CONSERVATION
TE PAPA ATAWHAI

CONSERVATION ADVISORY SCIENCE NOTES

No. 76

THE SUITABILITY OF NEW ZEALAND MOSS SPECIES AND HEATHER LITTER AS OVIPOSITION SITES FOR THE HEATHER BEETLE, *LOCHMAEA SUTURALIS (COLEOPTERA : CHRYSOMELIDAE)*

(Short Answers in Conservation Science)

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Department of Conservation, P 0 Box 10-420, Wellington, New Zealand

ISSN 1171-9834

Reference to material in this report should be cited thus:

Bourner, T.C. and Syrett, P., 1994.
The suitability of New Zealand moss species and heather litter as oviposition sites for the heather beetle, *Lochmaea suturalis (Coleoptera : Chrysomelidae)*. *Conservation Advisory Science Notes No. 76,* Department of Conservation, Wellington. 6p.

Commissioned by: Tongariro/Taupo Conservancy
Location: NZMS

The suitability of New Zealand moss species and heather litter as oviposition sites for the heather beetle, *Lochmaea suturalis* (*Coleoptera: Chrysomelidae*).

Bourner, T.C. and Syrett, P.

1 Summary

In their native habitat in Europe, heather beetles are known to oviposit on the *Sphagnum* mosses found beneath heather plants (*Calluna vulgaris*). Two moss species and litter, found to be common beneath heather plants in Tongariro National Park, were tested for their suitability as oviposition sites using imported heather beetles maintained under quarantine conditions. There was no significant difference between the rates of oviposition on *Racomitrium lanuginosum*, *Dicranoloma billardieri*, litter, or the *Sphagnum cristatum* control. Therefore, oviposition in *L. suturalis* does not appear to be restricted to the moss species present in Europe.

2 Introduction

The heather beetle, *Lochmaea suturalis* Thomson, is currently being tested for its suitability as a biocontrol agent for ling heather (*Calluna vulgaris*), which was deliberately introduced into Tongariro National Park (TNP) in a failed attempt to create a grouse moor. It was known from earlier studies (Cameron *et al*., 1944) that the sphagnum moss layer found beneath stands of heather in Europe is important as an oviposition and pupation site for the heather beetle. Since sphagnum moss is not usually found beneath heather plants in TNP, it was decided to investigate experimentally whether the moss species which are present could be suitable alternatives if the beetle were released to control *C. vulgaris.*

3 Methods

Six sites around TNP were searched briefly for mosses growing beneath heather plants. Samples of the most commonly occurring mosses from each site were collected for identification. The sites were selected for different ages of heather plants, and were from both the west and east sides of the park.

Site 1 was a hollow next to State Highway 4, just south of the junction with State Highway 47 (grid reference 27176 62220, TNP Parkmap 273-04, Department of Survey and Land Information). Heather plants here were up to 30 years old (Cathy Foster, pers. comm.), but the infestation was not dense. The site contained many mosses, but most grew quite sparsely and none appeared to predominate.

Site 2 was located at the Mangahuia Campsite on State Highway 47 (27234 62217). Heather plants here were large, forming extensive ground cover, and few mosses

were found.

Site 3 was at the lower end of the Mangatepopo Road (27283 62272), where heather grows extensively. Large quantities of *Racomitrium lanuginosum* were found both beneath and between heather plants.

Site 4, opposite the lower end of the Pukeonake track, close to a stream bed (27314 62262), yielded large quantities of *R. lanuginosum* and *Dicranoloma billardieri* beneath many plants. Moss growth beneath the largest *C. vulgaris* plants was scarce, although there was usually a deep layer of litter under these plants.

Sites 5 and 6 were next to the Waihohonu track on the drier Desert Road side of the park (27456 62162) where heather is a more recent arrival and plants tend to be quite small and more widely scattered. Site 6 was in an area which had been burned. Some heather had regrown, but cushions of *R. lanuginosum* had evidently been badly damaged by the fire and may have been dead. Other mosses were also rare. Site 5 was an adjacent unburned area with quite small heather plants, only some of which were associated with mosses.

By far the most abundant and widespread mosses were *R. lanuginosum* and *D. billardieri,* which were selected for oviposition tests. Many older heather plants were not associated with moss, but the deep litter layer beneath them appeared to have potential as a high-humidity oviposition site for heather beetles, so samples of litter were also taken for testing.

For the oviposition tests, heather plants approximately 20cm tall, taken from the Desert Road side of TNP, were matched in groups of four for size, growth form and quantity of new foliage. Plants were potted into 10cm plastic pots, and placed in the insect quarantine facilities for two weeks before the experiment, the four plants in each group being placed in different treatments. Moss or litter was placed around the base of each plant, in contact with the soil, which was kept moist by watering from below throughout the experiment. *Sphagnum cristatum*, from the west coast of South Island, was used as a control, having the high water-retaining properties associated with the *Sphagnum* species found beneath *C. vulgaris* in northern Europe. The other treatments were *R. lanuginosum, D. billardieri* and litter. The plants were individually covered with a muslin sleeve supported by a metal frame pushed into the soil and tied at the top with a plastic twist strip. Three *L. suturalis* adults (one female and two males) were placed on each plant. Ten replicates were prepared for each treatment.

Each plant, its moss or litter, and the soil surface, was checked weekly for adults, eggs and larvae. The sex of any live adults found was recorded, and they were returned to the plant. Dead adults were sexed and removed. The number of visible unhatched eggs was recorded. Larvae were counted and removed to be reared separately. Where all the foliage had been eaten, large bouquets of heather were attached to the original plant to provide food for the adults and larvae. Care was

taken during the sampling to cause as little disturbance to the moss or litter as possible, to avoid damaging unseen eggs or disrupting the behaviour of the adults. The experiment was terminated 53 days after the introduction of the adults, when no further eggs or first instar larvae were found. The total number of eggs and larvae found on each plant was calculated.

4 Results

Tables 1 and 2 show that in all treatments most females did not produce eggs or larvae, but that some females from all treatments did lay eggs. The numbers produced varied considerably between females.

The total number of eggs or larvae produced did not vary significantly between treatments ($P>0.05$). Detailed analysis was not possible because of the high number of females that did not lay eggs.

5 Discussion

The experiment failed to observe significant differences between levels of oviposition or larval emergence between the different moss or litter substrates. This was due to the very high variation within treatments. However, the number of females which failed to produce eggs or larvae was similar in each treatment. The observed rate of deaths of the adult females was also similar in each treatment.

The high failure rate may have been due to natural variation within the population, or to some aspect of the experimental design which discouraged mating or oviposition.

Although real differences between the treatments were not visible, the experiment did show that the beetles would lay eggs in the presence of mosses other than *Sphagnum*. It was observed that *S. cristatum* absorbed moisture from the soil more effectively than *D. billardieri*. *R. lanuginosum* did not absorb moisture well at all, the long stems being unsuited to confinement in a plant pot.

The results obtained with litter taken from beneath very large heather plants lacking any associated mosses were very encouraging, and show that the presence of a moss is unnecessary for oviposition. This was also the only treatment in which more larvae than eggs were observed. In all other treatments, either some of the eggs observed were infertile, or the larvae died before being retrieved. Some eggs may have been counted twice, but this should have been avoided, because most eggs were examined under a binocular microscope to check for signs of larval emergence, and empty egg shells were discarded. The greatest difference between these treatments and the litter was in the difficulty of finding eggs in the litter. From observations throughout the experiment it was clear that the adult beetles were able to conceal themselves in the loose structure of the litter, and the females

Table 1 Total observed numbers of eggs laid by *Lochmaea suturalis* females in pots containing *Calluna vulgaris* and mosses or litter from Tongariro National Park. Each pot contained one female and two male *L. suturalis* adults. Mosses: *Sphagnum cristatum, Sc; Racomitrium lanuginosum, Rl; Dicranoloma billardieri, Db.*

	Treatment			
Replicate	*Sc*	*Rl*	*Db*	Litter
1	0	8	25	44
2	0	0	8	0
3	0	0	0	0
4	7	0	0	0
5	0	0	0	0
6	0	0	0	6
7	0	0	0	5
8	0	0	90	0
9	19	0	8	0
10	0	7	0	1
Total	**26**	**15**	**131**	**56**

Table 2 Total numbers of *Lochmaea suturalis* larvae retrieved from pots containing *Calluna vulgaris* and mosses or litter from Tongariro National Park. Each pot contained one female and two male *L. suturalis* adults. Mosses: *Sphagnum cristatum, Sc; Racomitrium lanuginosum, Rl; Dicranoloma billardieri, Db.*

	Treatment			
Replicate	*Sc*	*Rl*	*Db*	Litter
1	0	0	30	37
2	0	0	24	0
3	0	0	0	0
4	19	0	0	18
5	0	0	0	0
6	0	0	0	35
7	0	0	0	45
8	0	0	58	0
9	0	0	7	0
10	0	4	0	5
Total	**19**	**4**	**119**	**140**

evidently concealed most of their eggs in this way as well. This appears to make heather litter an ideal substrate for ovipostion, provided that it retains enough moisture to prevent dehydration of the eggs. Given that many of the older heather plants in TNP have only this type of litter beneath their canopies, this is an encouraging result.

Addendum: After completion of this study, it was found that there was a microsporidian infection in the shipment of beetles from which these were taken (Peter Wigley, pers. comm.). This may help to explain the low number of ovipositing females in this experiment, but is unlikely to affect the overall conclusions that female *L. suturalis* will oviposit on the moss species tested.

6 Acknowledgements

Many thanks to Jessica Beever of Manaaki Whenua Landcare Research, Mount Albert, Auckland, for identification of the mosses collected from Tongariro National Park.

7 References

Cameron, A.E.; McHardy, J.W.; Bennett, A.H. 1944: The heather beetle *(Lochmaea suturalis).* British Field Sports Society, Petworth, Sussex, U.K. 69pp.

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