SHORT COMMUNICATION

Weta and the evolution of fleshy fruits in New Zealand

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Abstract: Fleshy fruits are typically coloured either red or black and are displayed in conspicuous locations where they can be easily located by birds. However, fleshy fruits in New Zealand are often white or translucently coloured and are displayed in the inner recesses of plant canopies. These characteristics have been attributed to coevolution with reptiles. I describe seed dispersal by a ground weta in Nelson lakes National Park, and hypothesise that the unusual characteristics of fleshy fruits in New Zealand may result from coevolution with weta.

Keywords: Fruit colour; *Gaultheria*; seed dispersal; *Zealandosandrus*

Duthie *et al*. (2006) recently documented that Wellington tree weta (*Hemideina crassidens*) consume fleshy fruits and disperse seeds after ingestion. No other insect is known to perform such a function, so New Zealand appears to be home to an entirely unique type of seed dispersal mutualist. However, the relative importance and evolutionary implications of seed dispersal by weta remain unclear. I describe a new weta/fruit interaction, the dispersal of mountain snowberries (*Gaultheria depressa* Hook.) by ground weta (*Zealandosandrus maculifrons*), and speculate briefly on how weta may have influenced the evolution of fruit form in New Zealand.

On the afternoon of 20 April 2006 an immature female ground weta was found under a small rock located 20 m above the treeline on Mt. Robert in Nelson Lakes National Park. It was captured by hand, placed in a small plastic container (25 × 25 × 10 cm) and transported 750 m down-slope to St. Arnaud (41° 48' S, 172° 49'E). It was held in laboratory conditions for 48 hours, during which time it defecated three times. It was then returned to where it was found. Inspection under a light microscope showed that all three faeces contained seeds and seed fragments. Thirty-nine intact seeds of *Gaultheria depressa* were recovered, providing the first evidence for seed dispersal by ground weta.

Gaultheria depressa is a prostrate, mat-forming plant with an unusual method of fruit presentation. Its fruits are large (1 – 2 cm in diameter) relative to overall plant size, polymorphic in colour (either white or red), and are often produced in the inner recesses of leaf canopies, where they are obscured from view by aerially searching frugivores. From this perspective, the architecture of mountain snowberry displays is unusual, given that birds are the most abundant seed dispersers, both in New Zealand and globally (see Clout and Hay, 1989). Fruit form in mountain snowberry may instead be better suited to small-sized, ground-dwelling frugivores such as lizards (Whitaker, 1987; Wotton, 2002; Olesen and Valido, 2003). Indeed, Patterson (1985) found that common skinks (*Oligosoma nigriplantare*), which rarely exceed 7 cm in length and can easily manoeuvre within the canopies of mat-forming plants, consume and disperse snowberries.

Several unusual characteristics of New Zealand fleshy fruits have been attributed to coevolution with lizards. Many New Zealand plant species produce fleshy fruits in their inner-most branches, which restricts access to birds but facilitates access to lizards (see Wotton, 2002). Many New Zealand fruits also come in unusual colours, such as translucent, white hues, which are thought to match the visual acuities of reptiles (Lord and Marshall, 2001). However, if seed dispersal by weta turns out to be a widespread phenomenon, these characteristics might also be attributable to coevolution with weta. Ground weta forage either in leaf litter at the soil surface, or just below the soil surface in burrows (Meads, 1990), and therefore are in close proximity to snowberry fruit displays. Insects are also known to lack visual receptors for red hues, which are the most common fruit hues in other locales and are readily detected by birds and mammals (Whelan and Wilson 1990). Therefore, the pale fruits produced by *G. depressa*, and other species with similar fruit colours (*Pimelea* spp. and *Muehlenbeckia* spp.), might result from coevolution with weta. However, lizard and weta

seed dispersers are not identical. Weta can be important seed predators (Mirams 1957; Beveridge 1964), whereas lizards lack sharp mandibles and strong jaw musculature that can crack thick seed coats.

Several other peculiar attributes of the New Zealand flora, such as leaf heteroblasty and divaricate branching architecture, have been attributed to coevolution with animals. A coevolutionary explanation for these attributes has sometimes proved contentious, perhaps because some putative selection agents are now extinct (e.g. moa). However, numerous taxa of weta, skinks, geckos and birds are extant. Therefore, experiments comparing the quality and quantity of seed dispersal by weta, reptiles and birds can be made to directly test whether the unique characteristics of New Zealand fleshy fruits are adaptations to a unique type of insect seed disperser.

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