*Carpodetus serrata*. The total observations for each disease are: fungus (Fig. 1), 3; fungus (Fig. 2), 1; *B. bassiana*, 7; bacterium, 4 (from a population of about 200-300 larvae between March 1978 to March 1983).

## ACKNOWLEDGMENTS

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# Notes on bog inhabiting Hepialidae (Lepidoptera) of New Zealand

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**Abstract**

Hepialidae are recorded from the bog habitat for the first time in New Zealand. Aspects of habitat and biology are described for 4 taxa of the subfamily Oxycaninae, including 2 undescribed species.

Keywords: Lepidoptera; Hepialidae; bog habitat; biology; host-plant; New Zealand.

## INTRODUCTION

Larvae of ground dwelling Hepialidae have been recorded in habitats ranging from grassland to forest, and from lowland through to alpine regions (Dumbleton 1966). Although Hepialidae are known to be associated with relatively moist conditions (Tindale 1938) they have not been recorded from habitats in which free water may overlay the soil throughout the year.

Four hepialid taxa (3 shown in Figs 1-6) are recorded here from bogs in central and south Otago of the South Island. Two of the taxa are undescribed and were first discovered by B. H. Patrick. They are referred to here as species 1 and species 2, although their taxonomic status has yet to be confirmed in a forthcoming revision of New Zealand Hepialidae (J. S. Dugdale pers. comm.). Species 1 has orange/brown wings with white stripe on the forewing, while species 2 is dark brown to black with white stripe. This paper presents locality records and some aspects of habitat and biology for the 4 taxa.

## LOCALITIES

**Species 1.** Bogs at Danseys Pass (44°57 'S, 170°22 'E, 930-1100m a.s.l.; Patrick 1982); Great Moss Swamp (45°33 'S, 169°54 'E, 850-1050m a.s.l.); McPhee's Rock, Rock and Pillar Range (45°27 'S, 170°E, 1200m); Catlins Forest Park (46°20 'S, 169°15 'E, 250m a.s.l.). The habitats at Great Moss Swamp and Catlins Forest Park are seriously threatened by flooding and drainage/ploughing respectively.

**Species 2.** Awarua Bog (46°30'S, 168°30'E, sea level).

***Cladoxycanus minos*** (Hudson). Monotypic genus, distributed from about latitude 39°30'S (K. J. Fox pers. comm.) southwards to coastal Southland (Dumbleton 1966) and very common on the east side of the South Island (B. H. Patrick personal observation). Recorded from bogs at Great Moss Swamp, Swampy Summit (45°47'S, 170°28'E, 740m a.s.l.), Lammermoor Range (45°40'S, 169°45'E, 1100m a.s.l.) and Mount Maungatua (45°53'S, 170°07'E, 800-900m a.s.l.).

***Wiseana umbraculata*** (Guenee). Ranges from North Auckland to the lower South Island and Stewart Island (Dumbleton 1966; J. S. Dugdale pers. comm.). Recorded from Awarua Bog.

## EMERGENCE AND FLIGHT BEHAVIOUR

All 4 taxa are nocturnal fliers although *W. umbraculata* is active before dark. Species 1 and 2 fly from about late March to possibly early June. *C. minos* flies from mid April to early June, and *W. umbraculata* from late October to early April (B. H. Patrick flight records). Both males and females are attracted to light. For species 1, only 2 females were collected at an automatic light trap by B. H. Patrick, compared to 18 males over a period of 7 nights.

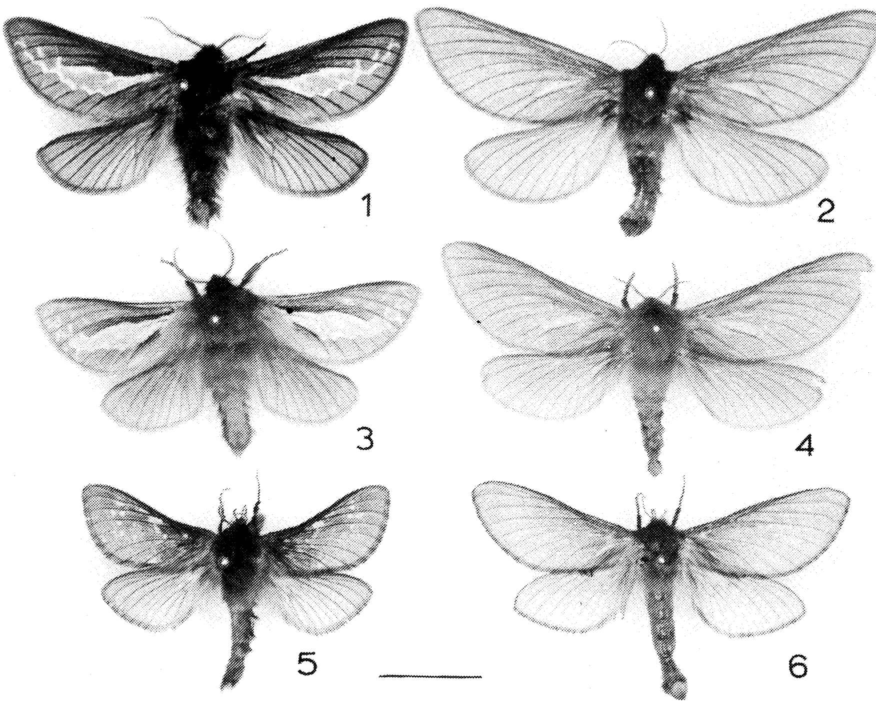
Adults of species 1 and 2 appear to emerge at or after dusk, as searching of the surface bog vegetation during the afternoon failed to reveal any emerging adults. Two pupae of species 1 which were kept in a container emerged after dark.

The moths of species 1 fly on relatively warm moist nights, estimated to be about 5-10°C. One such night occurred on 14 April 1983 at the Burgan Stream Hut (by Great Moss Swamp) where J. R. Grehan and J. S. Dugdale observed adults (males only) to be attracted to a 12 volt ultraviolet fluorescent tube and a pressure lantern. The adults began to fly shortly after the onset of dark (about 7.30 pm) but not in large numbers, averaging about 1 or 2 in half an hour, until about 10.00 to 10.30 pm. Over 50 specimens were counted before 11.30 pm. Some moths flew to the hut windows about 30 m from the bog. Although no females were collected at the lights in this particular case, Ms C. Butcher collected 2 specimens from tussock (*Chionochloa rubra*) by sweepnetting at night. The sex ratio of species 1 is about 1:1. A count by B. M. Patrick of 153 pupal exuviae gave a female:male ratio of 1.04:1.

## HABITAT AND BIOLOGY

Larvae and pupae of species 1 and 2 and *C. minos* have been collected from moss growing in a depth of water of 300 mm or more whereas *W. umbraculata* has only been found on saturated moss swards in comparatively close contact with the soil surface. The habitat in which these moths are found is referred to here as "bog" rather than "swamp" because open stretches of water are limited to shallow pools (Cockayne 1967). The bogs were dominated by moss, particularly the bog-moss *Sphagnum*, with scattered tussock and sedges. The moss sward often forms a "carpet" effectively concealing the water from sight. The bogs vary from a band of vegetation lining streams in gullies to relatively wide flat areas with slow flowing or almost still water (Fig. 7).

Ground dwelling Hepialidae normally excavate a tunnel in the soil. In the moss sward the larvae of species 1 and 2 and *C. minos* construct a more or less vertical tunnel which does not come into contact with the soil. The tunnel extends down through the moss from a feeding chamber located about 20-40 mm below the moss surface. The tunnel is silk-lined and, in the case of species 1, reaches a depth of about 100-150 mm and may extend below the water table (Fig. 8). The only observation of *W. umbraculata*




**Figs 1-6.** Hepialidae taxa inhabiting bogs in Otago, New Zealand. **1, 2.** Species 2: **1,** male; **2,** female. **3, 4.** Species 1: **3,** male; **4,** female. **5, 6.** *Cladoxycanus minos*: **5,** male; **6,** female. Scale line = 10 mm.

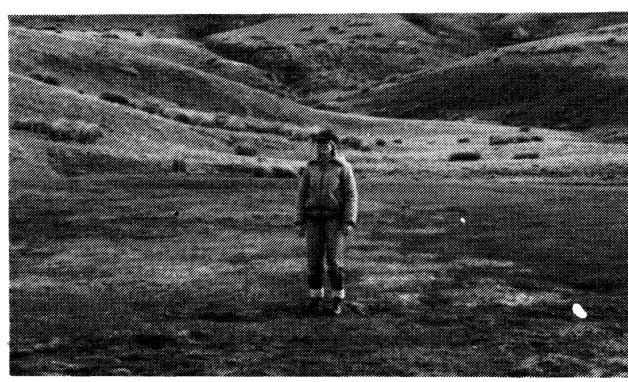


**Fig. 7.** Basin east of McPhee's Rock, Rock and Pillar Range, 1200 m, Otago. Dr Barratt standing on bog in foreground which contained immature stages of species 1.

larval tunnelling is at Awarua Bog where a tunnel was found which extended through the soil below the moss.

Species 1 is not confined entirely to tunnelling in the bog but has been found tunnelling into soil adjacent to the bog. In this situation the tunnel reached a depth of about 50 mm (n = 3) and was open to the ground surface. Immature stages of *C. minos* were not recorded here outside the bog habitat. At emergence the pupa of species 1, 2, and *C. minos* moves up to the moss sward surface and protrude for part of the pupal length (Fig. 9).

Food plants of species 1 in the bog habitat include the mosses *Calliergon subpapillosum* (Karemaiz), *Breutelia pendula* (Smith) Mitt., *Oxyrhynchium praelongum* (Hedw), *Meesia muelleri* (C.N. and Hampe), *Aulocomnion palustre* (Hedw) Schwargr., *Polytrichum commune* Hedw., and *Sphagnum cristatum* Hpe. Where larvae of species 1 have tunnelled into soil

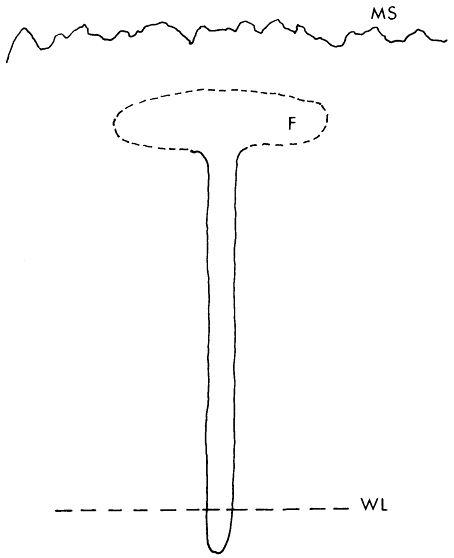



**Fig. 8.** Generalised diagram of species 1 larval tunnel to indicate approximate orientation of tunnel in relation to moss sward. MS, moss surface; F, feeding area; WL, water level.

**Fig. 9.** Pupal exuviae protruding from moss surface Scale line = 10 mm.

at the bog margin feeding damage has been seen on the grass *Poa colensoi*. Host plants of *C. minos* include *S. cristatum* and probably a similar range of mosses to species 1.

## DISCUSSION

Present observations indicate that *W. umbraculata* is less of a bog inhabiting species than the other 3 taxa recorded here. *W. umbraculata* has been recorded from wet pasture sites (Perrott 1974; Ferro 1976) with *Juncus* species (Dugdale pers. comm.) and it is likely that these sites originally comprised a bog or bog margin although there is no sharp distinction between a bog habitat and grassland (Cockayne 1967). Of two related species, *W. cervinata* is recorded from pasture (Perrott 1974) while the habitat of *W. signata* is reported to vary from flax swamps (Cockayne 1915) to sand dune country (Grehan 1983).

Although some larvae of species 1 were found in "dry" soil at bog margins, it does not appear to penetrate any further into the grassland habitat. While immature states of *C. minos* are recorded here from the bog habitat the insect has been found elsewhere associated with pasture (B. H. Patrick) and forest habitats (J. R. Grehan, M. J. Meads pers. comm.). It would therefore be of interest to know how *C. minos* utilises pasture and forest in comparison with the bog habitat.

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# A nuclear polyhedrosis virus of the poroporo stem borer, *Sceliodes cordalis* (Lepidoptera: Pyralidae)

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**Abstract**

A baculovirus in the porporo stem-borer, *Sceliodes cordalis*, is recorded for the first time in New Zealand. The nucleocapsids are 240 × 35 nm and are shown to be multiply embedded in cuboidal polyhedra. The virus was unable to cross-infect several other lepidopteran species.

Keywords: Nuclear polyhedrosis virus; baculovirus; *Solanum aviculare*; infectivity tests; *Sceliodes cordalis*; Lepidoptera; Pyralidae; poroporo.

Nuclear polyhedrosis viruses (NPV) comprise subgroup A of the family Baculoviridae. A nuclear polyhedrosis virus is now first recorded in larvae of the New Zealand poroporo stem borer, *Sceliodes cordalis* (Dbld.).

Infections were first found in larvae dissected from poroporo stems (*Solanum aviculare* Forst.) collected at Pukekohe. Larvae were reared in the laboratory on poroporo fruit until they died. Dead larvae were smeared, fixed in Carnoy's fluid, and triple-stained with Giemsa (Wigley 1980). When the smears were examined with the light microscope it was found that larvae were infected with a microsporidian pathogen (*Nosema* sp.) (Mercer 1981) and a nuclear polyhedrosis virus. This paper describes the morphology of the virus and presents the results of infectivity trials.

The morphology of the virus was studied by both light and electron microscopy. Smears were prepared for light microscopy as described above. Tissues from infected