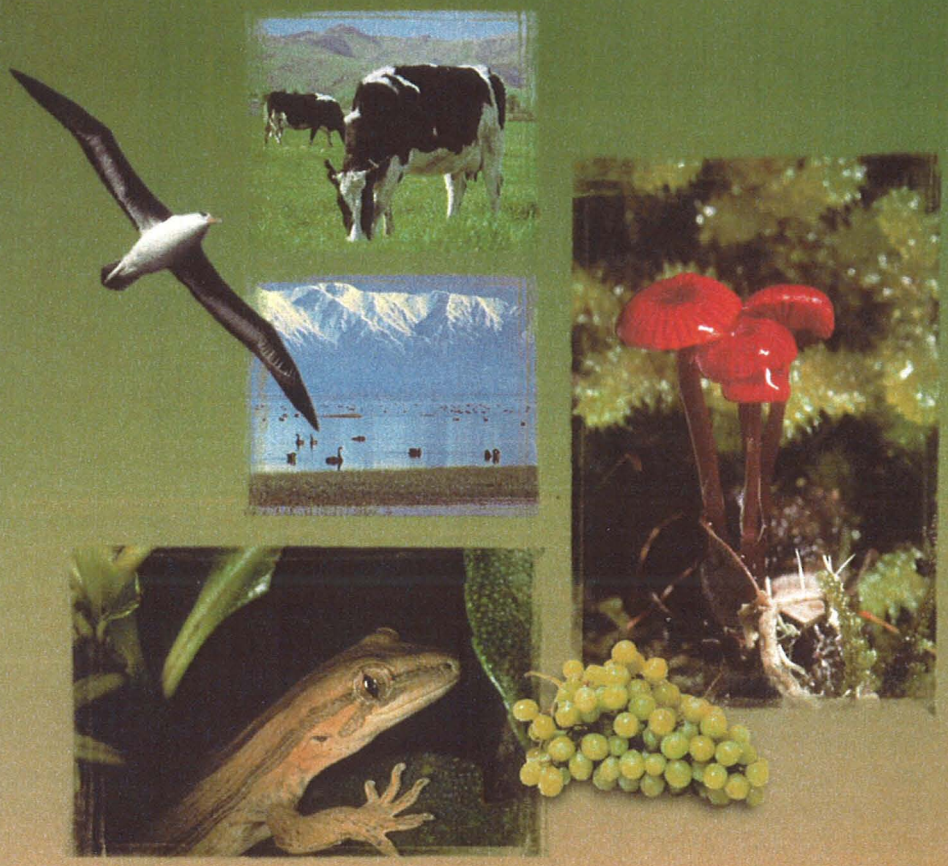
Lincoln University

Soil, Plant & Ecological Sciences Division



Captive Breeding of Wellington Speargrass Weevil

Stephen Pawson, R.M. Emberson and R.R. Scott

SOIL, PLANT & ECOLOGICAL SCIENCES DIVISION
LINCOLN UNIVERSITY
Te Whare Wānaka O Aoraki
PO BOX 84, LINCOLN UNIVERSITY, CANTERBURY 8150, NEW ZEALAND

Wildlife Management Report No. 33

Captive Breeding of Wellington Speargrass Weevil

Final report June 2004

Stephen Pawson, Rowan M. Emberson and R. Roderic Scott

Introduction

This project was initiated in May 1999 with the aim of determining optimum rearing conditions to breed *Lyperobius huttoni* Pascoe, 1876 in captivity. Since the retirement of Dr Rowan Emberson, the contract (investigation No 3278) has been undertaken by Stephen Pawson with supervision by Dr Scott. The programme has been relatively unsuccessful with only a single individual reared in captivity (in 2001). However, some highly relevant information has been accumulated over the last three years and is summarised in this report.

Collection and Field Observation

Weevils were collected from a number of locations during the study, principally from sites at Porters Pass and Kahutara Saddle (Seaward Kaikoura Range):

April 24, 2001: six adult weevils were collected Kahutara Saddle and, in 4-6 weeks, there were 18 larvae on the potted plants.

March 29, 2002: five adult weevils were collected from Porters Pass; no larvae were observed on potted plants and subsequent morphological examination found that all individuals were female.

February 13, 2003: four weevils were collected from Porters Pass, three were male.

March 24, 2004: 11 adult weevils were collected from Kahutara Saddle, nine were female.

From these limited data, there seems to be a subtle trend for increased numbers of females towards the end of the season. Males were more frequently observed/collected earlier in the season. Therefore, to provide a suitable breeding population, it may be necessary to collect over an extended period to ensure adequate numbers of both sexes.

Some weevils were collected on windy days, however, during such conditions few weevils were ever observed feeding; most had to be collected from under foliage. Such collecting was difficult because it took considerable time and energy to find individuals under the dense mat of dead foliage. This method of collecting also resulted in localised disturbance of habitat that should be avoided wherever possible. Best results were always achieved on calm, warm days when the sun was shining during the late afternoon. Under favourable conditions, weevils were often seen actively feeding and were easily collected without habitat disturbance. The 11 adults collected at Kahutara Saddle (24 March, 2004) were found in just over an hour's searching.

Larvae were found in the field by looking for dying *Aciphylla* plants during late summer. Modest (but not excessive) pressure applied to pull the plant out of the ground would snap the taproot at the point where the larvae were feeding. Larvae could then be removed by extracting them from the surrounding dead foliage with care. Of note, these larvae were often living in conditions that would be difficult to replicate in the laboratory. There was excessive moisture and large amounts of rotten or semi-decomposed *Aciphylla* root. This fibrous, paste-like substrate provided habitat for many other organisms but most notably Diptera larvae. To mimic these conditions in the laboratory would be difficult because managing the correct moisture regime and state of decomposition would require advanced control of the humidity. Furthermore, unwanted fungal and bacterial communities not present in alpine ecosystems (or kept in a natural balance) could easily colonise and dominate resources.

Sex Determination

Adult *Lyperobius huttoni* have been notoriously difficult to sex without the examination of genitalia (which can be done only with dead individuals). Females are often larger than males, but there are no reliable sexually dimorphic characters based on size. The most reliable character appears to be a well-developed bilateral group of hairs on the fifth sternite (ventral abdominal segment) (Figures 1a &1b). In addition, the fifth abdominal ventrite of females tends to be larger, longer and more rounded at the margins (Craw 1999).

Laboratory Rearing

Mixed results have been achieved over the years. In 2001, larvae were produced in the laboratory in 4-6 weeks. One individual was reared to adulthood but subsequently died. Similar attempts over subsequent years using the same protocol either failed to produce larvae or produced very few.

The larvae are active feeders that move around the substrate. Evidence of their tunnelling through the soil can be seen in the form of surface tracks that indicate their passage just below the surface of the soil. However, larvae also burrowed deeply in the soil profile as shown by them pushing soil out of the drain holes of the plant-pots. Larvae also fed externally on or bored tunnels into pieces of parsnip or *Aciphylla* root placed on the soil surface. A build-up of clay particles was observed on the head capsules of some larvae. The build-up continued to grow to a point where it interfered with the feeding behaviour of the individual. This "clay cap" could be removed relatively simply under a microscope with a pair of dissecting tweezers.

Attempts were made to use the insect general-purpose artificial rearing diet with dried, ground-up *Aciphylla* root as a major constituent. The high moisture content of this diet had little impact on larval survival. Larvae did not appear to feed on the diet but rather appeared to get smaller (probably using up stored food reserves). This approach was discontinued in favour of parsnip and *Aciphylla* root or petiole as larval food.

Adults would regularly attempt to walk away from host plants in the laboratory. Whether this was an indication of incorrect environmental conditions, some form of intraspecific competition or innate dispersal phase is unknown. Individuals fed during most of the day, with laboratory records of feeding as late as 11 pm. At rest, adult weevils were found close to the base of the plants or, alternatively, under refugia such as rocks and pieces of wood.

Figure 1a. Female abdominal segments showing exposed female genitalia. (Note the broad shape of the last abdominal segments. Females may possess the remains of the bilateral setae (hairs) shown in Figure 1b, however, they are never a prominent feature.)

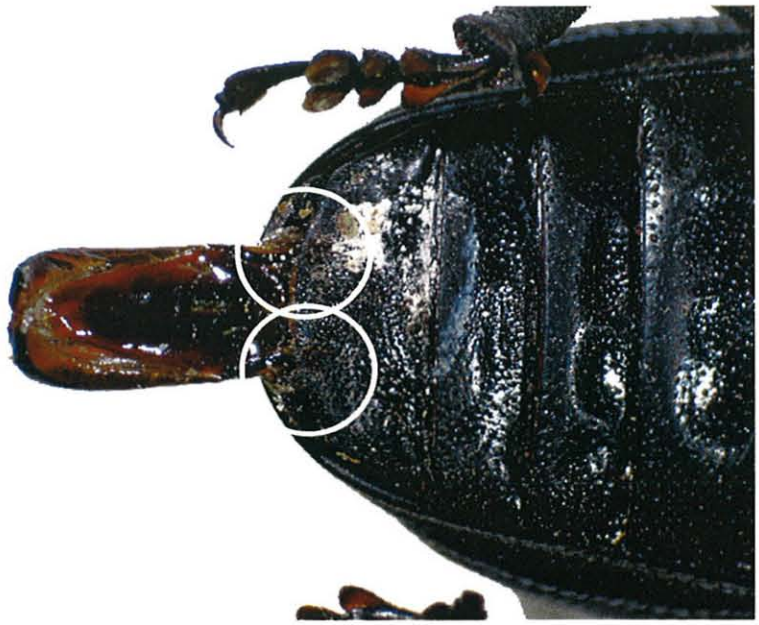


Figure 1b. Male abdominal segments showing exposed male genitalia. (Note the bilateral groups of pale brown setae (hairs) at the posterior end of the last abdominal segment. These are difficult to see in the illustration and are highlighted by the white circles. Under the microscope they are relatively easy to distinguish.)

Problems Encountered

Both adults and larvae consume large amounts of host plant material. *Aciphylla* plants are slow growing and may take 12 to 18 months to reach a suitable size for breeding *Lyperobius*. Younger plants are generally too small and larvae rapidly eat through the taproot killing the plant. They are also highly susceptible to attack by scale insects, mites and spittle-bugs (family: Cercopidae).

Adult weevil mortality was generally high. Many weevils died in January or February, which may represent a period of high natural mortality in the life cycle of *L. huttoni*. This assumption cannot be confirmed due to the relatively small sample sizes involved here.

One of the main sources of mortality appears to have been the fungus *Beauvaria* sp. High mortality of adults in February-March 2004 prompted further investigation. The entomopathogenic fungus *Beauvaria* was positively identified as the cause. It appears that *L. huttoni* and *L. carinatus* (Broun, 1881) are both susceptible to the fungus. Of

the 11 *L. huttoni* transferred from Kahutara Saddle in March 2004, seven were killed by the fungus and one more killed in attempting to surface sterilise it. All four *L. carinatus* collected from Camp Saddle in the Craigieburn Range also died from the fungal infection.

Fungal spores of *Beauvaria* are easily killed by sterilisation using chlorine. Thus all laboratory equipment should be immediately sterilised if contamination by *Beauvaria* is suspected. Most adult weevils survived a sterilisation technique recommended by Dr Travis Glare, AgResearch CRI, Lincoln, who works on this fungus. The technique involves dipping weevils in a 70% solution of ethanol for 30 seconds followed by immediate washing in copious amounts of distilled water. No method of surface sterilisation has been attempted so far with *Lyperobius* larvae.

This apparent susceptibility of *Lyperobius* to *Beauvaria* is of concern because a number of scientists are currently attempting to develop and/or import more pathogenic strains of *Beauvaria* for biological control of weevil pasture pest species, such as clover root weevil (*Sitona lepidus* Gyllenhal). The potential release of any new strains of *Beauvaria* should be treated with caution, since large areas of *Aciphylla* shrubland communities are part of High Country pastoral leases. Currently, these areas do not have a problem with *Sitona*, however, any general release of more pathogenic strains will be a potential risk to *Lyperobius* and other native weevil species. The Department of Conservation should therefore make its concerns known during the ERMA consultation and approval process.

Conclusions

The five-year project was, on the whole, not very successful. A suitable breeding programme for *Lyperobius huttoni* was not developed. Three key problems were encountered. First, the slow-growing host plants often led to a lack of suitable mature food sources. Secondly, the inability to collect appropriate numbers of males and females appeared to have had some impact on the number of larvae produced. Third, and probably the greatest concern, were the problems encountered with the entomopathogenic fungus *Beauvaria*.

Reference

Craw, R. C. 1999. Molytini (Insecta: Coleoptera: Curculionidae: Molytinae). Fauna of New Zealand no. 39. pp. 1-68