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Weka (*Gallirallus australis*) and *Leiopelma* frogs - a risk assessment

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ABSTRACT

Captive Weka (*Gallirallus australis*) were offered two species of native frogs (*Leiopelma hochstetteri* and *L. archeyi*) as prey. The anti-predator behaviour and/or gland secretions of the frogs were sufficient to avoid damage and allow them to escape. The leaf litter habitats where frogs occur in the Coromandel Ranges are least likely to be favoured by Weka. Objects under which frogs were found were heavier than those generally moved by Weka while foraging. Weka seem to constitute less of a risk to frogs than earlier believed.

KEYWORDS: Weka, *Gallirallus australis, Leiopelma hochstetteri, Leiopelma archeyi,* predation risk.

INTRODUCTION

The Weka (*Gallirallus australis*) is an omnivorous flightless New Zealand rail which occupies open and forest habitats from the coast to the subalpine grasslands. The Weka generally feeds on invertebrates, fruit and vegetation (Carroll 1963, Coleman *et al.* 1983, Beauchamp 1987, Bramley 1994). Weka have occasionally been seen killing lizards (Beauchamp 1987) as well as fallen nestling and ground-active young of New Zealand Robin (*Petroica australis*, Wilkinson 1927), Whitehead (*Mohoua albicilla*, Beauchamp unpubl. data), Saddleback (*Philesturnus carunculatus*, Tim Lovegrove, pers. comm.), California Quail (*Callipepla californica,* Wilkinson 1927), Blue Penguin (*Eudyptula minor*, Beauchamp, unpubl. data), and Fiordland Crested Penguin (*Eudyptes pachyrhynchus*, St Clair & St Clair 1992). There have also been reports of Weka killing adult birds including Mottled Petrel (*Pterodroma inexpectata*, Peter Harper, pers. comm.), House Sparrow (*Passer domesticus*, Tim Lovegrove, pers. comm.), Song Thrush (*Turdus philomelos*, Edgar 1972); and small mammals including stoats (*Mustela erminea*, Morrison 1980), and kiore (*Rattus exulans*, Beauchamp unpubl. data). Weka also take eggs of many ground-nesting birds (Wilkinson 1927, Wilson 1959, Jolly 1989) and have been seen altering petrel habitats to the point where petrel populations were threatened (Wilson 1959, Andy Cox, pers. comm.). However, most of the records of Weka feeding on vertebrates are

based on gizzard and faecal analysis and we cannot determine whether vertebrates were freshly killed or carrion. Consequently, most of the impact by Weka on vertebrate populations is based on extrapolation of species absences like the Banded Rail (*Rallus philippensis*, Cooper *et al.* 1986), Stewart Island Fernbird (*Bowdleria punctata stewartiana*, Cooper *et al.* 1986), Stewart Island Snipe (*Coenocorypha aucklandica iredalei*, Miskelly 1987) on the islands surrounding Stewart Island; or disappearances of species like the Red-fronted Parakeet (*Cyanoramphus novaezelandiae)* on Macquarie Island (Taylor 1979). Other population studies of the Little Spotted Kiwi (*Apteryx owenii)* on Kapiti Island (Jolly 1989, 1990, Colbourne 1992), and Fiordland Crested Penguin on the Open Bay Islands (St Clair & St Clair 1992) have shown an interaction with Weka, but have been inconclusive about the importance of this in population dynamics terms.

The evidence for frog consumption and the impact of Weka on wild frog populations is also uncertain. Green tree frog (*Litoria* spp.) remains have been found in wild Weka faeces but is unclear whether these frogs were killed by Weka or eaten as carrion (Carroll 1963, Coleman *et al.* 1983). There is no record of Weka eating native frogs *Leiopelma* spp. but MacMillan (1990) considered that this occurs. Weka could threaten native frogs through direct predation or alteration of the habitat through foraging methods.

Weka were removed from Codfish Island because they were killing Mottled Petrel and the petrel populations were threatened with extinction (Peter Harper, pers. comm.). In the early 1980s, Western Weka (*G. a. australis*) were removed from Maud Island, Marlborough Sounds, by the Wildlife Service to protect the Stephens Island frogs (*Leiopelma hamiltoni*, Green 1988), although no relationship between Weka foraging behaviour or predation on frog demography was established (Don Newman, pers. comm.). More recently, Weka were removed from the Chetwode Islands, Marlborough Sounds, in preparation for the re-introduction of Stephens Island frogs and other, unspecified species (Peter Lawless, pers. comm.).

Over the past decade the North Island Weka has disappeared from most of its range on the East Cape. Less than 2,500 North Island Weka remain on the North Island and most are in the recently colonised Toatoa and Whitikau region of the Raukumara Ranges (Beauchamp, unpubl. data), where Hochstetter's frog (*L. hochstetteri)* are in high density (Chris Ward, pers. comm.). Weka co-existed with Hochstetter's and Archey's frogs (*L. archeyi)* in the Coromandel Ranges until 1928 (John Cotter, pers. comm.). Recent releases of Weka in the southern Coromandel at Karangahake could bring Weka back into contact with Hochstetter's and Archey's frogs. Information is required to assess whether Weka really threatened these frogs so that management strategies can be considered.

This study aimed at assessing the likelihood that Weka would encounter Hochstetter's and Archey's frogs in the Coromandel should their ranges overlap, and whether the frogs found could escape unharmed.

METHODS

Frog census and habitat preferences

Frogs were searched for and taken the day before each feeding experiment. Each time a frog was encountered, its size and colour, the colour of the substrate the frog was resting on, the position of the frog in relation to other features (water, fern glades, screes, ridge lines), and the weight and colour of the cover object was recorded. The colour, snout-vent length and jaw width measurements and body mass was recorded for all frogs caught. Each capture location was marked with numbered tape.

Six adult Hochstetter's frogs were taken from two areas in 20 - 60 year old forest (Site 1 - NZMS 260T12, 483468; and Site 2 - NZMS 260 T12, 492463) after extensive searching of 100 m of stream bed margin, and up to 5 m from the water course. Eight adult Archey's frogs were taken from the bush-covered ridge line up to 300 m north of the summit of the Tapu to Coroglen Road (NZMS 260 T11, 407664 to 407653). Archey's frogs were also searched for on a dry but dark night in the same area. The locations of the frogs found were marked, and inspected the next morning to see if the frogs had moved during the night.

All frogs were transported to and from Karangahake in separate plastic containers with leaf litter and a moist sponge. Frogs were checked against the capture data and measurements and released at their exact point of capture within 24 h.

The work was carried out on the 19 March (Archey's frogs) and 20 March 1992 (Hochstetter's frogs) under permit from the Department of Conservation, and after consideration by its Animal Ethics Committee. The sample sizes of frogs collected and used were those imposed by this committee.

Feeding trials

The first experiment involved transferring the secretions of six frogs of each species to the food by rubbing gland areas of each species with 12 pieces of 5 mm^3 blocks of cheese and 12 pieces of 20 mm long shreds of cooked pasta. These food items and an otherwise identical control were then introduced to an aviary with two sub-adult male Weka (less than 60 days old). Weka were observed from a hide 3 m away.

The second experiment involved introducing a single live frog on a plate with 40 g of white and brown pasta. These experiments were carried out in an aviary with four captive reared sub-adult Weka, two males and two females. The Weka were not fed for 12 h before each experiment, and in the previous 24 h had been given a teaspoonful each of cheese and corn, 10 g of pasta and a quarter slice of wholemeal bread each. Weka held for 12 h without food do not produce faeces when handled and it appears from dye studies that food is passed within 4 to 12 h (Beauchamp, unpubl. data). The experiment was carried out during their normal feeding time and when competition for food was most intense.

If the first frog was not eaten within 5 min after its first encounter with a Weka, it was retrieved and another frog was introduced. During this experiment the observer was in the aviary and within 5 m of the plate of food.

Weka food availability

I scraped by hand the leaf litter from 0.3 m^2 plots in the places where Weka were most likely to forage in 96 areas near where the Hochstetter's frogs were found, and 102 places near where Archeyi's frogs were found. I also scraped 74 similar plots in the areas used by Weka at Karangahake. The number of invertebrates and other food items seen were recorded. I also simulated the destruction or movement of toetoe (*Cortaderia* spp.) clumps and logs in order to find frogs.

RESULTS

Frog census and habitat preferences

All Hochstetter's frogs found during daylight were in moist sites or beside a stream. Three frogs escaped into the stream before they could be caught. The rocks covering frogs were between 500 and 10,500 g (mean = 4975 g, S. E. = 4042 g, N =10). Most of the frogs were found on the stream margins where the rocks were covered in moss.

All Archey's frogs were found during daylight under rocks and logs. Rocks ranged between 1200 and 12,000 g (mean = 4244 g, S. E. = 3316 g, N = 9). Two frogs were found together under a fallen ponga (*Dicksonia* spp.).

A search of the Archey's frog habitat on a dry dark night found no uncovered frogs. Two frogs were found under rocks and both had moved by the following morning.

Feeding trials

No obvious additional glandular secretions were produced by either species of frogs when the food was rubbed against the frogs, and the Archey's frogs did not assume the arched head butt position.

The cheese with secretions and the control were eaten as soon as the person introducing the plates had left the site. Both Weka started by eating the food on a different plate, subsequently changing plates. All the food was finished within 2 min and there was no obvious difference in Weka behaviour when eating food with secretions or the control. Both Weka returned to the plates three times to look for more food, and attempted to turn the empty plates over to get scraps.

The first Archey's frog released in the second experiment was not recognised as food and the Weka started to eat the pasta it was sitting on. Only after the frog moved did a male Weka pick it up. The frog let out a series of high-pitched squeaks and was dropped within two m of the plate. It was picked up by the second male Weka and dropped a further 0.5 m away. The frog then assumed the arched head butt position (Green 1988) and was ignored by all four Weka. After 2 min it was picked up again by the second male and dropped after further squeaks. It adopted the arched head butt position again. It was left a further 2 min in this position but drew no further attention from the Weka, before it was recovered in the aviary. The frog assumed the normal position when picked up; it was undamaged.

The second frog was introduced 10 min after the first to the same group of Weka. It was picked up from the pasta by the first male, it squeaked and was

TABLE 1 - Abundance of amphipods in Weka habitat at Karangahake Gorge and the sites where frogs were collected. Data are: mean ± S.E. (N).

	Karangahaka Gorge	Tapu to Coroglen Road[1]	Tairua Catchment[2]
Large amphipods, >5mm			
Against objects	9.3±7.0 (19)	0.7±1.4 (22)	7.5±11.4 (12)
Rock scree	0	0.8±1.3 (14)	0.3±0.6 (16)
Open ground	17.6±24.0 (55)	1.1±1.4 (66)	2.7±5.2 (69)
Small amphipods, <5mm			
Against objects	29.9±36.2 (19)	0.3±1.0 (22)	6.0±7.8 (12)
Rock scree	0	0.3±0.7 (14)	0.5±1.6 (16)
Open ground	23.9±28.9 (55)	1.1±3.0 (66)	3.3±5.9 (68)

[1] Archey's frog habitat
[2] Hochstetter's frog habitat

dropped 0.5 m from the plate. It adopted the arched head butt position and after another minute was picked up and dropped again. It was left a further 4 min and recovered undamaged making its way out of the aviary.

The Hochstetter's frogs were introduced to the same four Weka as the Archey's frogs and in exactly the same way. The first frog was picked up by the second male Weka. It squeaked and was dropped by the plate. Within 2 min it was picked up twice and tasted with the tongue by this Weka. It was rejected and sat in the normal frog position until it hopped towards the side of the aviary. The frog was undamaged and recovered after 5 min near the aviary margin.

The second frog was introduced to the Weka 10 min after the first. It was picked up and tasted by the second male and dropped after considerable squeaking. After 5 min it had hopped through the group of four Weka and was found beside a log in the aviary where it was recovered undamaged.

Forest litter food availability

Weka only forage in forest litter if food is readily available, or when other food is limited (Beauchamp 1987). Amphipod size and abundance are good indicators of the likelihood that Weka will forage extensively there (Beauchamp 1987). Table 1 summarises the amphipod availability indices at the sites where frogs were collected, and in the area where Weka foraged in Karangahake Gorge during the same period. Karangahake Gorge had higher numbers of amphipods in both size classes than forested frog habitats.

Other invertebrates which Weka may feed on were also seen during litter scrapes in the Hochstetter's frog habitat. These included millipedes, centipedes, small beetles, beetle larvae, small snails, small weta, spiders, worms, a tipulid larvae nest, fruit of *Coprosma* and pigeonwood (*Hedycarya arborea*). In Archey's frog habitat beetle larvae, large spiders and *Coprosma* fruit were also found. These, were far less numerous than at Karangahake, where millipedes, worms, beetle larvae, and crickets were abundant.

I found no frogs while scraping litter, moving logs and destroying the bases of dead toetoe or any other imitated Weka foraging action.

DISCUSSION

This study indicates that Weka could pose little risk to native frog populations in the Coromandel and Raukumara Ranges. During the day most frogs were under rocks and logs that were heavier than objects moved by Weka during normal foraging. Weka would need to be extremely interested in a food item before attempting to move objects weighing more than 1 kg. Weka are also unlikely to encounter frogs because they were silent, and active at night when Weka foraging is minimal. Weka forage in moonlight in open habitats (Beauchamp 1987), but not on dark misty nights, when frogs are most active (Newman 1977).

The Weka used in this study were captive reared sub-adults who were yet to attain adult weights and who had not been fed for 12 h. They displayed the same range of foraging behaviour as wild Weka within the aviary, and on release survived for months before being killed by ferrets and dogs. They had previously fought over dead rats (Gary & Elaine Staples. pers. comm.), and investigated any potential food item. They had every opportunity to investigate the frogs and eat them.

The frogs did not squeak or adopt the head butt or other defensive positions when they were wiped against the food. It is possible that the amount of the secretion that was added to the food was insufficient to detract Weka, and that extra secretions are generated by grabbed frogs. Live Hochstetter's and Archey's frogs appeared to escape being eaten by using anti-predator behaviour and gland secretions (Green 1988). Weka dropped the frogs after tasting them with their tongues. Similar tasting and acceptance or rejection behaviours occur with fallen hinau (*Elaeocarpus dentatus*) fruit (Beauchamp 1987).

In the past low density Weka populations have been removed from offshore islands on the grounds that they may threaten frog populations (Green 1988), but there was no evidence of any impact. At high densities, Weka could potentially have a detrimental effect on frog populations during droughts, by reducing the humidity within forest leaf litter when foraging (Beauchamp 1987). This could restrict the habitats, movement and food available to frogs. Habitat disturbance would be most evident in areas with shallow, small or soft withered leaf litter, and where logs dried sufficiently to permit Weka movement (Beauchamp 1987, unpubl. data). Other areas likely to become less favourable for frogs would be shallow screes with rocks light enough to be moved by Weka (Bell & Bell 1994). Currently, Weka do not overlap with native frogs on offshore islands. However, if frogs were to be introduced to islands that had Weka, further work should be carried out to demonstrate that Weka and frogs are incompatible before Weka are considered a threat.

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LITERATURE CITED

BEAUCHAMP, A. J. 1987. A population study of the Weka (*Gallirallus australis*) on Kapiti Island. Unpublished Ph.D., Victoria University, Wellington.

BELL, E. A.; BELL, B. D. 1994. Local distribution, habitat and numbers of the endemic terrestrial frog *Leiopelma hamiltoni* on Maud Island New Zealand. N. Z. J. Zool. 21: 437-442.

BRAMLEY, G. N. 1994. The autecology and conservation of the North Island Weka. Unpublished M.Sc. Thesis Massey University, Palmerson North.

CARROLL, A. L. K. 1963. Food habits of the North Island Weka. *Notornis* 10: 289-300.

COLBOURNE, R. 1992. Little spotted Kiwi (*Apteryx owenl*) recruitment behaviour of juveniles on Kapiti Island, New Zealand. J. Roy. Soc. N. Z. 22: 321-328.

COLEMAN, J. D.; WARBURTON, B.; GREEN, W. Q. 1983. Some population statistics and movements of the Western Weka. Notornis 30: 93-107.

COOPER, W. J.; MISKELLY, C. M.; MORRISON, K.; PEACOCK, R. J. 1986. Birds of Solander Islands. Notornis 33: 77-89.

EDGAR, A. T. 1972. Classified summarised notes. Notornis 19: 339-364.

GREEN, D. M. 1988. Anti-predator behaviours and skin glands in the New Zealand native frogs, Genus *Leiopelma*. N. Z. J. Zool. 15: 39-45.

JOLLY, J. N. 1989. A field study of the breeding biology of the Little Spotted Kiwi (*Apteryx owenl*) with emphasis on the causes of nest failures. J. Roy. Soc. N. Z. 19: 433-448.

JOLLY, J. N. 1990. The Little Spotted Kiwi, *Apteryx owenl*. Pp. 87-96. *in* Fuller, E. (ed.) Kiwis. SeTo Publishing, Auckland.

MacMILLAN, B. W. 1990. Attempts to re-establish Wekas, Brown Kiwis and Red-crowned Parakeets in the Waitakere Ranges. Notornis 37: 45-51.

MISKELLY. C. 1987. The identity of the Hakawai. Notornis 34: 95-116.

MORRISON, K. 1980. Bird and stoat encounters in Fiordland. Notornis 27: 324.

NEWMAN, D. J. 1977. Hamilton's frog. Wildlife - A Review 8: 48-53.

St CLAIR, C. C.; St CLAIR, R. C. 1992. Weka predation on eggs and chicks of Fiordland Crested Penguin. Notornis 39: 60-63.

TAYLOR, R. H. 1979. How the Macquarie Island parakeet became extinct. N. Z. J. Ecol. 2: 42-45.

WILKINSON, A. S. 1927. Birds on Kapiti Island. Emu 27: 237-258.

WILSON, R. 1959. Bird islands of New Zealand. Whitcombe & Tombs Ltd., Christchurch.

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