

FORUM ARTICLE

Exploring the concept of niche convergence in a land without rodents:
the case of weta as small mammals

Fecundity

Although body mass of Orthoptera and rodents converge at about the size of small mice, the attributes of large insects and small mammals are nevertheless very different. Tree weta and mice are at different ends of their respective distributions, and this highlights a difference that is expressed in their reproductive capacity. Small Orthoptera (such as *Gryllidae* crickets) often exhibit a 'boom or bust lifestyle' like many small mammals; whereas larger Orthoptera, such as weta, tend to have slower growth and lower replacement rates (Whitman 2008).

The potential reproductive rate of mice far exceeds that of weta. Wild female mice (*Mus musculus*) become sexually mature at about 60–70 days old (Bronson 1984), have a 3-week gestation period, a litter size averaging six offspring and the ability to become pregnant soon after giving birth (Pelikan 1981). The reproductive characteristics of mice compared with other mammals can be characterised as r-selected, with a high intrinsic rate of increase (MacArthur & Wilson 1967). In contrast, tree and giant weta take about one year to reach sexual maturity, and once adult, probably experience just one breeding season and are thus, compared with many smaller Orthoptera, K-selected (MacArthur & Wilson 1967). Although details of weta reproduction are scarce, for two tree weta species held in captivity (*Hemideina thoracica*, *H. crassidens*), between 34 and 120 eggs per female were laid over approximately 6 weeks and hatching rates were between zero and 70% (Morgan-Richards, unpubl. data). Two wild-caught adult female tusked weta (*Motuweta isolata*) laid 153 eggs in captivity before death, although only 21 juveniles were recovered and 15 reared to adults (Stringer 1998). Using the tusked weta example, assuming 76 eggs per female and 100% fertility and survival, and an equal sex ratio, we calculated that a pair of tusked weta could in theory increase to 109 000 in 3 years. During the same time period a pair of mice (*Mus musculus*) could generate a population of over 30 million. The mouse intrinsic rate of increase is thus around 275 times greater than the weta.

The reproductive capacity of mice (and many other rodents) is highly responsive to short-term changes in resource availability (also a characteristic of r-selected species; MacArthur & Wilson 1967). As mice are not limited to seasonal breeding they can respond to food abundance at any time of the year (Brockie 1992). For example, in New Zealand, seed masting of *Nothofagus* beech stimulates a rapid increase of mice (King 1983; Choquenot & Ruscoe 2000; Ruscoe et al. 2005). There is no evidence that any weta do or could respond to such resource fluctuations in this way.

Metabolism

One reason that mice have such a high growth rate and responsive reproductive rate is that they are endothermic. Mammals expend a large proportion of the energy they consume

also predate seeds like some mammals (Duthie et al. 2006; Wyman et al. 2010), their influence depends on the number of seeds consumed and destroyed and the distance travelled. In tree weta the number of seeds eaten is probably low, the proportion destroyed high and the distance travelled minimal (Wyman et al. 2010), so their importance as seed dispersers is likely to be low compared with other animals such as mice and native birds. However, data for comparison of the actual amount consumed by various animals or even home range size are few. For example, estimates of mouse home ranges of between 250 and 470 m² (Maly et al. 1985; Mikesic & Drickamer 1992) are not directly equivalent to data showing nightly movements of tree weta of <12 m (Kelly 2006).

Conclusion

The usefulness of the comparison between the ecological niches of weta and mice (and other small mammals) is constrained by unspecific terminology and the superficial nature of initial comparisons, which obscure much of the ecological and evolutionary distinctiveness of weta. The very different metabolic and reproductive rates and diets of these animals (e.g. mice vs tree weta) likely mean they have significantly different impacts on ecosystems (summarised in Table 1). Persistence of the invertebrate-mouse cliché, despite a lack of supporting evidence for similarity, can best be attributed to lack of knowledge of weta. Thus studies of weta reproductive strategies and mate choice, population size and dynamics, fecundity, dietary repertoire, nutrient optimisation, and resource partitioning among weta taxa deserve close attention. Suitable data on these would also enable comparisons with taxa related to weta that co-occur with native mammals in other parts of the world (e.g. Australia).

Quantification of the effects that different weta species have on seed predation and dispersal, pollination, predation, and nutrient/energy cycling is critical and would enable comparison with other animals in New Zealand ecosystems. The co-occurrence of weta and introduced rodent species in New Zealand today provides the experimental framework for comparative analyses of the ecological niches occupied by weta species and the energetics of New Zealand ecosystems. This will in turn contribute to better interpretation of the evolutionary history of the New Zealand biota and provide an empirical basis for testing what are, in many cases to date, ad hoc interpretations.

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