

Scotch broom, *Cytisus scoparius*, seed size and seed predation by a bruchid beetle in New Zealand: evidence that biological control reverses evolution of increased competitive ability

Quentin Paynter^{*}, Paul Peterson, Hugh Gourlay and Simon V. Fowler

Manaaki Whenua Landcare Research, Private Bag 92170, Auckland, New Zealand. paynterq@landcareresearch.co.nz

Previous studies have shown that broom, *Cytisus scoparius* (Fabaceae), seeds are substantially bigger in broom's exotic range, and that larger seeds should have a positive influence on the competitive ability of seedlings and, therefore, the invasive ability of broom populations. We hypothesised that larger seed-size in the exotic range is due to an absence of selection pressure from specialist herbivores that affect seed size which could be reversed by introducing a seed-feeding biological control agent. A seed-feeding bruchid beetle, *Bruchidius villosus* (Coleoptera: Bruchidae), was first released in New Zealand in 1988. Each *B. villosus* larva completes its development within a single broom seed, so that maximum beetle size is constrained by seed size. We hypothesised that the size of *B. villosus* beetles is correlated with seed size and that beetle size is correlated with beetle fitness and we: (i) simultaneously collected beetles and seeds from a range of localities throughout New Zealand to investigate whether regional variation in seed size could be correlated with regional variation in beetle size; (ii) performed a laboratory study to investigate the influence of body size on the fecundity of female beetles; and (iii) we compared the size distributions of beetles emerging from pods in autumn, prior to hibernation, with the size distributions of beetles, that returned to the same broom plants the following spring, to investigate whether there was evidence for the survival rates of overwintering beetles being size-dependent. The results of these studies indicated that seed size strongly influences *B. villosus* fitness. If *B. villosus* exploits broom populations that produce large seeds more effectively than those that produce small seeds, this should impose a selection pressure favouring plants that produce small seeds and thereby impose "bottom up" regulation of beetle numbers at the cost of reduced seedling competitive ability.