The decline of North Island Weka (*Gallirallus australis greyi*) at Parekura Bay, Bay of Islands

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ABSTRACT

The North Island Weka (*Gallirallus australis greyi*) population at Parekura Bay was monitored in 1991-95, during a long dry El Niño event. Adult Weka had declined from ~400, in February 1987 (Beauchamp 1988), to 47–63 Weka in Parekura Bay and Whangamumu areas in June 1991. By March 1995 there were only three Weka left there. Enhanced production of young Weka was insufficient to prevent decline. Known mortality factors were road kills, Timms traps and dog and stoats. Throughout the study the population lacked females. A "crowing call" by males was identified as associated with mate loss and mate finding.

KEYWORDS: North Island Weka, *Gallirallus australis greyi*, decline.

INTRODUCTION

The North Island Weka (*Gallirallus australis greyi*) is a large, flightless, endemic forest-dwelling rail. The area of Northland bounded by Waipu Cove, Dargaville, Titoki and Matapouri had a large Weka population until about 1936-40 (Anon 1939). This population gradually disappeared, although some individuals survived at Waima, Onerahi and Waipu until after 1959 (Adams 1960, Ogle 1982). Another population at Opua, Bay of Islands, disappeared in 1945 (Anon 1948). Declines were attributed to ferrets (*Mustela furo*; Anon 1948), land clearance (Gee 1956), disease (McKenzie 1971) and cattle ticks (Carroll 1963).

During 1967-71, 5 groups totalling 149 Weka were taken from Te Puke Station, Tolaga Bay, for release near Rawhiti (Fig. 1; Robertson 1976). This was successful, and Weka had spread from Cape Brett to Whangamumu by 1976 (Robertson 1976), and in 1981 were near Russell. Weka established between Te Uenga Bay and Jack's Bay in 1982 (Fig. 2), and expanded south to Whangaruru Camp, North Head, and opposite at Oakura in the mid 1980's (Beauchamp 1988). In late 1989, Weka disappeared from most of the Cape Brett to Ngaiotonga areas (L. and B. Kelly, pers. comm.), and declined at Parekura Bay (T. Lauterbach, pers. comm.). By April 1991 the population was restricted to areas between Jacks and Te Uenga Bays, and near Whangamumu (Fig. 1 & 2).

In December 1990, I found that the last remaining dense mainland population of North Island Weka, on the East Cape at Motu, had substantially declined (Beauchamp 1997a). In 1991 the North Island Weka was designated "threatened", and initial conservation priorities were set as: assessing the factors causing decline on the East Cape (Bramley 1994, 1996), and the monitoring of other populations (Beauchamp *et al.* 1993, Beauchamp 1997b, Marchant & Higgins 1993).

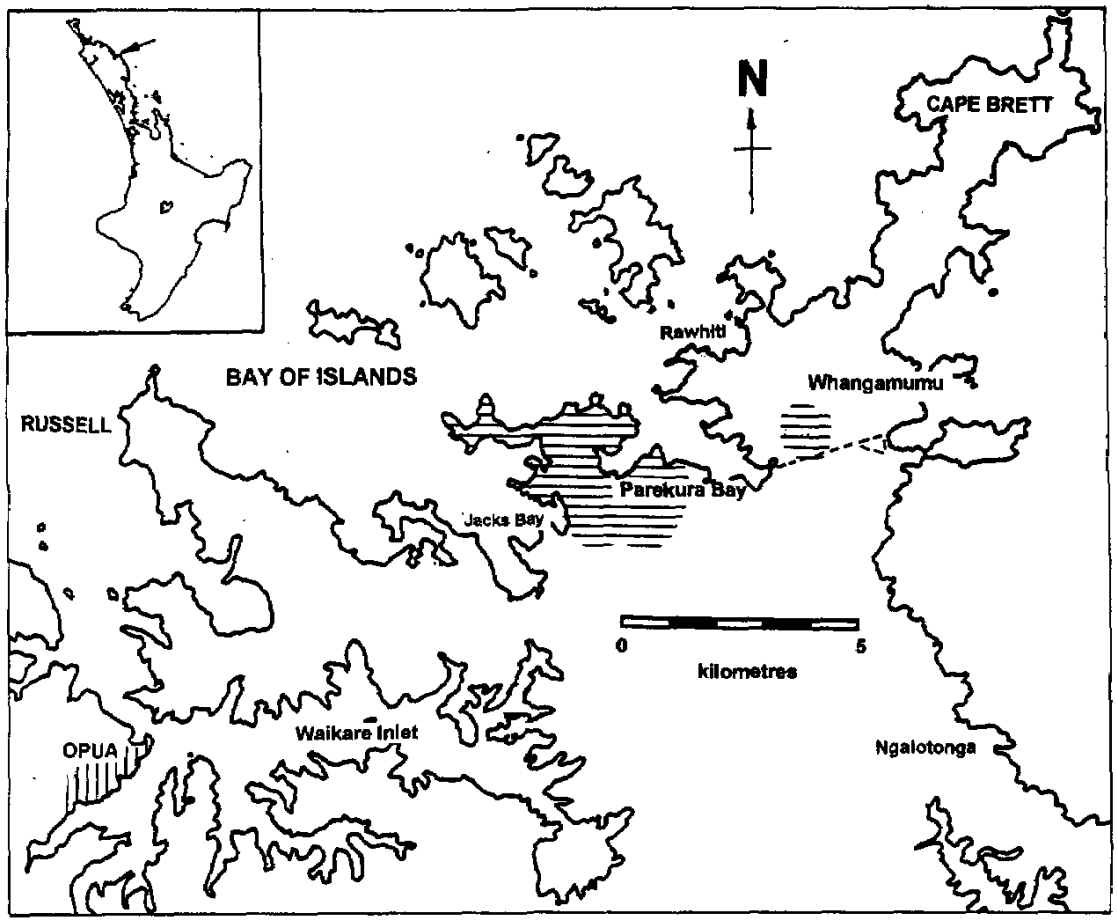

FIGURE 1 - The distribution of Weka populations in the Bay of Islands in 1991 and the locations referred to in the text. ≡ : Parekura Bay and Whangamumu populations, |||| : Opua population. – – – : Whangamumu Track.

The aims of this study were to monitor the size, breeding effort, productivity, and feeding of a population of North Island Weka in the Bay of Islands, North Island.

METHODS

Weka were studied most intensively in the built-up area of Parekura Bay (174°14'E, 35°14'S; Fig. 2) during 21 visits between May 1991 and May 1995 (Table 1), and during a dry El Niño weather pattern (Fig. 3).

Weka were caught with cage traps and hand-held snares for colour banding, ageing and sexing. Weka were aged by inspecting their plumage and the wing spur. First year birds had pointed primaries and a sharp recurved 4-6 mm long spurs; 1-3 year old birds had 6-14 mm long pointed spurs; and bird with longer or blunter spurs were older then 3 years (Beauchamp unpubl. data.).

Sight recovery and trapping records were used to estimate home range sizes of Weka seen five or more times, using the minimum convex polygon method

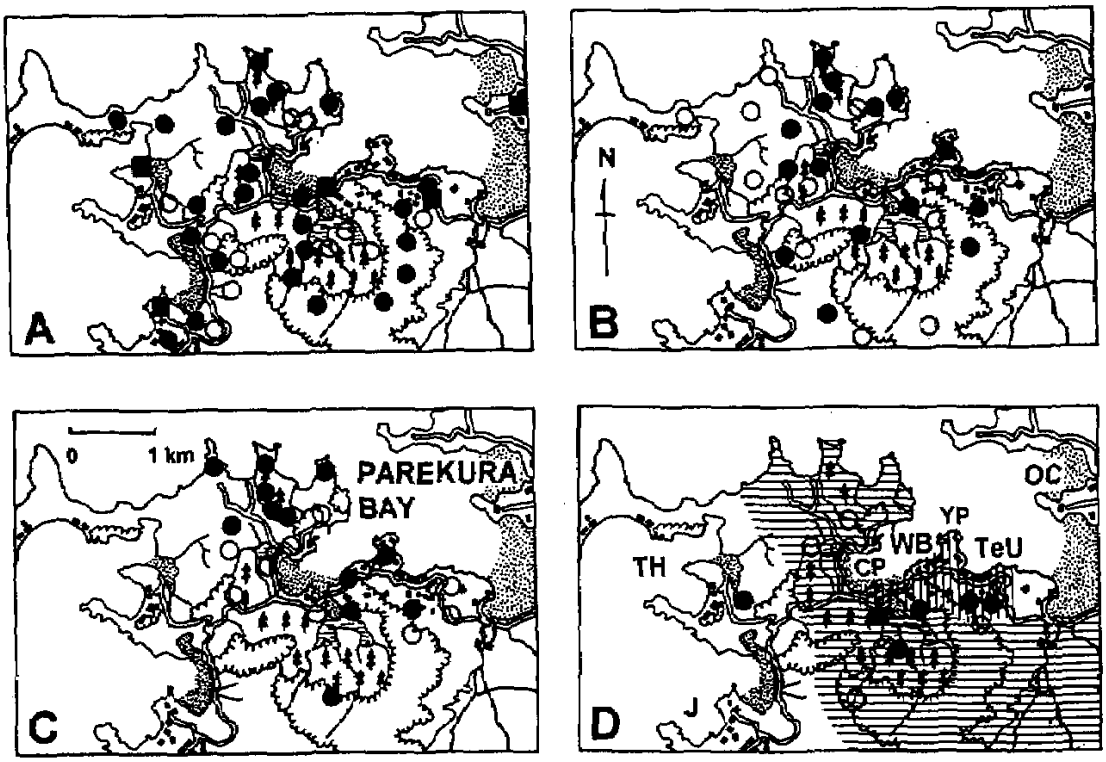

FIGURE 2 - The distribution of the Weka at Parekura Bay in April-June 1991(A), February 1992(B), February 1993 (C) and February 1994(D). ● : Calling pair, ○ : calling individual. ■ : Count site. |||| : Built up area in Waipiro and Te Uenga Bays, and the intensive study area. ≡≡ : Bentzen Farm. J : Jacks Bay, TH : Te Hue Bay, WB : Waipiro Bay, TeU : Te Uenga Bay, OC : Omakiwi Cove, YP : Yates Point, CP : Cobblers Point

(Hough 1982). Weka "spacing calls" were counted for an hour at dusk, and their locations were marked onto topographical maps with scale of 1:20 000 (Beauchamp 1997a). Counts were made at 5 locations (Jack's Bay, Te Hue Bay, Waipiro Bay, Te Uenga Bay and Omakiwi Cove) in 1992, but after 1993 were confined to the Waipiro and Te Uenga Bays (Fig. 2). The population within hearing range of the Waipiro Bay site was estimated using Weka spacing calls during one evening every visit. The same method was used to confirm the presence of other Weka at known locations during seven subsequent counts (see Table 1).

Fruit and cricket (*Teleogryllus commodis*) availability and distribution was assessed in each occupied Weka home range on most visits, by walking a standard route in the intensive study area (Fig. 2D). Faeces were collected in 1991-92 to compare Weka diet to food availability. Faeces were separated into two portions using a 500 mm sieve. The smaller filtrate was checked for worm chaetae. The larger portion was used to assess the minimum number of individual food items; and to visually assess the proportions of each component as vertebrate, cricket, other invertebrates, leaf litter and fibre, shoot meristem and fruit cases and seeds.

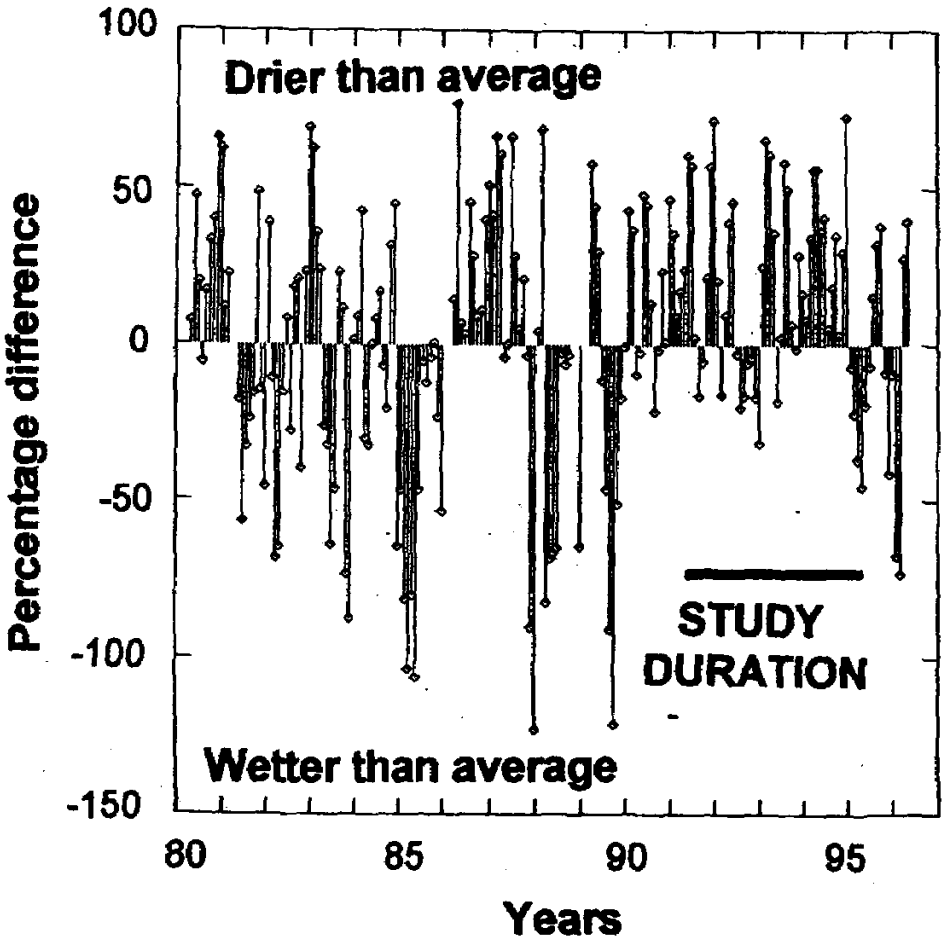

FIGURE 3 - The percentage difference between the running bimonthly rainfall and the average between 1980-96 at Russell. Negative percentages are higher rainfall totals than average and positive percentages are lower rainfall totals than average.

RESULTS

Weka activity, distribution and habitat

Weka were most active at dawn, and were mostly trapped in the early morning and early evening. They were only active during the day when they had dependent young. Weka were seen or heard in all habitats (Table 2).

Figures 1 & 2 give the distribution of Weka at Parekura Bay and the surrounding areas between 1991 and 1995. In 1991 the population was split into two centres (Fig. 1); 40-50 adults between southern Parekura Bay and Jacks Bay, and 7-12 adults in the eastern region of Parekura Bay near the Whangamumu saddle. Weka declined north of Whangamumu track and near Jack's Bay after August 1992, but the distribution in Parekura Bay was less affected (Table 1) until autumn 1993. Later Weka became restricted to the built-up area of Parekura Bay (Fig. 2D), before the population collapsed in1995.

TABLE 1 - Weka population changes, and 'spacing' call rate per month at Waipiro Bay, Parekura Bay

	Estimated number of adults in				Weka calling at Waipiro Bay			
Time	Total population *	*Intensive* study area + Waipiro#	Waipiro station	*Dependent* young in ISA	Proportion of total, %	Pairs	Single	Mate-finding
April 1991	50	39	30	1	61	-	-	-
June 1991	-	35	27	3	74	-	-	-
September 1991	46	33	27	9	60	4	16	1
December 1991	-	35	28	3	85	7	7	-
January 1992	30	26	23	2	59	-	-	-
April 1992	-	25	23	5	54	-	-	-
May 1992	-	27	24	3	75	-	-	-
July 1992	-	28	24	0	-	12	12	2
September 1992	33	34	24	2	-	-	-	-
December 1992	-	26	20	2	-	4	15	-
February 1993	32	21	14	5	-	8	15	1
September 1993	-	12	6	4	-	2	6	1
December 1993	-	10	4	9	-	-	-	1
January 1994	13	8	2	7	-	1	5	-
May 1994	-	8	2	5	-	0	3	-
November 1994	-	7	3	1	-	0	3	-
January 1995	6	4	0	0	-	0	0	-
March 1995	2	1	0	0	-	0	0	-

* = Estimated total number of adults found during spacing call surveys of the intensive study area (ISA), Waipiro Bay, and the wider area.
# = Estimated adults within the 60 ha of the intensive study area, and within the additional 260 ha covered by the Waipiro Bay count station.

TABLE 2 - Weka habitat characteristics within the intensively studied home ranges

	Te Uenga Bay		Waipiro Bay				
	East	West	East	West	Middle	Cobblers Point	Yates Point
Minimum home range size, ha	3.0	2.5	1.0	7.5	2.3	4.0	2.0
Habitat composition:							
Shrubland	2.0	2.5	0.5	2.0	1.3	1.0	0.5
Grassland	1.0	0	0.5	0	1.0	1.0	1.0
Forest	0	0	0	5.0	0	4.0	0.5
Pine forest	0	0	0	0	0	1.0	0
Mangroves	0	0	0	0.5	0	0.01	0
Swamp	0	0	0	0.01	0	0	0
Pond	no	no	no	no	no	no	no
Stream	no	no	yes	yes	no	no	no
No. of houses	2	2	2	4	1	1	1
No. of cats	1	1	0	1	1	2	0
No. of dogs *	2 (1)	2 (1)	0	1	1	(1)	0

*Small resident dogs and dogs at houses during holidays and weekends. Numbers in brackets were dogs that were regular visitors.

TABLE 3 - Percentage occurrence (mean ± S.E.) by volume of 6 food groups consumed by Weka at Parekura Bay in 1991

	Month			
Food group	March	June	September	December
Vertebrates	5.0 ± 2.3			
Crickets	60.4 ± 38.2	13.5 ± 24.9	0.5 ± 1.5	
Other invertebrates	23.2 ± 28.4	23.0 ± 31.0	26.4 ± 24.9	75.5
Vegetation fibre	3.2 ± 3.5	9.0 ± 19.6	51.2 ± 23.5	15.5
Fruit seeds	3.0 ± 4.3	13.0 ± 22.5	10.2 ± 21.1	5.0
Unknown	5.0 ± 12.0	41.0 ± 44.5	11.6 ± 17.9	5.0
Sample size	17	7	11	2

No Weka appeared to live exclusively in the pine plantations, and home ranges including pine also had bush and swamp. Most home ranges included diverse habitats, had dense cover, and a source of water. Home ranges were 1.0-7.5 ha (Table 2).

Weka were not found in properties with large dogs, and three residents had not seen Weka since they have had dogs. One newly resident terrier caused a pair of Weka to desert their nest in November 1991. This pair subsequently modified their home range and raised 4 further broods (15 young).

Most Weka called from cover (96%, N = 82 choruses in 1991), but a few called from the roadside margins of fields. Throughout 1991-93 spacing call choruses were dominated by pairs and male calls (Table 1). After February 1993, 91% of

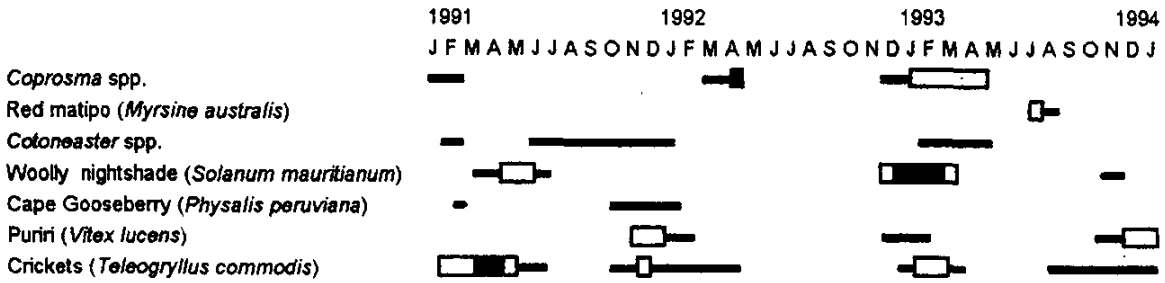

FIGURE 4 - Fruit and cricket availability at Parekura Bay. —— = Uncommon in some home ranges (<10% of trees with fruit and <0.1 cricket m^{-2}), □ = Common, most home ranges (>10%-<50% of trees with fruit and <1 cricket m^{-2}), ■ = Very common, in all home ranges (>50% of trees in fruit and >1 cricket m^{-2})

chorus calls were from individuals (N = 35 choruses in 10 counts). Repeat calls indicated stable roost sites. On 9 occasions, between November 1991and November 1994, we recorded 11 male Weka (1, 2, 1, 2, 1, 1, 1, 1 and 1, respectively) giving a "crowing call" at locations where pairs had called previously. This call resembled that of the Pukeko (*Porphyrio p. melanotus*; Marchant & Higgins 1993). This call was given repeatedly at dusk, for up to 2 h. From 7 of the 9 sites where this call was given, Weka disappeared within 6 months. This call was also given by 2 males in Te Uenga Bay immediately after they lost their partners (6 August 1991,14-15 August 1994). One continued to call for most of 48 h.

Diet

The proportions of each food group eaten changed with availability in a predictable way (Table 3 & Fig. 4). The introduced cricket was numerous until early June 1991 (Fig. 4), and was an important food. When cricket availability declined, Weka switched to invertebrates from the shoreline and leaf litter, seeds and shoots. During September 1991, most of the Weka ate a higher proportion of fruit and young meristems of plants.

Breeding and productivity

Breeding success varied substantially with the stability of pairs and the amount of supplementary feeding (Table 4). Breeding took place throughout the year. There was no significant difference in the number if clutches laid in each season (χ^2 = 0.06, d.f. = 3), or fledged each season (χ^2 = 1.67, d.f. = 3). However, there was a significant difference in the number of young fledged each season (χ^2= 13.63, d.f. = 3, P<0.01), with significantly more young fledged in summer (December - January) than at other times (χ^2= 11.94, d.f. = 1, P<0.001).

Most females paired with older males and bred successfully in their first year, though one pair of 7 months old Weka raised four young. Some pairs bred almost continuously. At least 2 males courtship fed, and continued to feed their incubating

TABLE 4 - Breeding performance of Weka at Parekura Bay.

Location	Presence of a pair	Number of young fledged	
		Total	No./year
Cobblers Point	September 1991-April 1992*	5	5.0
Waipiro Bay, West	March 1991- March 1995*#	29	7.2
Waipiro Bay, East	August 1991 - November 1991	2	2.0
Yate's Peninsula	November 1992 - February 1993*	1	1.0
Te Uenga, West	March 1991 - March 1995*#	25	6.2
Te Uenga, East	May 1993 - June 1994	4	4.0

* The members of each pair changed, or may have changed, within this period.
# Areas where supplementary food was provided.

partner. Clutch overlap indicated that females could get sufficient energy and nutrients to lay within 40 days of the hatching of their previous clutch, and then do the diurnal incubation, while their partners looked after the previous brood.

Residents first saw chicks, on average, at 14 days old (S.E. = 1.0, N = 7). Young were generally secretive until 10 days old, and parents gave 'distress calls' and 'distress squeaks' when dogs appeared, and lead their young using 'pair contact' and 'boom' calling (Beauchamp 1987a). The chick leading call ('put' call, Beauchamp 1987a) was heard infrequently. Young older than 20 days called continuously while with their parents. Young birds started to feed independently when 14 - 21 days old.

During 1991-1994 weka were fledged on average at 2.8 young/pair (N = 5 pairs), 2.5 young/pair (N = 5 pairs), 3.0 young/pair (N = 3 pairs) and 6.5 young/pair (N = 4 pairs), respectively. Sixty-seven young were fledged between March 1991 and March 1995.

Detailed information was collected from 2 males and their various partners who were in close contact with human residents. One male foraged in compost bins and cat bowls, and was occasionally thrown food from three occupied houses in Waipiro Bay. The other male fed on fish and bread from a specially designed treadle feeder in Te Uenga Bay. Table 5 summarises the productivity of these Weka between January 1991 and December 1994.

The pair at Waipiro Bay raised 9 young between March 1991 and March 1992, and deserted one clutch after disturbance by a dog. The female was either displaced in July 1992, or the male formed a trio. The male and a new female raised 3 young in November 1992, and then the original pair raised 14 young in 5 clutches (2, 1, 1, 5 & 5 young respectively; N. & G. Nicholson, pers. comm.), before the male disappeared between July and October 1994. A new pair raised three young before they disappeared in early 1995.

The pair at Te Uenga Bay fledged 6 young in 3 clutches between July 1990 and May 1991. The female died in July 1991, and the male paired again in June 1992. This new pair fledged 19 young in 10 clutches, before the male was killed by a stoat (*Mustela erminea*).

TABLE 5 - Breeding performance in two Weka home ranges at Parekura Bay, between January 1991 and December 1994

	Te Uenga	Waipiro
No. of breeding attempts	12	9
Successful breeding attempts	10	8
Number of young fledged	25	26
Chicks lost during parental care	1	1
Number of overlapping clutches	6	4
Months with overlapping clutches	June 1991; Nov 1992, Mar, June, Sep 1993, Nov 1994	June 1991; Mar, June, Sep 1993
Maximum time between clutches, months	11	7
Maximum time between partners, month	10	3
Sex ratio of fledged young male:female	1:0.92	1:1.33

Juvenile dependency lasted between 26 and 140 days (N = 8). The duration of parental care differed seasonally. There was less reliance on human food in the wetter periods, and the clutches hatched between April-September were cared for shorter periods ($\bar{x}$ = 42 days, S.E. = 4.2 d, N = 4) than those hatched at other times ($\bar{x}$ = 84 days, S.E. = 20.12 d, N = 4; Mann Whitney's U = 2.24, $P<0.05$). The male cared for young for on average 21.6 days (S.E. = 8.1 d, N = 8) longer than the female, but overall differences were not significant (Mann Whitney's U=1.36, $p>0.05$). Juvenile Weka left the parental home range after being chased by parents, or when parents showed no interest in feeding them. Chasing and pecking by the parents occurred when the next clutch hatched, or when the adults started moulting. Four young returned for a brief period (7-14 days) after they left the parental home range.

Sub-adult mortality and recruitment

Sub-adult mortality was high, and only 3 of 28 banded young (10.7%), raised in the intensive study area, are known to have survived to more than 6 months old.

Twenty-one females, 17 males and 29 birds of undetermined sex were fledged from the intensive study area between February 1993 and March 1995. Two of 15 colour-banded females were seen after fledging in this area, but only one established there, when 7 months old. At least 2 of the 4 male Weka that established in the intensive study area in 1992-95 were raised there. Both males established at 3 months old and took partners at 4 and 7 months.

Adult demography

The turnover of Weka with established home ranges in the intensive study area was 20%, 40%, 30%, 20% and 75% of the population in 1991-95, respectively. There were, on average, 10 Weka with established home ranges from 1991-93, 7 in 1994 and 4 in 1995. Overall productivity was 4.12 times higher than that required to maintain the 10 Weka in the intensive study area, but young did not survive, and recruitment was only 56% of that required to maintain the population.

New males entered the study population in April and October 1992; September 1993 and July 1994. Males died or left the area in December 1991, October 1992, October 1993; June and September 1994 and March 1995. Female Weka entered the population in July 1992 (3) and January and September 1993. Females died or left the area in August and December 1991; April, August and October 1992, June 1994, and February and March 1995. Males that successfully found another partner took 10, 6 - 8, and 4 - 6 months to find one.

The estimated mean longevity of paired Weka was 4 years (range, = 1.6 - 7) for males, and 2.5 years (range, = 0.8 - 4) for females.

Some causes of adult mortality

The study was carried out during an extended El Niño period of with drier than average conditions (Fig. 3). There were extreme droughts in the late summer and autumn of 1990 - 91, and during 1993 and 1994. These droughts completely dried the forest leaf litter and humus and decreased food availability. Anecdotal reports on the distribution and number of pairs, suggest that the population declined by about 40% in the built-up area of Waipiro and Te Uenga Bays between September 1990 and April 1991 (A. Duff, B. Hall, F. Stewardson, R. Lowe, D. Matthews & J. Caudwell, pers. comm.). Counts at Waipiro Bay suggest that there was a further decline in the surrounding area in 1993 (Table 1). The small remnant population at Whangamumu (Fig. 1) disappeared between August and November 1992. By 1994, most Weka resided in the built-up parts of Waipiro and Te Uenga Bays (Fig. 2D), where water and food provided by humans were available.

No direct relationship between brushtail possum (*Trichosurus vulpecula*) poison operations and Weka losses was detected. The Rawhiti area had a large and extensive sodium monofluroacetate (1080) paste poison programme in 1989-91, but no dead Weka were found (B. King, pers. comm.). Poison pellets were laid in Parekura Bay and in bait stations in Te Uenga and Waipiro Bays in March 1992; no Weka were found dead. Weka were between 0.015 and 0.01 ha^{-1} on Bentzen Farm from March 1991 until early 1993. The first extensive possum poisoning operation took place north of the road between Parekura and Jacks Bays (Fig 2C & 2D), in September-November 1994 (M. McKenzie, pers. comm.), but by this time Weka densities had already dropped to 0.0025 ha^{-1}. Cyanide was laid in the southern block after September 1994 (C. McGee, DoC Russell, pers. comm.), and 1080 was laid behind Waipiro Bay in December 1994. Seven hundred possums were killed but no dead Weka were found (C. McGee, pers. comm.).

Two Weka were killed in Timms® traps in August 1992 (T. Lauterbach, pers. comm.) and another one in January 1993 (G. Williams, pers. comm.).

Stoats were caught near houses in Parekura Bay in March, April and August 1992 (T. Lauterbach, pers. comm.), and were seen there in June, July and December 1992. Stoats were seen near piles of desiccated skinned possum carcasses on the margin of the built-up area behind Waipiro and Te Uenga Bays in December 1994. In early 1995, stoats were seen in the home ranges of all 3 remaining pairs in the

intensive study area of Parekura Bay, and on the road to Waikare Inlet. In March 1995 a male Weka was killed by a stoat, and the female was injured. Stoats probably killed 2 other Weka, too (K. van Berkum, N. & G. Nicholson, pers. comm.).

Dog numbers increased substantially in the summer and weekends at Parekura Bay. We recorded resident and visiting dogs chasing and injuring Weka three times (16 May & 4 December 1993, 26 March 1995) and dogs caused at least one nest desertion. Two dogs regularly roamed in Waipiro Bay and Te Uenga Bay, and one killed a Weka. Before this study, a resident spaniel killed many Weka on the eastern margin of Te Uenga Bay (Bill van Berkum, pers. comm.).

Six Weka (including 3 sub-adults) were killed by cars between January 1992 and January 1995 (M. McKenzie, pers. comm.).

DISCUSSION

Supplementary feeding maintained Weka productivity above the mortality rate in the intensively studied area. However, sub-adult mortality was high, and few Weka survived to 150 days old, when pair bonding is possible (Beauchamp, unpubl. data). In addition, the mortality of paired female Weka was higher than that of males, and replacement females were lacking.

The high frequency of the "mate finding" call (typical after mate loss) outside of the intensively studied area, and the lack of home range maintenance by males after a partner was lost, indicated that juvenile production or survival was no better outside the intensive study area. This call was not heard on Kawau Island where mates were readily available (Beauchamp, unpubl. data.) or the South Island (Beauchamp 1987b, unpubl. data.), but was recorded in the Toatoa and Whitikau Valleys, Opotiki (Beauchamp 1997a).

Bramley (1994,1996) used radio telemetry to assess Weka loss factors at Rakauroa, East Cape. He found that road deaths, and ferret predation were important mortality factors of adult Weka, and that Weka fledged few young (0.38 young per nest attempt), probably due to cat (*Felis catus*) or ferret predation (Bramley 1996).

This study did not use telemetry to track the fate of young, because we were denied access to a critical property, Bentzen Farm, which would have prevented us from tracking Weka. Some mortality factors (road deaths and mammalian predation) were similar to those identified by Bramley (1996), but there were important differences. At Rakauroa, ferrets and wild cats (55 seen in 18 months) were numerous, but stoats were absent or rare. At Parekura Bay, only three wild cats were seen during the study, stoats were present and ferrets were absent (Miller & Pierce 1995). Other potentially important controlling factors, including the impact of drought and likely habitat changes, differed during the East Cape and the Bay of Islands studies (Bramley 1994, Beauchamp 1997a).

Predatory mammals probably killed Weka throughout this study. Juvenile Weka dispersal was likely a time of increased predation risk (Beauchamp, unpubl.; E. & G. Staples, pers. comm.).

Stoats were seen most frequently in the built-up area in Waipiro and Te Uenga Bays in 1992 and 1995. In 1995 they killed and injured Weka. Similar increases or movements of stoats and ferrets have had a detrimental impact on other Weka populations. Stoat predation was implicated in the reduction of Western Weka (*Gallirallus a. australis*) at Portage, Marlborough Sounds, from 0.1 ha^{-1} to 0.001 ha^{-1}, between February 1995 and June 1996 (T. Hook, pers comm., Beauchamp, unpubl data.). Ferrets killed at least five, and probably 9, of 13 Weka (four breeding pairs, one wild reared sub-adult and four newly released sub-adults) at Karangahake Gorge, southern Coromandel Peninsula, in less than 14 days during December 1995 (G. Staples, pers. comm.).

Dogs were a problem to both Weka and Kiwi in the Bay of Islands (Taborsky 1988, Miller & Pierce 1995). Two North Island Brown Kiwi (*Apteryx australis mantelli*) were killed by a dog in Waipiro Bay during this study. Dogs injured Weka, making them more vulnerable to other mortality factors. At Karangahake Gorge one dog killed at least five of the 10 Weka released before he was removed, and other dogs killed at least one Weka each (Bramley 1994, G. Staples, pers. comm.).

Weka numbers and distribution declined substantially in the Cape Brett to Ngaiotonga region, between 1987 and March 1991 (Beauchamp 1988). Anecdotal records and counts suggest that there were more substantial declines in Weka numbers in the region between Jacks Bay and Parekura Bay (Fig. 1) during the summer and autumn of 1990-91, and in Parekura Bay during 1993, than at other times. These coincided with severe drought, which dried out forest leaf completely, reducing food supplies. The densities of important supplementary foods like crickets only increased substantially once in the four summers, and fruit was generally unavailable. During the 1990-91 drought, most Weka disappeared from the rural area south of Opua (Fig. 1), and from parts of Kawau Island (Beauchamp 1997b). In 1991, Weka numbers were significantly lower than in subsequent seasons in the Mansion House Reserve (Beauchamp 1997b).

Changes in land use, and the impact of possums (*Trichosurus vulpecula*) on food supplies may also have affected the suitability of the Cape Brett region to hold a viable Weka population. When Weka were released at Rawhiti in the 1970s, there were no possums, few roads, and fewer houses (Robertson 1976). The area now has roads and many houses. Brushtail possums reached the area in the early 1980's (B. King, pers. comm.). By 1987, they were at high density; and since 1989, there have been continuous possum poisoning and trapping operations.

This study could not define the importance of factors in the failure of the Parekura Bay population. However, it found that raising Weka productivity alone was not sufficient to prevent this small population from declining. Poor sub-adult and female survival was evident. Apparently healthy Weka populations can decline rapidly (Beauchamp 1997a, 1997b), and populations will not recover if mammalian predation, and other anthropogenic impacts are significant. The factors limiting all existing Weka populations need to be identified and their impacts reduced. In some regions mammalian predators may need controlling in areas surrounding Weka populations to ensure their long term viability.

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