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## First New Zealand record of the Australian species *Hemiodoecus leai* China, 1924 (Hemiptera: Peloridiidae); a hitchhiker on moss

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### Abstract

The Australian mossbug *Hemiodoecus leai* China, 1924, is recorded for the first time in New Zealand based on repeated sampling from a self-sustaining population at Opoho Creek, Dunedin (South Island) since 2011. The history of the discovery of *H. leai*, probably accidentally introduced with moss used to transport fish ova from Tasmania, is summarised. A brief taxonomic treatment accompanied by illustrations and data on distribution, puts this discovery in context with the 2011 taxonomic review of New Zealand Peloridiidae published in the *Fauna of New Zealand* series. Biological notes based on field and laboratory observations are also provided.

**Key words:** mossbugs, taxonomy, distribution, biology, biosecurity

### Introduction

Mossbugs or Peloridiidae are primitive members of the order Hemiptera. Their current distribution and diversification resulted from the breakup of Gondwana. Peloridiids can be found feeding on the sap of moss in the temperate and subantarctic rainforests of Chile, Argentina, Australia, Lord Howe Island, New Caledonia and New Zealand. Although distributed from Northland to Stewart Island in New Zealand, no mossbug was previously known from the eastern South Island.

The discovery of the adventive species *H. leai* China, 1924, constitutes the first record of the genus *Hemiodoecus* China, 1924, for New Zealand and brings the number of known Peloridiidae for this country to four genera and 14 species. The endemic New Zealand genera *Oiophysa* Drake & Salmon, 1950 (5 species), *Xenophyes* Bergroth, 1924 (6 species), and *Xenophysella* Evans, 1982 (2 species) were reviewed by Burckhardt (2009), Burckhardt *et al.* (2011), and Larivière *et al.* (2011). The genus *Hemiodoecus*, an Australian endemic, was revised by Burckhardt (2009) and includes three species: *H. acutus* Burckhardt, 2009, from Victoria, *H. crassus* Burckhardt, 2009, from Australian Capital Territory, and New South Wales, and *H. leai* from New South Wales, Victoria, and Tasmania. *Hemiodoecus leai* may have been accidentally introduced to New Zealand in the second half of the 19th century with moss-containing fish ova shipments from Tasmania.

### New Zealand discovery of *Hemiodoecus leai*

The peloridiid species *Hemiodoecus leai* was first collected at Opoho Creek, Dunedin (South Island) in December 2011. Intermittently over the following two years a total of 14 adults and eight nymphs were caught by brushing moss in situ, and one additional adult was caught in a pitfall trap. Of these, 8 specimens were deposited in the New Zealand Arthropod Collection (NZAC) and three were kept alive for observation; the remainder were kept alive and released back into the field.

Opoho Creek runs adjacent to a suburb of the same name near Signal Hill, a few kilometres to the northeast of

the Dunedin city centre. The creek and surrounding regenerating bush area (often referred to as Opoho Bush) lie next to the southern limit of Signal Hill reserve and are part of the Dunedin City Town Belt reserves. The habitat of *H. leai* at Opoho Creek (Fig. 9) is characterised by regenerating broadleaved forest including mahoe (*Melicytus ramiflorus*), lemonwood (*Pittosporum eugeniioides*) and tree fuchsia (*Fuchsia excorticata*), interspersed with introduced trees such as sycamore (*Acer pseudoplatanus*) and pine (*Pinus radiata*) and bordered by Kanuka (*Kunzea ericoides*) forest and a Eucalypt plantation.

It is likely that *H. leai* has been introduced, probably accidentally with moss used to transport fish ova from Tasmania between 1868 and 1885, and may have remained undetected since. The area of Opoho Creek where the mossbugs were found was developed in 1868 by the Otago Acclimatisation Society for rearing introduced fish (Otago Daily Times 1868a) and the first shipment of ova arrived in that year, from New Norfolk in Tasmania (Otago Daily Times 1868b). The method for transporting live fish ova at that time was developed by James Youl in Tasmania, and involved packing ova in boxes with layers of moss and encasing them in ice (Smith 2014). New Norfolk is a town approximately 35 km north-east of Hobart along the Derwent River. This location falls well within the distribution range of *H. leai* which is known from sites across Tasmania including the greater Hobart area, as well as from southern Victoria and higher parts of New South Wales. In 1885 the hatchery at the Opoho Creek site closed.

## Taxonomy

### Addition to the key to New Zealand genera

The following couplet, based on the key to world genera and species published by Burckhardt (2009: 184–185), can be added before couplet 1 of the key to New Zealand genera published by Larivière *et al.* (2011: 19).

0. Loral ridge present on ventral surface of head (Fig. 1). Areolae of head distinctly delimited by a rim anteriorly (Figs 1, 3) . . .  
 ..... *Hemiodoecus*  
 - Loral ridge absent on ventral surface of head (Fig. 2). Areolae of head not or indistinctly delimited anteriorly (Fig. 2) . . . . .  
 ..... 1 (couplet 1 of Larivière *et al.*, 2011)

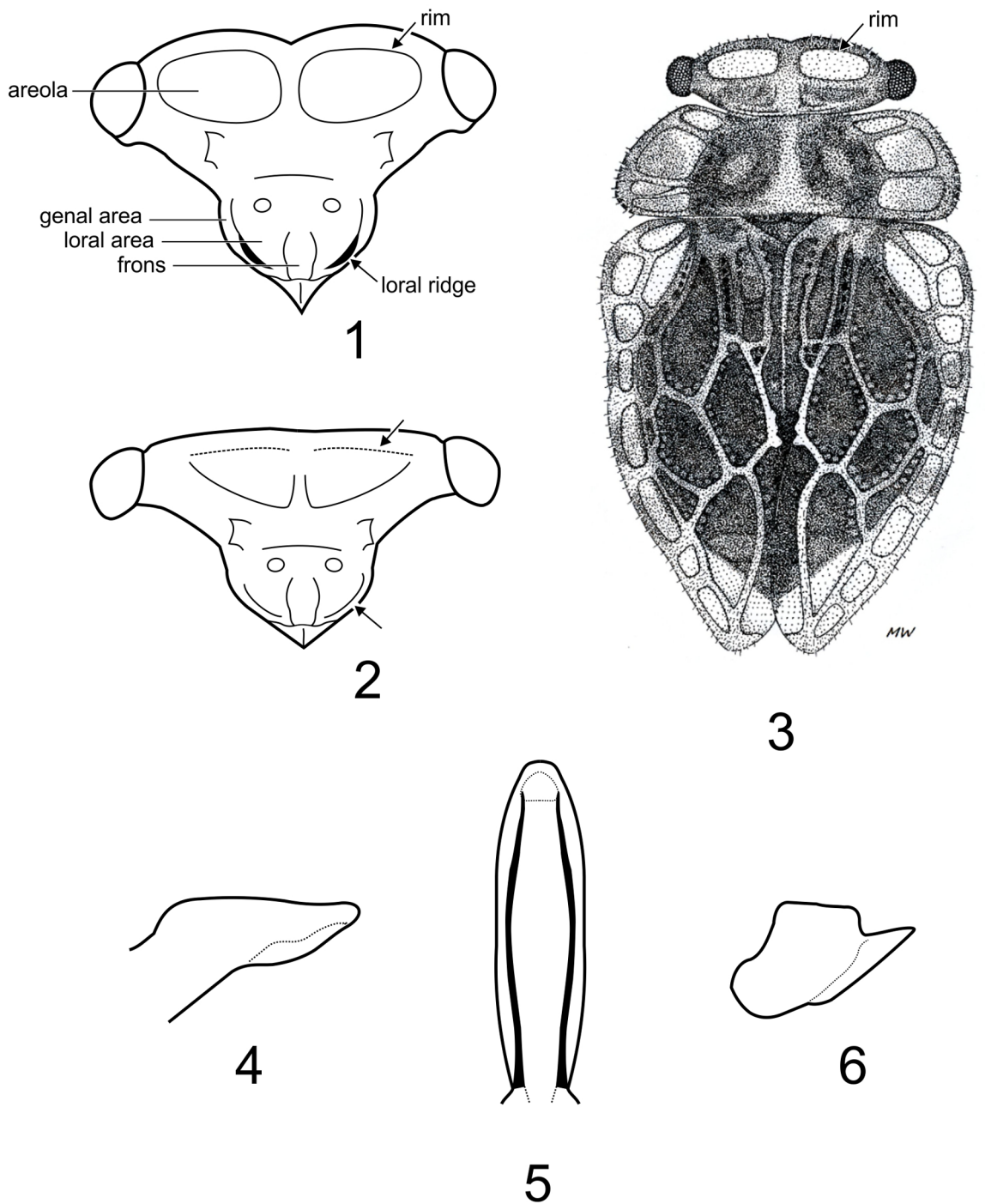
### Recognition of *Hemiodoecus* China, 1924

Table 1 provides a list of morphological characters of diagnostic value among the genera of Peloridiidae occurring in New Zealand. Characters and characters states are mostly those of Burckhardt (2009) and Larivière *et al.* (2011), with supplementary observations made here.

### *Hemiodoecus leai* China, 1924

*Hemiodoecus* China, 1924: 199. Type species: *Hemiodoecus leai* China, 1924, by monotypy.

**Description.** Adult (Figs 3, 7). Body length 2.95–3.63 mm. Dorsal colour yellowish brown with darker brown areas on paranota as well as basally and apically on tegmina. **Head.** Anterior margin convex on either side of median notch. Areolae rather large, triangular-rounded. **Thorax.** Pronotum broad, 1.4 x as wide as head between eyes. Tegmina with vein C strongly curved basally, hence humerus appearing rounded or somewhat angular; costal margin distinctly concave in basal third and then slightly sinuate; subcostal cell slightly widened apically or not. **Abdomen.** Male genitalia—Parameres (Fig. 4) slender, suboval, acutely rounded apically. Aedeagus (Fig. 5), in anterior view, rather narrow, slightly convex on each side, blunt apically. Female genitalia—Tergite 9 (Fig. 6), in lateral view, with rather straight dorsal margin and long, acute apical process. Other characters as in Burckhardt (2009: 196).



**FIGURES 1–6.** *Hemiodoecus leai*. Fig. 1, schematic view of head (ventral). *Xenophyes cascus*. Fig. 2, schematic view of head (ventral). *Hemiodoecus leai*. Fig. 3, habitus drawing, dorsal view of female (scale bar 1 mm); fig. 4, male paramere, schematic view (lateral); fig. 5, male aedeagus, schematic view (anterior); fig. 6, female tergite 9, schematic view (dorsal).

**Material examined.** 4 males, 4 females (NZAC) as follows: NEW ZEALAND DN Dunedin, Opoho Creek, 45°51'22"S 170°32'02"E, 23 Nov 2011, M. Wakelin, caught in pitfall trap, 1 female (NZAC0408145); same locality, 45°51'22"S 170°32'02"E, 5 Dec 2011, M. Wakelin, brushed from moss on rock, 1 female (NZAC04081446); same locality, 45°51'22"S 170°32'02"E, 20 Dec 2011, M. Wakelin, moss on rock, 1 dead female (NZAC04081447); same locality, 45°51'22"S 170°32'02"E, 16 Feb 2012, M. Wakelin, swept from moss on rock, 1 male (NZAC04081448); same locality, 45°51'35"S 170°31'57"E, 27 Apr 2012, M. Wakelin, swept from moss on rock, 1 female (NZAC04081449); same locality, 45°51'22"S 170°32'02"E, 9 May 2014, M. Wakelin, swept from moss on rock, 3 males (NZAC04081450, NZAC04081451, NZAC04081452).





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**FIGURES 7–9.** Fig. 7, *Hemiodoecus leai* habitus photo, dorsal view of male (scale bar 1 mm); fig. 8, recently emerged female and its final instar exuvia; fig. 9, moss covered rock (see arrow) in typical mossbug habitat at Opoho Creek, Dunedin.

**TABLE 1.** Comparative morphology of genera.

	<i>Hemiodoecus</i>	<i>Oiophysa</i>	<i>Xenophyes</i>	<i>Xenophysella</i>
Body length	2.95–3.63 mm	2.19–2.98 mm	2.18–3.23 mm	2.34–3.00 mm
Head length	subequal to pronotal length	about 0.5x pronotal length	about 0.7x pronotal length	subequal to pronotal length
Head areolae	distinctly delimited anteriorly by a rim	not delimited anteriorly by a rim	not or vaguely delimited anteriorly by a rim	not or vaguely delimited anteriorly by a rim
Loral area	with oblique loral ridge	flat (without ridge)	flat (without ridge)	flat (without ridge)
Paranota	inner posteroventral portions impunctate (smooth)	inner posteroventral portions coarsely punctate	inner posteroventral portions impunctate (smooth)	inner posteroventral portions impunctate (smooth)
Tegmina	veins distinctly raised, largely margined with punctures	veins distinctly raised, largely margined with punctures	veins distinctly raised, with punctures restricted to clavus and at most some adjacent veins	veins distinctly raised, with punctures restricted to clavus and some adjacent veins
Veins ScP and MP	apically fused, reaching C together	apically fused, reaching C together	not apically fused, reaching C separately	not apically fused, reaching C separately
Veins C and ScP	unfused in apical three-quarters of tegmina	unfused in apical three-quarters of tegmina	unfused in apical three-quarters of tegmina	fused in apical three-quarters of tegmina
Claval cell	narrow and long, extending beyond scutellum by about 2/3 of its length	broad and short extending beyond scutellum by at most 1/2 its length	broad and moderately long, extending beyond scutellum by 1/2 its length or slightly more	narrow and long, extending beyond scutellum by about 2/3 of its length or slightly less
Subcostal cell	much shorter than basal radial cell	much longer than basal radial cell	much shorter to slightly longer than basal radial cell, often subdivided	much longer than basal radial cell
Cell m and apical radial cell	touching or linked by very short petiole	linked by long petiole	linked by long petiole or cell m not developed	linked by long petiole
Male aedeagus	fusiform, simple	S-shaped, with membranous apical dilatation	S-shaped, with membranous apical dilatation	fusiform, with wing-like dorsal processes
Male paramere	without small lobes dorso-basally	without small lobes dorso-basally	without small lobes dorso-basally	with small lobes dorso-basally

**Geographic distribution.** Australia (New South Wales, southwestern Victoria, Tasmania); New Zealand, South Island, Dunedin, Opoho Creek (introduced).

**Notes on biology.** The following observations were made of three captive individuals, one adult male and two female nymphs that were reared to adults, and several nymphs that have emerged in captivity. The mossbugs were held in a square plastic container (c. 15 cm wide by 8.5 cm high) lined with paper towel, covered with perforated plastic film, and containing about 20 individual moss plants. The moss rhizoids and stems were wrapped in toilet tissue and sprayed once a week with water to keep moist. The container was kept on a bench in an uninsulated Dunedin garage so ambient temperature and humidity would approximate nearby forest conditions. Observations were made on a regular basis, between the hours of 7:00 and 22:00, by eye or using a stereo microscope. **Feeding** was similar for male, female and nymph; appeared to take place on the mosses *Ptychomnion aciculare* (Ptychomniaceae), *Weymouthia mollis*, *W. cochleafolia* (Meteoriaceae), *Bartramia* sp. (Bartramiaceae), and *Polytrichadelphus magellanicus* (Polytrichaceae)—widespread in New Zealand and present in Australia and southern South America—and could continue for extended periods, up to 19 days. **Activity** was similar for male, female and nymph; they were ‘inactive’ (possibly feeding) for approximately 70% of the time; each period of inactivity ranging from one hour to 25 days. Generally the bugs remained in the basal third of moss fronds (Fig. 8), sometimes going deep into the rhizoid mat. They only occasionally moved across open terrain between fronds,

were not seen jumping or climbing from the container and did not appear to be nocturnal. There was little reaction to contact with other organisms (a snail and a mite) but some kind of signalling may have occurred when a nymph's final moulting seemed to attract two other adult peloridiids. **Moulting** to adult was observed in two female nymphs, occurred in the early morning, facing downwards on a vertical stem. Prior to moulting, one nymph did not appear to feed and moved less than 1 cm over 26 days. After moulting, there was little activity, the newly emerged adults apparently not feeding or moving for 12 and 14 days. **Seasonality.** Adults were found in February, April, August and December; nymphs were found in January, February, April and August suggesting nymphs and adults may overwinter. **Lifespan** for a captive adult female was 15 months; another female and male kept in captivity are still alive after 21 and 25 months respectively. **Reproduction.** *H. leai* has paired ovaries each with five ovarioles and a spermatheca (Pendergrast 1962); upon dissection, one ovigerous female collected in December was observed to have about six fully formed eggs. Sixteen nymphs were found to have emerged in captivity between November and June. The eggs could have been laid as a result of mating observed 13 or 16 months prior in August and November. Alternatively the original moss collected may have contained eggs, indicating a minimum incubation of 22 months. It is not clear if the eggs were laid by one or both females, at one time or progressively over a longer time or if the nymphs emerged together. The 16 nymphs were noticed over a six month period; they developed slowly, most moulting to the second stage after about one month; only two nymphs moulting to the third stage after seven months; six nymphs died as first or second instar.

**Remarks.** Burckhardt (2009) keyed *H. leai* against the world fauna, described the adult and fifth instar nymph, and provided information on distribution and habitat in Australia (e.g., moss in rainforest, including *Nothofagus*, or sphagnum moss bogs at higher altitudes in the mountains of southeastern Australia).

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