L&S files, Napier	Adult seen
19	Boundary Stream Scenic reserve	N114: c. 260 885	1945	M. Heays, Te Rangi Station	Present until drought of 1945-47
20	Maungaharuru Range	N114: 295 881	1945-47	M. Heays, Te Rangi Station	Visited house gardens until drought of 1945-47
21	Tutira	N114: sq. 42 38	1880s	H. Guthrie-Smith	Widespread throughout area
22	Esk Valley	N124: c. 230 660	1939	R. Turnbull, Blackburn Rd., Ongaonga	Adult, killed by rabbit's dogs
23	Esk Valley	N124: c. 248 655	c. 1940	<i>Ibid</i>	Adult found walking about after scrub fire
24	Esk Valley	N124: c. 250 650	1939	<i>Ibid</i>	Kiwi found on nest
<b>Section B: Northern Hawke's Bay, 1970-1992</b>					
1	Anini Stream, Ruakituri catchment	N96: 656 496	1976-77 and 1988	R. Ward, Howard Cr., Taradale	Calls on most nights
2	Hangaroa River	N96: 784 501	1981	<i>Ibid</i>	Calls
3	East Shore, Lake Waikaremoana	N105: 446 234	19-11-89	J. McLennan, DSIR, Havelock North	1M, 1F, calls
4	East Shore, Lake Waikaremoana	N105: 415 248	19-11-89	<i>Ibid</i>	1M, call
5	East Shore, Lake Waikaremoana	N105: 451 253	19-11-89	<i>Ibid</i>	1F, call

6	Lake Waikareiti Waikaremoana	N96: 583 319	?-4-91	R. Colbourne, DOC, Wellington	Female, caught and examined
7	Waikaremoana, Lake Ruapani Track	N105: c. 570 300	?-4-91	<i>Ibid</i>	Male, caught and examined
8	Waikaremoana, Mokau Inlet	N96: 513 301	8-4-91	J. McLennan, DSIR, Havelock North	Male call
9	Panekiri State Forest	N105: 490 200	1984	FSU	Report
10	Panekiri State Forest	N105: 510 220	1984	<i>Ibid</i>	Report
11	Lake Kaitawa, Waikaremoana	N105: 554 227	7-1-89	R. Ward, Howard Cr., Taradale	1 call and burrow
12	Putere	N115: 982 518	25-1-72	K. Hawkins, DOC, Wairoa	Male on two eggs
13	Otoi	N105: c. 500 085	4-2-72	<i>Ibid</i>	Adult, killed by dog
14	Putere	N105: 390 055	27-7-73	<i>Ibid</i>	Female on road
15	Cricklewood Station	N115: 600 990	6-11-79	<i>Ibid</i>	Egg found by scrub cutters
16	Putere Rd.	N115: 400 900	8-1-84	<i>Ibid</i>	Young female killed on road
17	Cricklewood Rd.	N105: 520 025	25-6-87	<i>Ibid</i>	Male caught on road
18	Putere Rd.	N105: 520 025	30-7-87	<i>Ibid</i>	Female killed on road
19	Putere Rd.	N105: 474 016	28-6-87	<i>Ibid</i>	Adult seen on road
20	Wairoa	N115: 715 930	16-8-87	<i>Ibid</i>	Active in day, injured bill
21	Rangiahua Station	N105: c. 470 400	1970s	<i>Ibid</i>	Adults and eggs
22	Rangiahua Station	N105: 674 045	1984	FSU, Wildlife Service, Napier	Report
23	Rangiahua Station	N105: 669 051	1984	<i>Ibid</i>	Report
24	Rangiahua	N105: c. 665 055	1979-80	K. Hawkins, DOC, Wairoa	Eggs found by by scrub cutters
25	Putere	N105: 435 045	1970-76	D. Caves, Wairoa	Many calls
26	Putere	N105: 415 045	1973-75	<i>Ibid</i>	Calls
27	Ferndale block, Putere	N105: sq. 44 40	1982	K. Hawkins, DOC, Wairoa	Calls
28	Putere	N105: 464 010	21-11-77	T. Pellet, Mohaka S.F.	Dead bird
29	Putere	N105: c. 405 065	1989	C. Greatrex, Berry Rd., Te Pohue	Chick caught
30	Maungataniwha	N104: 53 095	?-10-81	J. McLennan, DSIR, Havelock North	Male caught
31	Maungataniwha	N104: sq. 4242	1978	D. Neill, Westshore, Napier	Many calls and probes
32	Waiiau development block	N104: 320 150	1984	R. Parrish, Wildlife Service, Napier	Calls, sign
33	Waiiau development block	N104: 320 159	1984	<i>Ibid</i>	Calls, sign
34	Haliburton property	N114: 270 980	1983-86	J. McLennan, DSIR, Havelock North	3 males and 5 females
35	Ruapunga Reserve	N115: 565 950	10-4-84	<i>Ibid</i>	2 male calls
36	Waitere	N114: 205 905	1982-83	<i>Ibid</i>	c. 30 kiwis
37	Bellbird Bush Scenic Reserve	N114: c. 237 835	1973	L&S files, Napier	Calls, probe holes
38	Tutira	N114: c. 325 700	1980?	R. MacMillan, Main Rd., Tutira	Chick found wandering among sheep
39	Aropaoanui	N125: 395 665	1981	D. Wareham, Arapawanui	Adult, caught in gin trap
40	Aropaoanui	N125: 395 665	?-1-84	B. Hunter, Arapawanui Station	Several calls
41	Aropaoanui	N125: 395 665	1989	D. Neill, Whirinaki, Napier	2 calls
42	Moeangiangi River Valley	N125: 443 693	1984	R. Parrish, Wildlife Service, Napier	Unconfirmed report of calls
43	Whitepine Bush Scenic Reserve	N124: 300 640	1984-87	J. McLennan, DSIR Havelock North	1F, checked several times
44	Te Haroto	N114: c. 045 865	1982	T. Billing, Westshore, Napier	Adult, killed by dog

45	Tarawera	N114: c. 023 974	1988	C. Greatrex, Berry Rd., Te Pohue	Adult seen on road
46	Tataraakina development	N114: 085 975	1984	R. Parrish, Wildlife Service, Napier	Calls block
47	Esk Valley Kiwi Reserve	N124: 185 655	? -6-89	C. Greatrex, Berry Rd., Te Pohue	Male call
48	Esk Valley	N114: 152 732	1989	<i>Ibid</i>	Male call
<b>Section C: Southern Hawke's Bay, pre 1970</b>					
1	Silverford	N134: 186 389	12-11-66	R.E.R. Porter, DSIR, Havelock North	Calls
2	Te Waka Bush, Maungaharuru Range	N124: 083 699	19605	R. Parrish, Wildlife Service, Napier	Comment from adjoining landowner
3	Te Waka Bush, Maungaharuru Range	N124: 083 699	c.1960	J. King, Thompson Rd., Napier	Probe holes
4	Te Waka Bush, Maungaharuru Range	N124: 083 700	c.1969	<i>Ibid</i>	Adult, poisoned by cyanide
5	Hartree Refuge	N124: 962 603	19605	R. Parrish, Wildlife Service, Napier	Comment from landowner
6	Ruahine Range, Tuki Tuki River catchment	N140: c. 610 875	c. 1969	R. Oliver, Waverly St., Waipawa	Adult caught and examined
7	Ruahine Range, Tuki Tuki River	N140: c. 640 925	c.1969	<i>Ibid</i>	Probe holes
<b>Section D: Southern Hawke's Bay, 1970-1992</b>					
1	Mt. Cameron	U21: 265 864	?-11-88	J. MacKenzie, Kahungunu, Puketapu	Calls and probes over several years
2	Te Pohue SH 5	N124: c. 128 688	c.1975	J. King, Thompson Rd., Napier	Adult, caught on road-side
3	Ahimanawa Ranges	N114: 795 955	?-4-75	J. McLennan, DSIR, Havelock North	2M calls
4	Ahimanawa Ranges	N114: 945 825	?-5-84	<i>Ibid</i>	2M, 1F calls
5	Ahimanawa Ranges	N113: 899 948	?-11-90	C. Greatrex, Berry Rd., Te Pohue	Probe holes
6	Kaweka Ranges, Bums Range	N123: 785 448	25-1-84	<i>Ibid</i>	1F call
7	Kaweka Ranges, Tutaekuri River	N123: 851 548	2-2-84	<i>Ibid</i>	1M call
8	Kaweka Ranges, Makahu saddle	N123: 875 645	1977-80	M. Gilmore, NZFS, Napier	Adults seen on road
9	Kaweka Ranges, Lotkow Hut	N123: 898 598	1977-80	<i>Ibid</i>	Calls and probes
10	Kaweka Ranges, Jap Creek	N123: 895 635	1977	<i>Ibid</i>	Footprints and probes
11	Kaweka Ranges, Twin Lakes	N123: 815 555	?-12-76	<i>Ibid</i>	Footprints
12	Kaweka Ranges, Comet Range	N123: 744 432	?-1-75	<i>Ibid</i>	Calls
13	Kaweka Ranges, Makino River	N113: 859784	?-1-77	<i>Ibid</i>	Calls
14	Kaweka Ranges, Makino River	N113: 857 776	?-1-80	J. McLennan, DSIR, Havelock North	1 M response to taped call
15	Kaweka Ranges, Oamaru Hut	N113: 729 909	?-2-78	R.E.R. Porter, DSIR, Havelock North	Adult seen under log
16	Kaweka Ranges, Donald River	N123: 877 546	?-3-75	<i>Ibid</i>	Adult seen
17	Kaweka Ranges, Bums Range	N123: c. 780 453	1980	<i>Ibid</i>	Probe holes
18	Kaweka Ranges, Kaweka Flats	U20: 048 102	20-12-86	A.A. Fairweather, DSIR, Havelock North	2M calls
19	Kaweka Ranges, Makino bivouac	U20: 055 174	10-11-89	D.A. Appleton, Chaucer Rd., Napier	2M, 1F calls

20	Kaweka Ranges, Middle Hill	U20: 061 140	15-12-86	<i>Ibid</i>	3M, 1F calls
21	Kaweka Ranges, Kaweka Flats	U20: 050 100	21-5-87	<i>Ibid</i>	1F call
22	Kaweka Ranges, Te Puia Lodge	U20: 045 199	?-7-84	C. Speedy, NZFS, Napier	Probe holes
23	Kaweka Ranges, Makino Hut	U20: 051 183	?-7-84	<i>Ibid</i>	Probe holes
24	Kaweka Ranges, Makino Hut	U20: 037174	?-7-84	<i>Ibid</i>	Probe holes
25	Kaweka Ranges, Middle Hill	U20: 054142	?-7-84	<i>Ibid</i>	1M, 1F call
26	Kaweka Ranges, Te Puia Lodge	U20: 044 202	?-12-83	N. Bolton, NZFS, Napier	Calls
27	Kaweka Ranges, Middle Hill	U20: 048 137	?-7-84	C. Speedy, NZFS, Napier	1M call and adult seen
28	Kaweka Ranges, Koaro Stream	U20: 053 136	?-7-84	<i>Ibid</i>	1F call
29	Kaweka Ranges, Koaro Stream	U20: 062 134	?-7-84	<i>Ibid</i>	1M call
30	Kaweka Ranges, Koaro Stream	U20: 066141	?-7-84	<i>Ibid</i>	1M call
31	Kaweka Ranges, Koaro Stream	U20: 056 131	?-7-84	<i>Ibid</i>	1F call
32	Kaweka Ranges, Koaro Stream	U20: 066141	?-7-84	<i>Ibid</i>	Footprints in snow
33	Kaweka Ranges, Koaro Stream	U20: 050 125	?-7-84	<i>Ibid</i>	Footprints in snow
34	Kaweka Ranges, Makahu catchment	U20: 052122	?-7-84	<i>Ibid</i>	Footprints in snow
35	Kaweka Ranges, Middle Hill	U20: 047 104	?-7-84	<i>Ibid</i>	1M call
36	Kaweka Ranges, Kaweka Flats	U20: 045100	?-7-84	<i>Ibid</i>	1M call
37	Kaweka Ranges, Kaweka Flats	U20: 046 099	?-7-84	<i>Ibid</i>	1F call
38	Kaweka Ranges, Makahu catchment	U20: 043 092	?-7-84	<i>Ibid</i>	Footprints and probe holes
39	Kaweka Range, Green Flats	U20: 080 066	9-8-84	<i>Ibid</i>	1M call
40	Kaweka Range, Lotkow Road	U20: c. 070020	1981	D. Lumley, NZFS, Napier	Egg found on road
41	Kaweka Range, Black Birch Range	U20: c. 070050	1983	P. Lister, NZFS, Napier	Footprints
42	Kaweka Range, lap Creek	U20: 069 036	?-8-84	C. Speedy, NZFS, Napier	1M, 1Fcall
43	Kaweka Range, lap Creek	U20: 073 036	?-8-84	<i>Ibid</i>	1M, 1Fcall
44	Kaweka Range, Makahu Saddle	U20: c. 039 068	1983	D. Lumley, NZFS, Napier	Probe holes found on several occasions
45	Kaweka Range, Lotkow Hut	U20: 077 023	?-8-84	C. Speedy, NZFS, Napier	1M call
46	Kaweka Range, Gold creek	U20: 039 964	?-8-84	<i>Ibid</i>	1M, 1F call
47	Kaweka Range, Gold creek	U20: 033 972	?-8-84	<i>Ibid</i>	1F call
48	Kaweka Range, Gold creek	U20: 034 971	?-8-84	<i>Ibid</i>	1M call
49	Kaweka Range, Glenross Range	U20: 029 930	?-9-84	<i>Ibid</i>	1M call
50	Kaweka Range,	U20: 103 110	?-8-84	<i>Ibid</i>	1F call
51	Kaweka Range, Harkness Hut	U20: 898 182	May, 92	DOC, Napier.	1F call
52	Kaweka Range, Venison Tops	U20: 967 121	May, 92	<i>Ibid</i>	3M, 1F calls
53	Kaweka Range, Manōaturutu Hut	U20: 975 153	May, 92	<i>Ibid</i>	5M, 1F calls

54	Kaweka Range, Mangatainoka Hut	U19: 947 236	May, 92	<i>Ibid</i>	1M call
55	Kaweka Range, Rocks Ahead Hut	U20: 945 091	May, 92	<i>Ibid</i>	1F call
56	Kaweka Range, Rotwood Hut	U19: 012 229	May, 92	<i>Ibid</i>	4M, 2F
57	Ruahine Range, Ikawetea Stream	U21: 860 755	1-10-85	G. Dickson, Tavistock Rd., Waipukurau	Pair calling
58	Ruahine Range, Ikawetea Stream	U21: 860 755	1-2-86	<i>Ibid</i>	Calls
59	Ruahine Range, Ikawetea Forks	N133: 669 271	c. 1984	Wildlife Service, Napier	No details
60	Ruahine Range, Mangatera River	N133: 595 195	c. 1984	<i>Ibid</i>	No details
61	Ruahine Range, Bruce Ridge	U21: 725 617	1988-89	S. Bolton, DOC, Pohongata	Feathers and calls
62	Ruahine Range, Mokai Patea Range	U21: 741 615	20-5-88	T. Rouse, DOC, Palmerston North	Feathers and probes
63	Ruahine Range, Kawhatau River	U22: 717 566	21-8-90	K. Hunt, DOC, Napier	Probes
64	Ruahine Range, Ohutu Ridge	U21: c. 770 690	1970s	H. Dorrian, DOC, Mangaweka	Calls
65	Ruahine Range, Makaroro Hut	U21: 870 647	1991	R. Ferris, DOC, Ongaonga	Male call
66	Gwavas Station	N140: 900 059	4,5-4-84	J. McLennan, DSIR, Havelock North	3M, 1F responses to taped calls

Appendix 2: Results of surveys for kiwi in reserves in Hawke's Bay.

Reserve	No. of nights sampled	No. of hours listening	No. of kiwi heard
White Pine Bush	1	3.0	1
Boundary Stream	2	8.5	0
Thomas's Bush	1	4.0	0
Bellbird Bush	2	4.5	0
Turangakumu	2	7.5	0
Balls Clearing	2	4.0	0
Hutchinson	1	1.5	0
William Hartree	1	2.0	0
Esk Kiwi Reserve	1	3.5	0
Mahia	2	6.5	0
Morere	1	3.0	0
Gisborne Water Supply	1	3.0	0
Tangoio	2	3.5	0
Hartree	2	8.0	0
Raupunga Water Supply	2	5.5	2
Kakariki	1	2.0	0
Te Waka Bush	1	3.5	0