

RESEARCH PAPER

Revision of the New Zealand endemic genus *Phormiobius* (Coleoptera: Staphylinidae: Pselaphinae)

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Abstract. To date monotypic, endemic New Zealand tyrine genus *Phormiobius* Broun, 1917 (Staphylinidae: Pselaphinae: Pselaphitae) (type species: *P. halli* Broun, 1917) is revised to include six species, five of which are new: *P. brouni* sp. nov., *P. graceae* sp. nov., *P. matau* sp. nov., *P. pseudhalli* sp. nov., and *P. ramsayi* sp. nov. A lectotype is designated for *Phormiobius halli*. A species-level identification key is provided, and comparative notes on the morphology of New Zealand tyrine genera is included.

Key words. Coleoptera, Staphylinidae, Pselaphinae, Tyrini, *Phormiobius*, taxonomy, new species, lectotype designation, key, aptery, endemism, New Zealand

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Introduction

Despite the lack of Batrisitae and Clavigeritae, the local pselaphine staphylinid fauna of New Zealand is diverse (e.g., PARKER & GRIMALDI 2014, NOMURA & LESCHEN 2006), especially in free-living euplectites and faronites, the latter has been thoroughly revised in recent years (e.g., PARK & CARLTON 2014). With respect to the supertribe Pselaphitae in New Zealand, there are 11 genera placed into two tribes, Pselaphini and Tyrini, with seven of them placed into the subtribe Tyrina and presently containing 17 species (HLAVÁČ & CHANDLER 2005, NOMURA & LESCHEN 2006). The Pselaphini are currently under revision (e.g., OWENS et al. 2019, OWENS & CARLTON 2020), but the tyrines remain virtually unstudied.

Tyrines, like most pselaphites, have the tarsomere 3 longer than the tarsomeres 1 and 2 combined (CHANDLER 2001), and can be discriminated from Pselaphini by having two subequal tarsal claws (e.g., NEWTON et al. 2000). They can also be recognized by what many pselaphine workers refer to as having a prominent ‘rostrum’¹⁾. This character is

variable with the antennal tubercles contiguous or separate by a fovea or groove and occurs in many other groups of New Zealand Pselaphinae.

Tyrina, one of the four subtribes of tyrines, contains all the New Zealand species of the tribe (HLAVÁČ & CHANDLER 2005). The group is thought to be of Gondwanan origin (JEANNEL 1950) or at least has the highest representation of genera in continents of this region (PARKER 2016). Three tyrine genera (*Phormiobius* Broun, 1917, *Plesiotyrus* Broun, 1914, and *Zeatyus* Sharp, 1881) are monotypic and endemic to New Zealand, while three genera (*Agatyus* Broun, 1917, *Hamotulus* Schaufuss, 1887 and *Tyrogetus* Broun, 1893) are found in both Australia and New Zealand (NOMURA & LESCHEN 2006). The single species of New Zealand *Gerallus* Sharp, 1874 was found introduced from Australia (KUSCHEL 1990). Although general notes of each tyrine genus was included in the faunal review by NOMURA & LESCHEN (2006), the current taxonomic status of New Zealand tyrines, like most pselaphine groups, requires revision. Moreover, we have examined at least two undescribed genera and several new species in *Agatyus*, *Hamotulus*, *Phormiobius*, *Tyrogetus*, and *Zeatyus*.

Phormiobius is one of many apterous tyrines and is distinctive from all members of the New Zealand tyrines by the strongly transverse, shortened, and basally narrowed

¹⁾ A rostrum in beetles usually refers to the preocular elongation of the head with mouthparts mounted apically (e.g., LAWRENCE et al. 2011). In tyrines, it refers to the elongated posterior portion of the frons which forms two lobes into which the antennae are inserted.



elytra, and a comparatively large abdomen (NOMURA & LESCHEN 2006). We initiate a full revision of the Tyrini by revising *Phormiobius* to include a total of six species, five of which are new.

Materials and methods

Specimens were examined from the New Zealand Arthropod Collection, Auckland, New Zealand (NZAC), the Field Museum of Natural History, Chicago, United States (FMNH), the National Museum, Prague, Czech Republic (NMPC), and the Natural History Museum, London, United Kingdom (BMNH).

External morphology was examined using a Leica MZ12 binocular stereomicroscope. Male genitalia mounted in Euparal, were examined using a Leica DM 4500B compound microscope. Image was captured using a Nikon DS-Fi1 camera attached to a compound microscope and stacked from multiple layers using Zerene 1.04 software. Area codes and their abbreviations follow CROSBY et al. (1998). Terminology largely follows CHANDLER (2001) and LAWRENCE et al. (2010).

The following abbreviations for measurements are applied: HL = length of visible portion of head; HW = width of head across eyes; PL = pronotal length at midline; PW = greatest pronotal width; EL = elytral length at midline; EW = greatest elytral width; AL = abdominal length at midline; AW = greatest abdominal width. Body length (BL) is measured from the anterior clypeal margin of the head to the posterior edge of the abdomen. In the descriptions, an 'A' refers to antennomere, a 'P' refers to palpomere, a 'T' refers to tergite, a 'V' refers to ventrite, and a 'C' refers to abdominal concavity. Numerals for abdominal tergites refer to visible segments (e.g. tergite 1 refers to first visible tergite). Holotype and paratype labels are red and blue, respectively, and label data from holotypes and syntypes are transcribed using the conventions indicated in LORD & LESCHEN (2014).

Females of *Phormiobius* lack distinct characters for species-level identification, and therefore we associate them with males only by geographic distribution. However, *P. graceae* sp. nov. and *P. pseudhalli* sp. nov. are sympatric, so the associated females are recorded together in Appendix. Accordingly, type designations, the key and the distribution map are based solely on males.

Systematics

Phormiobius Broun, 1917

(Figs 1–2)

Phormiobius Broun, 1917: 381. Type species: *Phormiobius halli* Broun, 1917: 382, by monotypy.

Redescription. Body length 2.14–2.77 mm, elongate in dorsal view; vestiture of long decumbent curved or straight setae; surfaces glabrous, micropunctate, and lacking distinct microsculpture; body colour dark reddish-brown to dark-brown, mouthparts, and tarsi paler. Head (Figs 1A–C) elongate, about 2× longer than wide, with frons bilobate and moderately projecting, forming short abroad rostrum; weak vertexal sulcus demarking posterior margins of

rostrum, lacking frontal fovea; vertex bifoveate, asetose fovea (Fig. 1A) small; subantennal excavations broad and separated by narrow median carina and bounded by distinct epistomal ridge (Fig. 1B), genal carina absent, dorsal postantennal pits present and small, tempora weakly rounded; eyes small and coarsely faceted [13–19 facets]. Antenna (Fig. 2E) with 11 antennomeres, antennal club formed by three terminal antennomeres, finely tuberculate and pubescent, lacking distinct apical or subapical rims, antennomere 1 (scape) about twice as long as wide, pedicel about 1.2× longer than wide, A3–A8 with ratio of length/width subequal, A9 moderately transverse, about 1.2× wider than long, A10 transverse, about 1.4× wider than long, A11 elongate and symmetrical, about 1.8× longer than wide. Maxillary palpi (Fig. 1G) with P2 pedunculate at base, about twice the length of P3, P4 with sensory area bearing single elongate apical sensillum; posterior gular region slightly convex, with large, single posterior tentorial pits (Fig. 1C).

Prothorax (Fig. 1E) slightly wider than long, and spindle-shaped and widest at apical two-fifths, setose lateral procoxal foveae medium-sized; pronotum (Fig. 1D) lacking antebasal sulcus, setose lateral antebasal fovea large, median antebasal fovea setose and well-developed.

Elytra (Fig. 1F) shorter than abdomen, combined width about 2× wider than long, with distinctively constricted bases, forming lip-like basal rim, posterior edge sinuate; each elytron with two asetose subbasal foveae and two asetose basal fovea; lacking discal striae.

Mesoventrite (Fig. 2C) with shallow asetose prepectal foveae, well-developed setose median mesoventral fovea flanked by well-developed setose lateral mesoventral foveae with branches that do not join at middle, with small asetose anterolateral mesoventral foveae. Mesoventrite and metaventrite fused. Lateral mesocoxal foveae setose and deep, lacking median and lateral metaventral fovea, metaventral notch narrow and short.

Abdomen (Figs 2A–B) moderately convex, dorsoventrally not strongly flattened; tergites moderately convex, with well-developed transverse basal grooves or sulci lined with ctenidia, lacking discal carinae; T1 slightly shorter than T2, T3 elongate and subequal to combined lengths of T1 + T2, T4 subequal to T2; asetose basolateral fovea present on T1–T4, T1–T3 trifoventate on each side, T4 unifoventate; T5 of male broadly rounded or truncate. Paratergites well developed. Abdominal ventrites 1–4 bifoveate, with large and open pocket-shape asetose basolateral foveae, V4 with vaguely visible fovea on the inner side of each basolateral fovea; males with narrow to broad concavities or impressions on V2 and V3, and sometimes V1 and V4. Abdominal ventrite 5 of male with apex emarginated, abdominal V5 of female with apex entire. Male V6 (penial plate) sclerotized and easily visible in ventral view. Legs long and slender, metatrochanter of male with modified processes, male metafemora (Fig. 2D) weakly to strongly elbowed, tibia more or less parallel-sided and not strongly curved, metatibia of male nearly straight or weakly bent at apical one-fourth, small apical spine present. Aedeagus symmetrical, lacking parameres, basal capsule sub-globo-

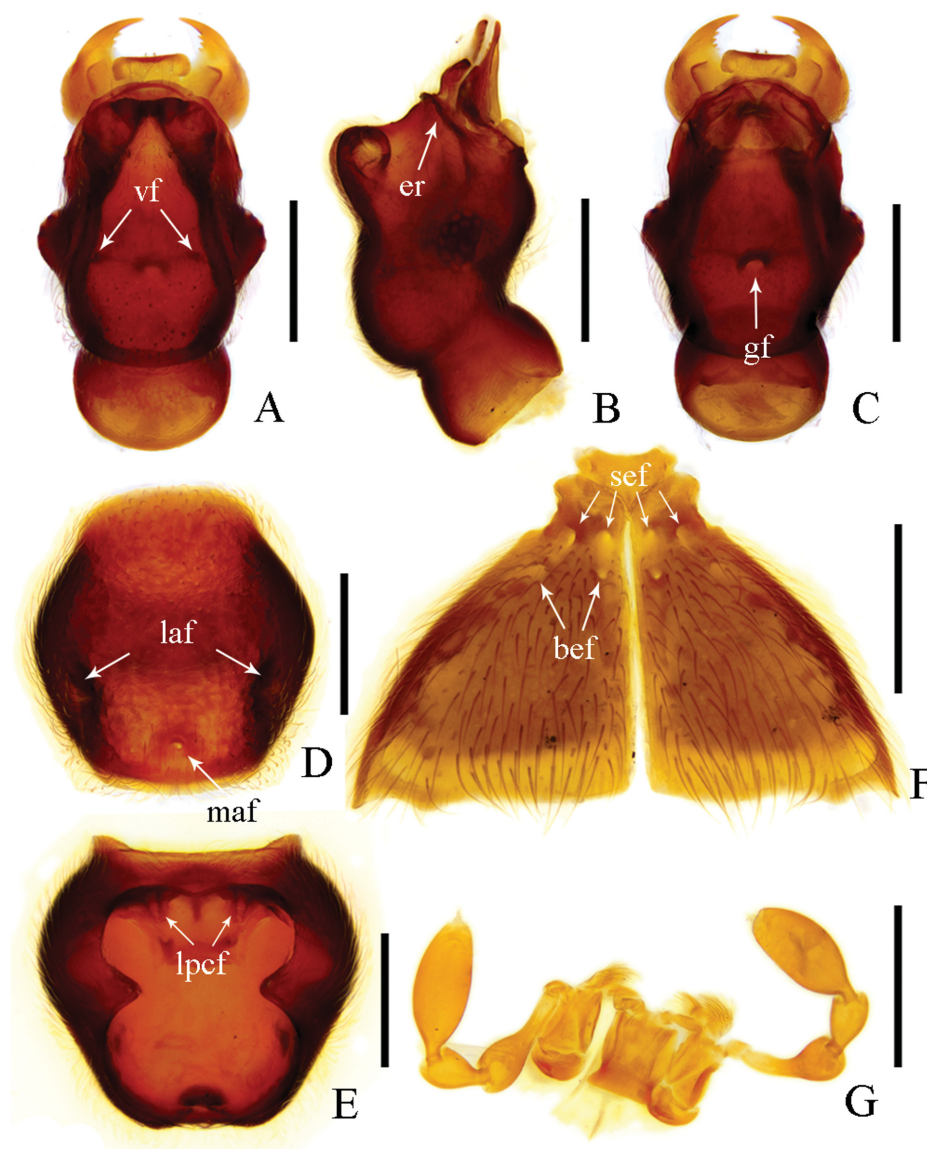


Fig. 1. Morphology of *Phormiobius* Broun, 1917 (based on *P. graceae* sp. nov.). A – head, in dorsal view; B – same, in lateral view; C – same, in ventral view; D – pronotum; E – prothorax; F – elytra, in dorsal view; G – mouth parts. Abbreviations: bef – basal elytral foveae, er – epistomal ridge, gf – gular foveae, laf – lateral antebasal foveae, lpcf – lateral procoxal foveae, maf – median antebasal fovea, sef – subbasal elytral foveae, vf – vertexal foveae. Scale bars = 0.2 mm.

se; internal sac with large sclerites (lacking in *P. graceae* sp. nov.); median lobe uni- to multi-lobate.

Differential diagnosis. *Phormiobius* can easily be distinguished by having pyramidal elytra that are short, transverse and narrowed basally and lacking grooves or carinae, a broad abdomen (not dorsoventrally flattened) with T1 and T2 subequal in length, and T3 the longest; males have distinct concavities on abdominal ventrites, and lack well-developed sulci on head and pronotum. Other characters that differentiate this genus from other tyrines are head with a well-developed bilobate frons (rostrum), antennal lobes contiguous and divided by narrow sulcus, vertex bifoveate, lacking frontal fovea and genal carina, maxillary palpi with P2 pedunculate at base and P4 fusiform to oval, not pedunculate; and pronotum with well-developed antebasal fovea, lacking antebasal sulcus.

Comments to classification. The phylogenetic relationship of *Phormiobius* to other tyrines is uncertain and a worldwide revision and comprehensive phylogenetic study is needed. In the generic key of the subtribe Tyrina by HLAVÁČ & CHANDLER (2005), *Phormiobius* is keyed out to a couplet that includes southern South American and Australian taxa but shares some characteristics with some taxa outside this region. For example, the pyramidal shaped elytra with strongly narrowed bases are distinctive for other tyrines (see HLAVÁČ & CHANDLER 2005; *Agatyrus* (New Zealand), *Anagonus* Fauvel, 1903 (New Caledonia), *Franziotus* Leleup, 1972 (Madagascar), *Mipseltyrus* Park, 1953 (North America), *Plesiotyrus* (New Zealand), *Tyrinasius* Kurbatov, 1993 (Asia) and *Tyrogetus* (Australasia), and *Zeatyus* (New Zealand)), and among them the length of T1 and T2 are unequal in *Mipseltyrus*, *Tyrinasius*, and *Tyrogetus*. Among the world fauna, *Phormiobius* is most

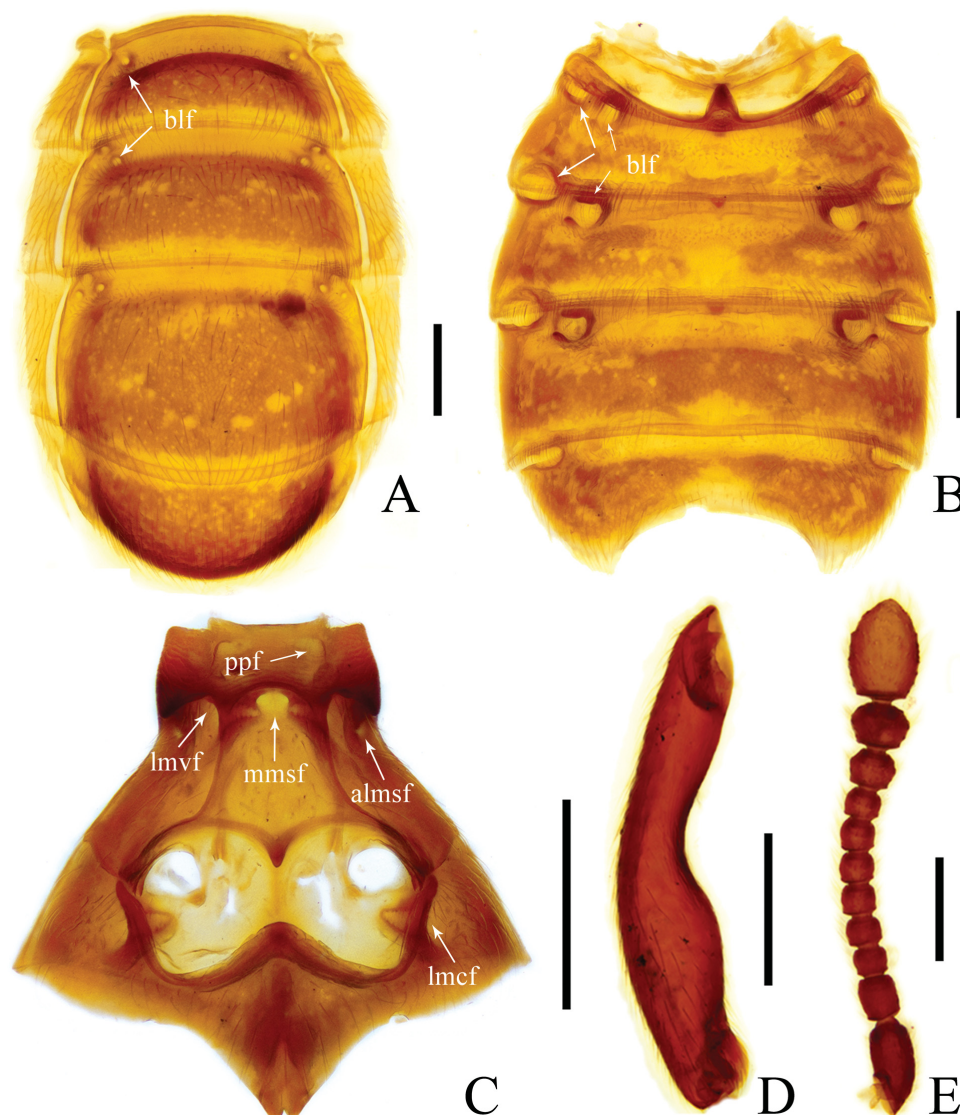


Fig. 2. Morphology of *Phormiobius* Broun. A – T4–T8; B – V4–V7; C – meso- and metaventrite; D – metafemora; E – antenna. Abbreviations: almsf – anterolateral mesoventral foveae, blf – basolateral foveae, lmcf – lateral mesocoxal foveae, lmvf – lateral mesoventral foveae, mmsf – median mesoventral foveae, ppf – prepectal foveae. Scale bars = 0.2 mm.

like *Franziotus*, by greatly reduced elytra that are distinctly narrower than abdomen. The elytral and abdominal characters are variable and used for generic diagnostics for tyrines, and the pyramidal elytra could be associated with hind wing loss or reduction as the case of *Phormiobius*.

With respect to the New Zealand fauna, BROUN (1917) suggested that *Phormiobius* was closest to *Tyrogetus*, but among the currently described genera, it is actually most like *Agatyris* differing from it by the absence of elytral grooves and small vertexal fovea on head. *Zeatyris* also lacks elytral grooves or carinae and it lacks pronotal foveature. However, *Zeatyris* is unusual among the New Zealand tyrines by having an inflated maxillary palpomere 4 and also has a relatively small triangular palpomere 3 that is about as wide as long, a diagnostic character of Somatipoinina (CHANDLER 2001). Contrary to other Somatipoinina, the mesal sulcus of the enlarged palpomere 4 does not form a distinct furrow in *Zeatyris*, rather it is broad with a large concave surface, which may

be a derived form within Tyrini and other Somatipoinina. *Zeatyris* lacks a metaventral notch into which the abdominal process of abdominal ventrite fits into, a character that is variable in Tyrina and present also in *Phormiobius*. With respect to new genera and species to be described in a later paper, *Phormiobius* resembles two species which have a reduced basal elytral foveal pattern, and the male has a distinctive clypeal horn.

Sexual dimorphism in pselaphines is rampant (e.g., CHANDLER 2001) and apart from their distinctive body form, a defining feature of *Phormiobius* species is the distinctive concavities present on the male abdominal ventrites. These may be deep, asetose and polished, with a distinct edge, or shallow, or setose with a pair of posterior spines and with an ill-defined edge. Function of these concavities, as well as the presence of modified metatrochanteral processes of the males, requires observation of live specimens.

Biology. Specimens were collected by sifting leaf litter and moss, but we are unsure if they are specific to certain

microhabitats, like moss, which is a poorly studied habitat for New Zealand pselaphines in general (SHEN et al. 2020). Two species are known by singletons, *P. brouni* sp. nov., from Nelson, and *P. ramsayi* sp. nov., from Waikato, and therefore, special efforts should be made to collect these species to determine their threatened species status (see LESCHEN et al. 2012) and their habitat preferences.

Key to species of *Phormiobius* (males)

- 1 Concavity on V3 with conspicuous apical spines. 2
- Concavity on V3 lacking apical spines. 4
- 2 Concavity on V2 with apical spines (Figs. 3B).
..... *P. brouni* sp. nov.
- Concavity on V2 lacking apical spines. 3
- 3 Concavity on V2 (Fig. 5B) about as wide as length of metatrochanter; metatibia with small apical tooth (Fig. 5D); South Island. *P. halli* Broun, 1917
- Concavity on V2 (Fig. 7B) narrower than length of metatrochanter; metatibia with small apical tooth (Fig. 7C); North Island. *P. pseudhalli* sp. nov.
- 4 Abdominal ventrite 4 weakly or distinctly concave in the middle. 5
- Abdominal ventrite 4 unmodified (Fig. 6B).
..... *P. matau* sp. nov.
- 5 Concavity on V1 present and distinct (Fig. 8B).
..... *P. ramsayi* sp. nov.
- Concavity on V1 absent (Fig. 4B).
..... *P. graceae* sp. nov.

Phormiobius brouni sp. nov.

(Figs 3, 10)

Type material. HOLOTYPE: ♂, point-mounted (NZAC), 'Coll. A. E. Brookes. 10.Feb.1949. [in Brookes' hand] // Aorere Valley, Bainham, W. Nelson [in Brookes' hand] // A.E. Brookes Collection'.

Description. Body (Fig. 3A) length 2.41 mm, about 2.67× as long as wide (BL/AW = 2.67). Head about 1.24× longer than wide (HL/HW = 1.24). Pronotum about as long as wide (PL/PW = 1.02). Elytra wider than long, about 0.51× as long as wide (EL/EW = 0.51) and about 0.52× as long as pronotum (EL/PL = 0.52). Abdomen about 1.26× longer than wide (AL/AW = 1.26).

Male. Eyes with 14 facets. Abdominal concavities (Figs 3B–C) present on V1–V4; C1 polished and relatively deep, C2 deep and polished with edge conspicuously demarcated with side rims forming apical spines, greatest width bigger than length of metatrochanter and slightly widened posteriorly; C3 similar to C2 in shape, and with apical spines more strongly projecting, greatest width slightly narrower than C1; C4 small and shallow with vaguely visible edges. Metatrochanter (Fig. 3D) with knot-shape tubercle; metatibia (Fig. 3E) with small apical spine. Tergite 5 about 1.25× wider than long, and broadly rounded.

Female. Unknown.

Differential diagnosis. This species can be easily distinguished from its congeners by males having four well-developed concavities on V1–V4, with spines on the rims of C2 and C3. Additional male characters that characterize this species are as follows: metatrochanter with a knot-shape

tubercle and metatibia with a small apical spine.

Etymology. This species is dedicated to Thomas Broun honoring the centenary of his death (15 July 1838 – 24 August 1919) and his legacy naming the great majority of New Zealand beetle species; it is a noun in genitive singular.

Distribution. South Island: NN.

Phormiobius graceae sp. nov.

(Figs 4, 10)

Type material. HOLOTYPE: ♂, point-mounted (NZAC): 'New Zealand, BP, Orete Forest, Te Puia Hut, 26 Apr 1993, G. Hall // sifted litter, 93/96'. PARATYPES (13 ♂♂, all NZAC): **BP:** 3 spec., same data as holotype; 1, Orete Forest, Te Puia Hut, 25/01/1993, J.S. Dugdale, litter, 93/03; 1 spec., Orete Forest, Te Puia Hut, 15/09/1992, G. Hall & R.C. Henderson, sifted litter, 92/50; 1 spec., Te Koau, 125m, 02/05/1993, R.C. Henderson, litter, 93/107; 1 spec., Rereauira, 26/01/1993, J.S. Dugdale, litter, 93/05. **GB:** 1 spec., Kakanui, 350m, 01/02/1993, J.S. Dugdale, litter, 93/14. **HB:** 1 spec., Balls Clearing S.R., 21/10/1984, C.F. Butcher, sifted litter and rotten wood, 84/72; 2 spec. [in ethanol], Lake Waikaremoana, Rahuinui Stream, 600m, 26/11/2018, sifted leaf litter and moss, 38°44'41"S, 177°06'58"E, J. Shen, JWS082. **WN:** 1 spec., Tararua Forest Park, Holdsworth, 16/04/2005, R. Leschen, leaf litter, 40.53S, 175.28E, RL976; 1 spec. [in ethanol], Summit Track, Rimutaka Hill, 23/01/2008, K. Marske, R. Leschen & T. Buckley, sifted wood and leaf litter, S41.06.897°, E175.13.700°, 509m, KM240.

Description. Body (Fig. 4A) length 1.96–2.14 mm (♂, 2.02–2.14 mm; ♀, 1.96–2.05 mm), about 2.62× as long as wide (BL/AW = 2.57–2.68). Head about as long as wide (HL/HW = 1.00–1.07). Pronotum about as long as wide (PL/PW = 0.93–1.01). Elytra wider than long, about 0.46× as long as wide (EL/EW = 0.44–0.48), and about 0.76× as long as pronotum (EL/PL = 0.75–0.77). Abdomen about 1.21× longer than wide (AL/AW = 1.16–1.27).

Male. Eyes with 14–15 facets. Abdominal concavities (Fig. 4B) present on V2–V4; C1 absent; C2 deep, wide, and setose, edge without rims and not clearly demarcated, greatest width bigger than length of metatrochanter and slightly widened posteriorly; C3 shallow and without apical spines, greatest width almost as big as length of metatrochanter. Metatrochanter (Fig. 4C) with blunt and round protuberance; metatibia (Fig. 4D) with small apical spine. Tergite 5 (Fig. 4E) about as long as wide, broadly rounded; ventrite 5 (Fig. 4F) slightly emarginated at apex. Aedeagus (Figs 4G–I) with basal bulb rounded in lateral view and lobate in dorsal view; median lobe bilobate in lateral view with ventral process strongly pointed downwards in lateral view.

Female. Eyes with 13–16 facets.

Differential diagnosis. This species can be easily distinguished from all other species by males having concavities on abdominal V2, V3 and V4, apart from *P. brouni* sp. nov., which also has a concavity on V4, but it is weakly formed. Moreover, the concavities of *P. graceae* sp. nov. are not deep nor having apical spines. Additional male characters that characterize this species are as follows: metatrochanter with short crescent-shaped protuberance and metatibia with a small apical spine.

Etymology. This species is dedicated to one of the collectors, Grace Hall for her assistance in the field, her technical work in the NZAC, and friendship over many years; it is a noun in genitive singular.

Distribution. North Island: BP, GB, HB, WN.

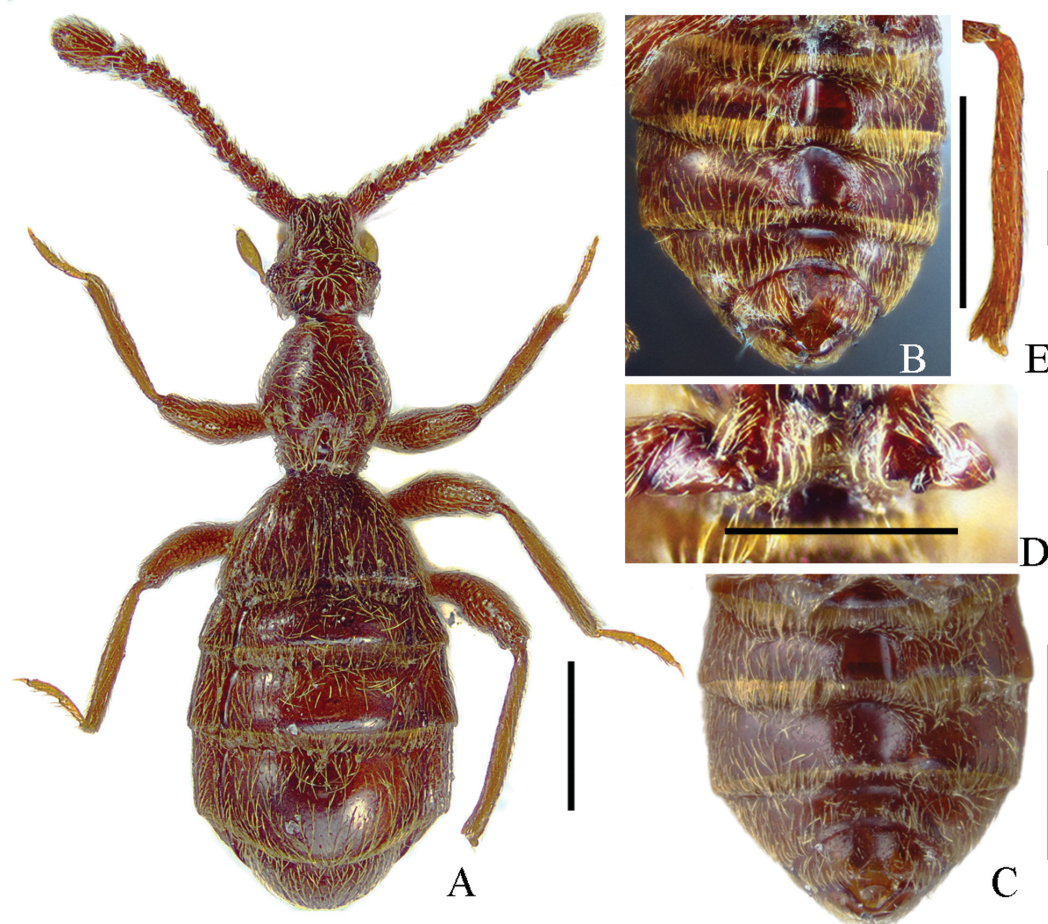


Fig. 3. Diagnostic characters of *Phormiobius brouni* sp. nov. A – habitus; B – abdomen, in ventrolateral view; C – same, in ventral view; D – metatrochanter; E – metatibia. Scale bars: A–C = 0.5 mm, D–E = 0.1 mm.

Phormiobius halli Broun, 1917

(Figs 5, 9, 10)

Phormiobius halli Broun, 1917: 382 (original description).

Type material. LECTOTYPE: ♂ by present designation (BMNH): card-mounted, 'type [circular label with red border], 3833. ♂. [in Broun's hand, label with faint blue line] // New Zealand. Broun Coll. Brit. Mus. 1922-482. [red underline] // Belgrove. 24.10.1914. [in Broun's hand] // *Phormiobius halli*. ♂ [in Broun's hand]'. PARALECTOTYPES: 1 ♂, card-mounted (BMNH), '3833. ♂. [in Broun's hand, label with faint blue line] // New Zealand. Broun Coll. Brit. Mus. 1922-482. [red underline] // Belgrove. 24.10.1914. [in Broun's hand] // *Phormiobius halli*. ♂ [in Broun's hand]'; 1 ♀, card-mounted (BMNH), '3833. ♀ [in Broun's hand] // New Zealand. Broun Coll. Brit. Mus. 1922-482. [red underline] // Belgrove. 24.10.1914. [in Broun's hand] // *Phormiobius halli*. ♀. [in Broun's hand]'; 1 ♀, card-mounted (BMNH), '3833. ♀ [in Broun's hand] // New Zealand. Broun Coll. Brit. Mus. 1922-482. [red underline] // Gordons. 15.11.1914. [in Broun's hand] // *Phormiobius halli*. ♀. [in Broun's hand]'; 1 spec., point-mounted (NZAC), 'Belgrove 24.10-14. [in Broun's hand] // T. Broun Collection // A.E. Brookes Collection'; 1 spec., card-mounted (NZAC), 'Belgrove, Oct. 1914 T. Hall [in Brookes' hand] // 3833 [in Brookes' hand]'; 1 ♀, card-mounted (NZAC), 'Belgrove, 24.11.1914. [in Broun's hand] // 3833, ♀ [in Broun's hand] // *Phormiobius halli*, ♀ [in Broun's hand] // T. Broun Collection, A.E. Brookes Collection'; 2 ♀♀, mounted on the same card (NZAC), '3833. ♀. [in Broun's hand] // Belgrove, 24-10-14 [in Broun's hand]'; 2 spec., mounted on same card (NZAC), 'Belgrove. Nelson. [in Brookes' hand] // *Phormiobius halli* Broun. 3833. [in Brookes' hand]'

Additional material examined. 88 spec. (all NZAC, except where indicated): NN: 3 ♂♂, 3833, Hope across, 19/08/1915, T. Broun, A.E. Brookes Collection; 1 ♀, Hope, 20/02/1915, 3833, T. Broun Collection, A.E. Brookes Collection; 3 ♀♀, Hope, 10/12/1914, T. Broun Collection, A.E. Brookes Collection; 2 ♂♂, Maruia Springs, 09/1948, E.S.B., A.E. Brookes Collection; 1 ♂, Mt. Owen, 3833, 17/12/1914, T. Broun; 1 ♀, Mt. Owen, 30/3/1938, E.S. Gourlay; 1 ♂ 3 ♀♀, Upper Maitai, 03/05/1950, E.S. Gourlay; 2 ♂♂ 5 ♀♀, Upper Maitai, 13/02/1957, E.S. Gourlay; 1 ♂, Upper Maitai, 19/05/1941, E.S. Gourlay; 1 ♂, Upper Maitai, 07/04/1963, E.S. Gourlay; 1 ♀, Upper Maitai, 13/05/1950, E.S. Gourlay; 2 ♀♀, Upper Maitai, 07/03/1949, E.S. Gourlay; 1 ♀, Eves valley, 30/03/1955, E.S. Gourlay, leaf mould; 1 ♀, Dun Mountain Track, 06/12/1969, G.W. Ramsay, litter; 1 ♀, Mt. Malita, 2400ft, 01/04/1966, J.I. Townsend, moss in open area, near bush edge; 2 ♀♀, Gordons Knob, 3833, T. Broun Collection, A.E. Brookes collection; 1 ♂, Kaituna Track, 04/12/2018, 40, 42.807S, 172 34.434E, sifting moss, R. Leschen & V. Sykora, RL2060; 1 ♂, Pupu Hydro Walkway, 02/12/2018, sifting moss and litter, 40, 51.338S, 172 44.300E, R. Leschen & V. Sykora, RL2048; 1 ♀ (NMPC), Kahurangi National Park, Whanganui, 12km northwest of Collingwood, 40°60'47.4"S, 172°58'11.4"E, 25m 10/12/2016, M. Fikáček & M. Seidel lgt.; 2 ♀♀ (NMPC), Kahurangi National Park, Pupu Hydro Track, 5.8km west of Takaka, 40.85507°S, 172.73821°E, 75m, 12/12/2016; M. Fikáček & M. Seidel lgt. BR: 4 ♂♂ 7 ♀♀, Maruia Springs, 25/04/1977, J. Nunn; 2 ♂♂, L. Rotoiti, 03/04/1916, T. Broun, A.E. Brookes Collection; 1 ♂, 1 ♀, Lake Rotoiti, Brunner Peninsula Nature Walk, 16/04/2004, A.C. Eyles, moss and lichen on live tree trunks; 1 ♂, Lake Rotoiti, Brunner Peninsula Nature Walk, 16/04/2004, A.C. Eyles, ex. moss and fungi on ground; 2 ♀♀, Lake Rotoiti, 23/03/1977, A.K. Walker, rotten wood; 1 ♀, Lake Rotoiti, 21/03/1965, N.A. Walker, leaf litter; 1 ♂, Lewis Pass, 22/02/1953, A.E. Brookes; 1 ♂, Lewis Pass, 22/02/1958, A.E. Brookes, leaf mould; 1 ♀, Lewis Pass, 14 km east, 19/11/1961, G. Kuschel, leaf

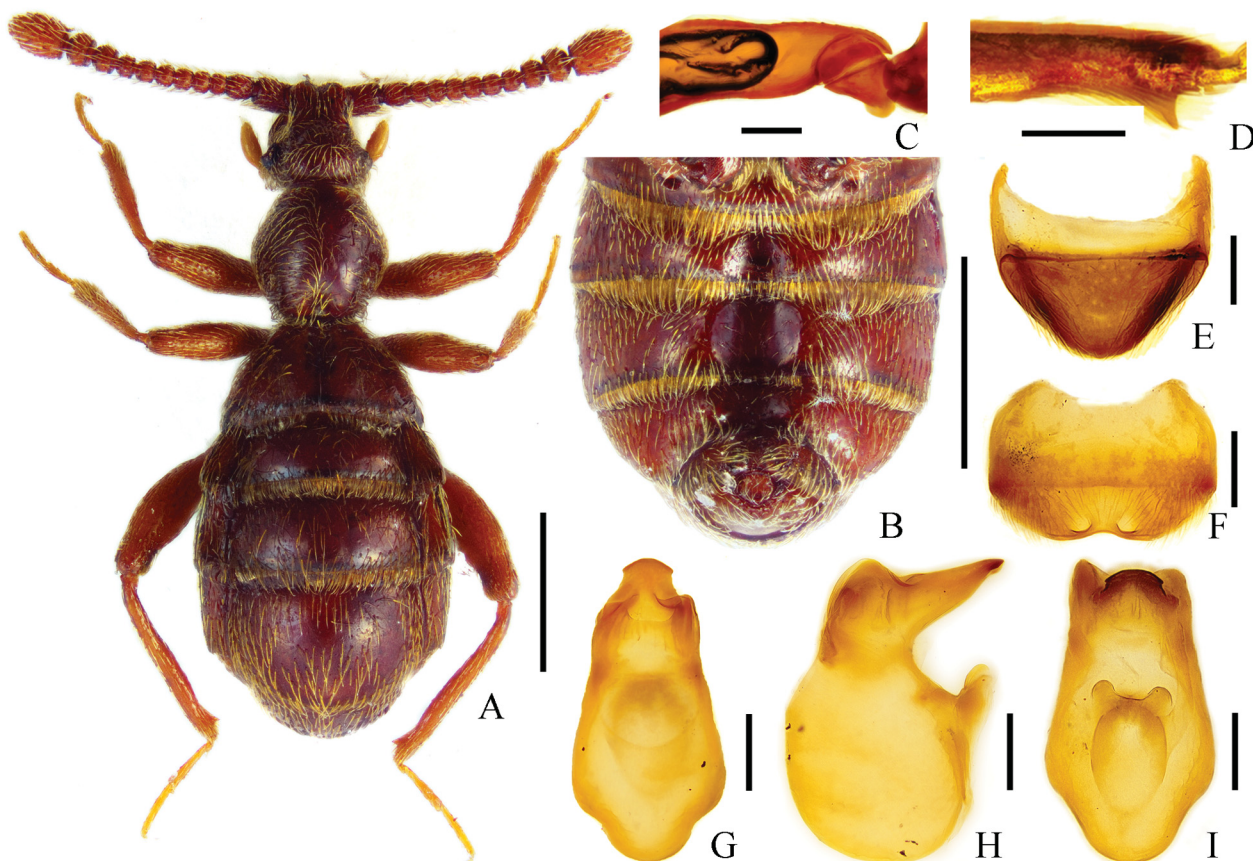


Fig. 4. Diagnostic characters of *Phormiobius graceae* sp. nov. A – habitus; B – abdomen, in ventral view; C – metatrochanter; D – metatibia; E – T8; F – V8 and T9; G – aedeagus, in dorsal view; H – same, in lateral view; I – same, in ventral view. Scale bars: A–B = 0.5 mm, C–I = 0.1 mm.

litter; 3 ♂♂ 1 ♀, Lewis Pass, 3500ft, 08/12/1957–12/12/1957, E.S. Gourlay; 1 ♀, Arnaud, 19/05/1916, T. Broun; 2 ♂♂ 3 ♀♀ (FMNH), Nelson Lakes National Park, Lake Rotorua, 450m, 03/02/1977–07/02/1977, S. Peck & J. Peck, *Nothofagus* forest, berlese forest litter; 1 ♀, Howard, 10/05/1915, E.S. Gourlay; 2 ♀♀, Glenhope Scenic Reserve, 21/02/1989, J. Nunn; 1 ♀, Mt. Robert, Speargrass Track, 30/12/2005, J.T. Nunn, forest floor litter; 1 ♀, Lake Rotorua, near road end, 05/11/2014, J. Nunn, in deep damp *Nothofagus* litter. **MB:** 4 ♂♂ 4 ♀♀, Mt. Richmond Forest Park, Brown River, beech forest along SH6, 13/12/2007. K. Marske, J. Allwood, sifted woody debris, leaf litter and moss, S41.12.614', E173.34.757', 53m, KM129; 1 ♀, Hanmer Springs, 20/10/2007, J. Nunn, washed soil sample, beech forest. **Unknown locality:** 4 ♂♂, 3833, Broun; 1 ♂, 3833, 18/07/1915, T. Broun Collection, A.E. Brookes Collection.

Redescription. Body (Fig. 5A) length 2.12–2.20 mm (♂, 2.15–2.20 mm; ♀, 2.12–2.18 mm), about 2.62× as long as wide (BL/AW = 2.47–2.76). Head about 1.22× longer than wide (HL/HW = 1.16–1.27). Pronotum about as long as wide (PL/PW = 1.09–1.10). Elytra wider than long, about 0.5× as long as wide (EL/EW = 0.48–0.53) and about 0.76× as long as pronotum (EL/PL = 0.73–0.79). Abdomen about 1.22× longer than wide (AL/AW = 1.20–1.24).

Male. Eyes with 16–17 facets. Abdominal concavities (Fig. 5B) present on V2 and V3; C1 absent; C2 deep and polished, with lateral edges clearly demarcated and forming well-developed rims, greatest width about as wide as length of metatrochanter and slightly widened posteriorly; C3 shallow, surface setose, with apical spines, greatest width wider than length of metatrochanter; ventrite 4 without

concavity. Metatrochanter (Fig. 5C) spinate, apex of spine rounded; metatibia (Fig. 5D) with distinct small apical spine. Tergite 5 (Fig. 5E) about 1.32× wider than long, broadly rounded; ventrite 5 (Fig. 5F) slightly emarginated at apex. Aedeagus (Figs 5G–I) with basal bulb oval in dorsal view; median lobe broad and curve-sided in dorsal view, multilobate with ventral lobe forming flattened shelf.

Female. Eyes with 15–16 facets.

Differential diagnosis. This species can be distinguished from other species by the following male characters: concavities on V2–V3 (C1 and C4 absent), C2 polished with definitive rims, C3 setose and lacking rims and with apical spines pointed; metatrochanter spinate, apex of spine rounded; metatibia with a small apical spine.

Comments. Broun described this species based on three males and nine females collected from Belgrove, southwest of Nelson, by Thomas Hall (see WATT 1977) among decaying flax-leaves in October 1914. We located two males and three females in the BMNH Broun collection, and one male and six females in the NZAC. There is a discrepancy among the labels of the specimens because some were dated November 24, others October 24 (and some undated as well), and a single specimen also labeled as Gordon's, which refers to the small mountain range south of Belgrove. We treated all of these as syntypes. To stabilize this name, a lectotype (Fig. 9) is here designated for *Phormiobius halli*.

Distribution. South Island: NN, BR, MB.

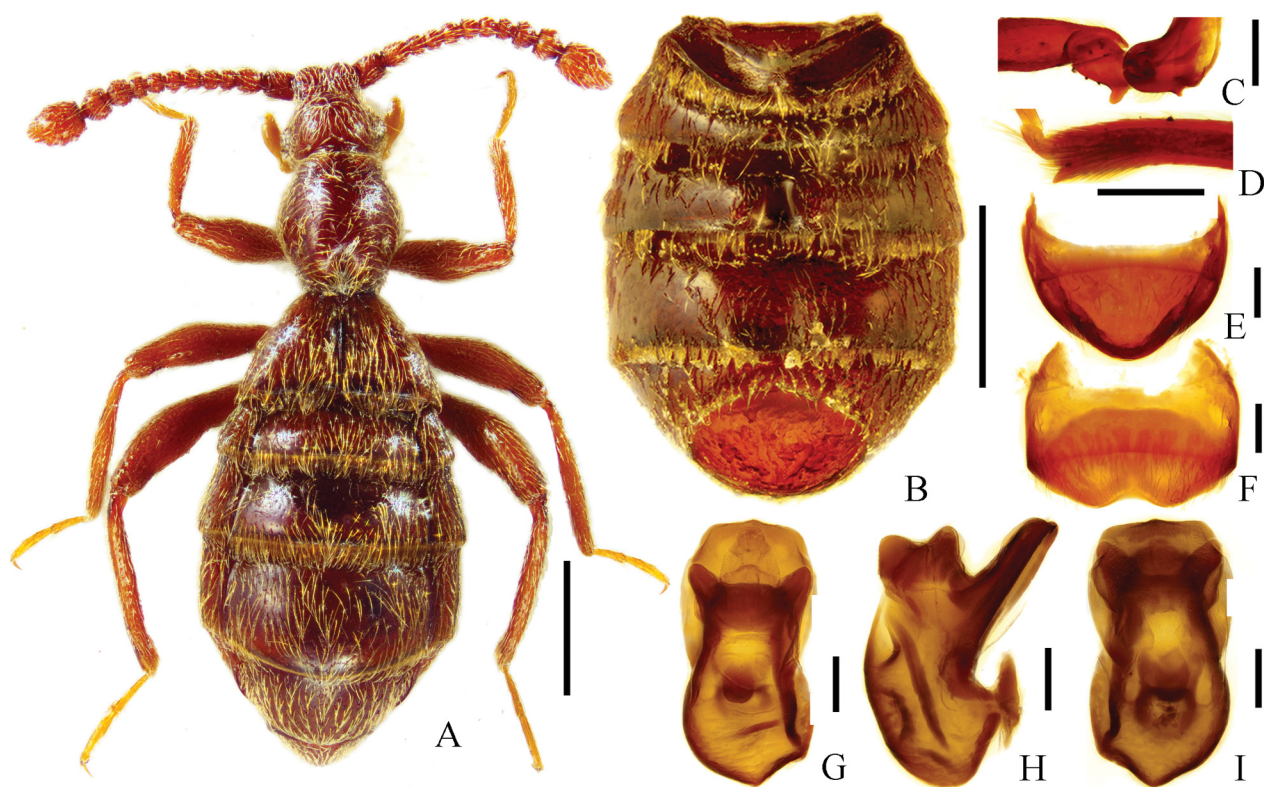


Fig. 5. Diagnostic characters of *Phormiobius halli* Broun, 1917. A – habitus; B – abdomen, in ventral view; C – metatrochanter; D – metatibia; E – T8; F – V8 and T9; G – aedeagus, in dorsal view; H – same, in lateral view; I – same, in ventral view. Scale bars: A–B = 0.5 mm, C–I = 0.1 mm.

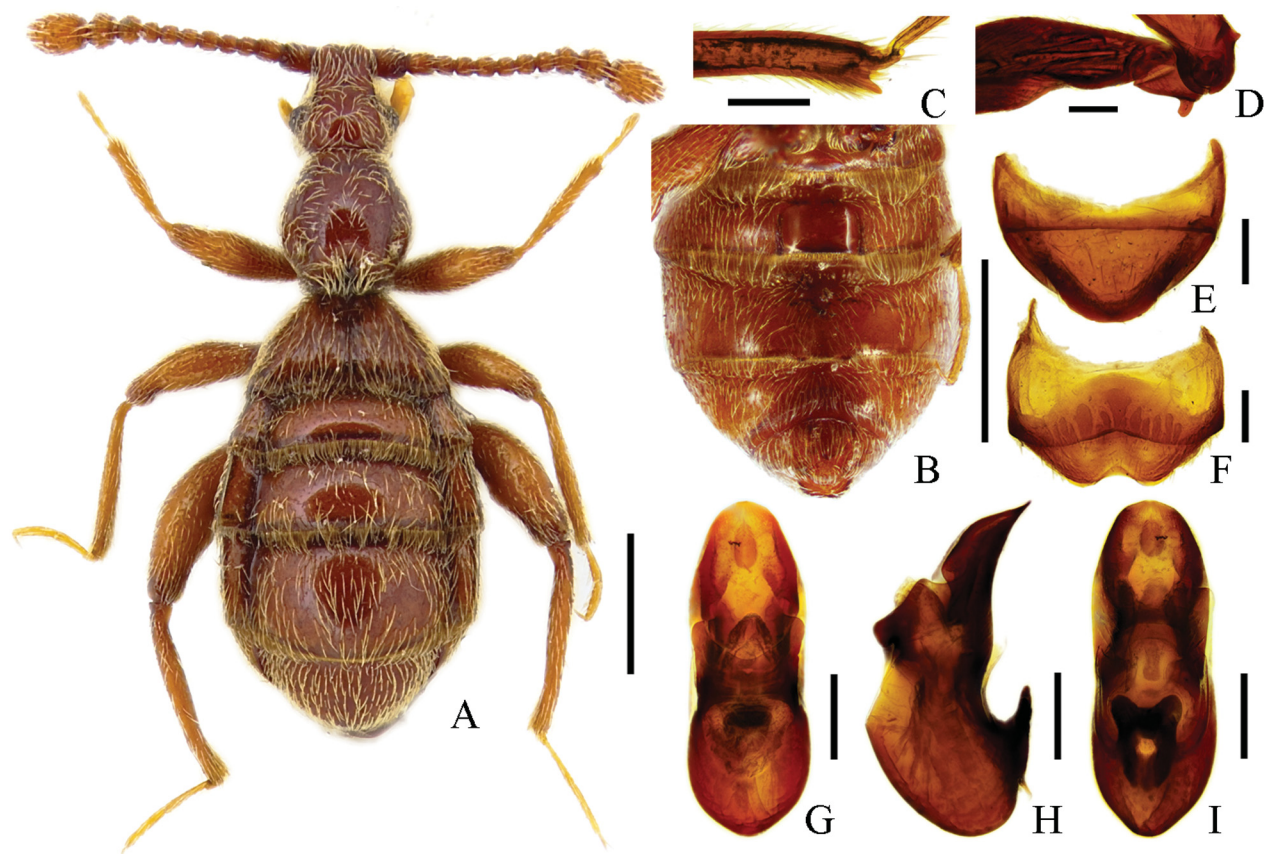


Fig. 6. Diagnostic characters of *Phormiobius matau* sp. nov. A – habitus; B – abdomen, in ventral view; C – metatibia; D – metatrochanter; E – T8; F – V8 and T9; G – aedeagus, in dorsal view; H – same, in lateral view; I – same, in ventral view. Scale bars: A–B = 0.5 mm, C–I = 0.1 mm.

Phormiobius matau sp. nov.

(Figs 6, 10)

Type material. HOLOTYPE: ♂, point-mounted (NZAC): 'Shakespeare Bay, Picton // 11 Aug 1969, J.Mc. Burney // litter'. PARATYPES (2 ♂♂, NZAC [1 in ethanol]): **MB:** Pelorus Bridge Scenic Reserve, Totara Walk, beech forest, 17m, 12/12/2007, K. Marske, J. Allwood, sifted beech litter and woody debris, S 41.17.927', E 173.34.380', KM118.

Additional material examined. 11 ♀♀ (all NZAC): **SD:** 1 ♀, same data as holotype; 1 ♀ [in ethanol], Pelorus Bridge Scenic Reserve, Totara Walk, beech forest, 17m, 12/12/2007, K. Marske, J. Allwood, sifted beech litter and woody debris, S41.17.927', E173.34.380', KM118; 3, Opouri Saddle, 16/03/2018, J. Nunn, in forest floor litter. **MB:** 4 ♀♀, Ronga Saddle, 316m, 04/02/2014, J. Nunn, sifted forest floor litter, S41°07.402', E173°36.981'; 2 ♀♀ [in ethanol], Pine Valley, 06/12/2018, sifting moss on rocks, 41, 30.209S, 173 30.486E, R Leschen & V. Sykora, RL2068.

Description. Body (Fig. 6A) length 1.95–2.12 mm (♂, 2.10–2.12 mm; ♀, 1.95–2.05 mm), about 2.70× as long as wide (BL/AW = 2.69–2.71). Head about 1.24× longer than wide (HL/HW = 1.22–1.25). Pronotum about as long as wide (PL/PW = 1.08–1.09). Elytra wider than long, about 0.52× as long as wide (EL/EW = 0.51–0.53) and about 0.70× as long as pronotum (EL/PL = 0.69–0.71). Abdomen about 1.39× longer than wide (AL/AW = 1.39–1.40).

Male. Eyes with 13–14 facets. Abdominal concavities (Fig. 6B) present on V2 and V3; C2 deep and polished with edge conspicuously demarcated with lateral rims, greatest width twice length of metatrochanter and slightly widened posteriorly; C3 shallow with sparse setae and lacking lateral rims, apical spines minute. Metatrochanter (Fig. 6D) spinate, apex of spine rounded and curved in lateral view; metatibia (Fig. 6C) with big apical spine. Tergite 5 (Fig. 6E) about 1.21× wider than long, broadly rounded; ventrite 5 (Fig. 6F) strongly emarginated at apex. Aedeagus (Figs 6G–I) with basal bulb elongate and oval in dorsal view; median lobe unilobate in lateral view with pointed apex and raised rim at apical one-third; bilobate in dorsal view and about as wide as basal bulb and convergent towards apex.

Female. Eyes with 13–14 facets.

Differential diagnosis. This species can be easily distinguished from its congeners by males having sharply demarcated concavities on V2 and the very shallow concavities on V3 with minute spines. Additional male characters that characterize this species are as follows: metatrochanter with hook-like round spine that is curved in lateral view and metatibia with a large apical spine.

Etymology. The generic name is a direct transliteration of Māori for *matau* meaning 'hook' with respect to the hook-like process on the metatrochanter; it is a noun in nominative singular, standing in apposition.

Distribution: South Island: SD, MB.

Phormiobius pseudhalli sp. nov.

(Figs 7, 10)

Type material. HOLOTYPE: ♂, card-mounted (NZAC): 'New Zealand, WN, Orongorongo V., W.N. 18 Jan 1994 // hard beech forest litter, Tullgren, #39'. PARATYPES (10 ♂♂, all NZAC): **RI:** 1 ♂, Ruahine Ra., Armstrong Saddle, 1250m, 08/02/1980, C.F. Butcher, ex. Senecio bidwillii; 1, Ruahine Ra., Triplex, 10/02/1980, C.F. Butcher, litter, 80/16; 2 ♂♂ [in ethanol], Ruahine forest, Around Awatere Hut, 39°58'14"S, 176°08'23"E, 580m, sifted leaf litter, moss and rotten woods, 27/11/2018, J. Shen, JWS083; 1 ♂ [in ethanol], Ruahine State Forest Park, Oroua River, 19/01/2008, K. Marske, R. Leschen & T. Buckley, sifted

leaf litter, S39.57.660', E176.00.841', 580m, KM211. **WN:** 2 ♂♂, Tararua Forest Park, Holdsworth, 16/04/2005, R. Leschen, leaf litter, 40.53S, 175.28E, RL976; 2, Mt. Holdsworth, start of Interior Track, 30/1/1985, H.P. McColl, litter, 85/3; 1 ♂ [in ethanol], Summit Track, Rimutaka Hill, 23/01/2008, K. Marske, R. Leschen & T. Buckley, sifted wood and leaf litter, S41.06.897', E175.13.700', 509m, KM240.

Redescription. Body (Fig. 7A) length 2.06–2.11 mm (♂, 2.07–2.11 mm; ♀, 2.06–2.10 mm), about 2.56× as long as wide (BL/AW = 2.42–2.69). Head about 1.20× longer than wide (HL/HW = 1.15–1.25). Pronotum about as long as wide (PL/PW = 1.08–1.10). Elytra wider than long, about 0.50× as long as wide (EL/EW = 0.49–0.52), and about 0.75× as long as pronotum (EL/PL = 0.71–0.78). Abdomen about 1.21× longer than wide (AL/AW = 1.20–1.23).

Male. Eyes with 14–15 facets. Abdominal concavities (Fig. 7B) present on V2 and V3; C1 and C4 absent; C2 deep and polished, with lateral edges clearly demarcated and forming well-developed rims, greatest width narrower than length of metatrochanter and slightly widened posteriorly; C3 shallow, surface setose, with apical spines, greatest width wider than length of metatrochanter; ventrite 4 without concavity. Metatrochanter (Fig. 7D) spinate, apex of spine rounded; metatibia (Fig. 7C) with distinct small apical spine. Tergite 5 (Fig. 7E) about 1.32× wider than long, broadly rounded; ventrite 5 (Fig. 7F) slightly emarginated at apex. Aedeagus (Figs 7G–I) with basal bulb oval in dorsal view; median lobe broad and parallel-sided, unilobate and apiculate in lateral view, with small dorsocentral lobe at apical one-third.

Female. Eyes with 13–16 facets.

Differential diagnosis. This North Island species was initially confused with specimens of the South Island species *P. halli*, but the genitalia are significantly different with those of *P. halli* which have the median lobe apically multilobate. *Phormiobius pseudhalli* sp. nov. can be further separated by the narrower concavity on V2, and the lack of a small apical tooth on the metatibia.

Etymology. The naming of this species refers to its similarity to *P. halli*; it is a noun in genitive singular.

Distribution. North Island: RI, WN.

Phormiobius ramsayi sp. nov.

(Figs 8, 10)

Type material. HOLOTYPE: ♂, point-mounted (NZAC): 'NEW ZEALAND WO Mahoenui Gribbens Road 26 Jun 1977 G.W. Ramsay // Litter 77/81'. PARATYPE: 1 ♀, same label data as holotype.

Description. Body (Fig. 8A) length 1.90 mm, about 2.19× as long as wide (BL/AW = 2.19). Head about 1.29× longer than wide (HL/HW = 1.29). Eyes with 15 facets. Pronotum about as long as wide (PL/PW = 0.97). Elytra wider than long, about 0.58× as long as wide (EL/EW = 0.58) and about 0.76× as long as pronotum (EL/PL = 0.76). Abdomen about 1.21× longer than wide (AL/AW = 0.94).

Male. Eyes with 15 facets. Abdominal concavities (Fig. 8B) present on V1, V2, V3 and V4, and all inner surfaces polished; C1 and C2 well-impressed with distinct edges, C2 deep and lacking spines, greatest width longer than length of metatrochanter and slightly widened posteriorly; C3 broader than C2 and lacking spines, C4 very weak.

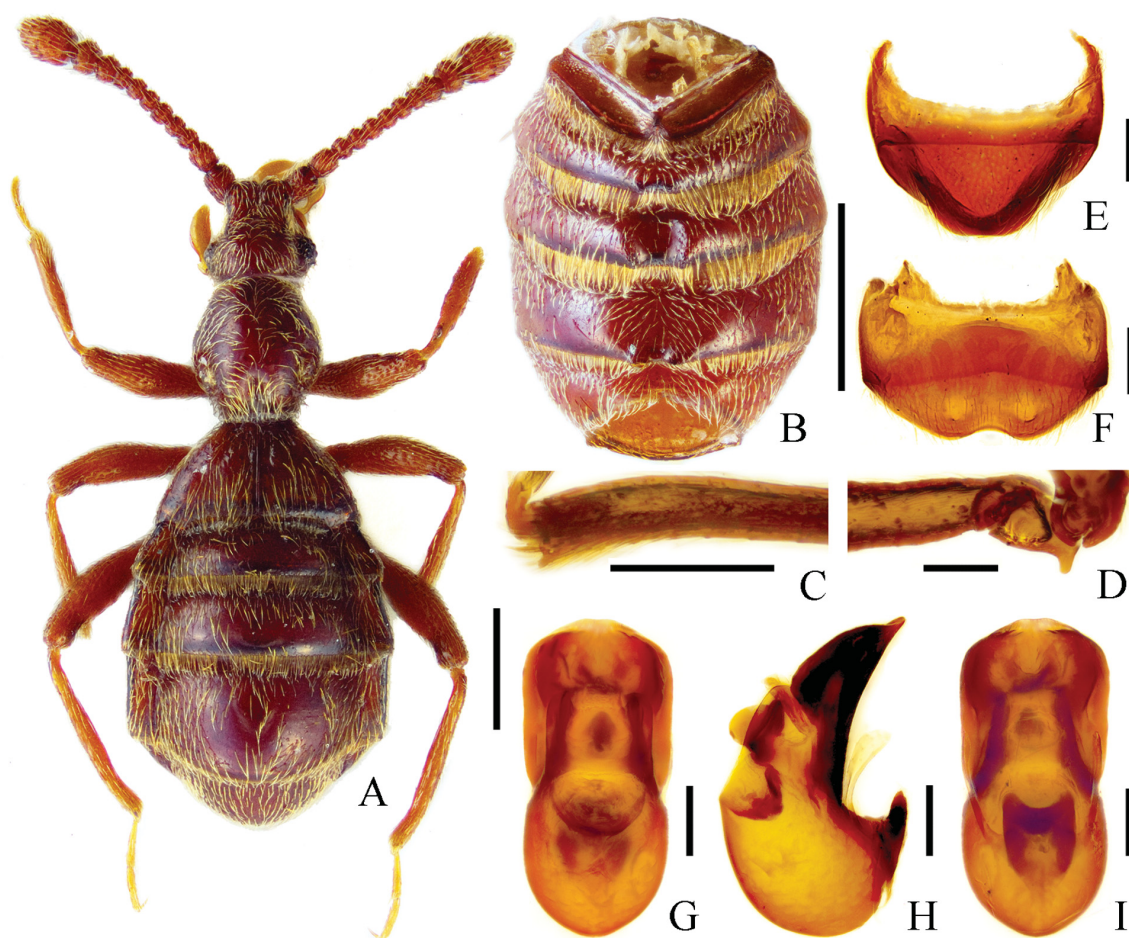


Fig. 7. Diagnostic characters of *Phormiobius pseudhalli* sp. nov. A – habitus; B – abdomen, in ventral view; C – metatibia; D – metatrochanter; E – T8; F – V8 and T9; G – aedeagus, in dorsal view; H – same, in lateral view; I – same, in ventral view. Scale bars: A–B = 0.5 mm, C–I = 0.1 mm.

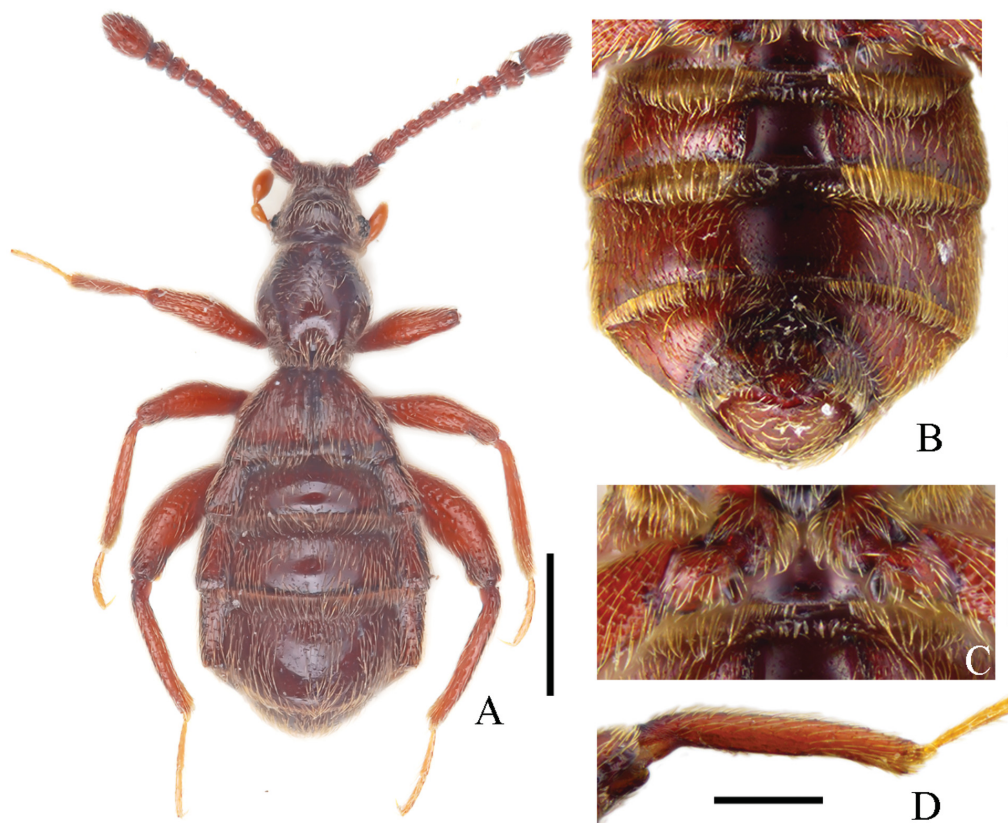


Fig. 8. Diagnostic characters of *Phormiobius ramsayi* sp. nov. A – habitus; B – abdomen, in ventral view; C – metatrochanter; D – metatibia. Scale bars: A–B = 0.5 mm, C–D = 0.1 mm.

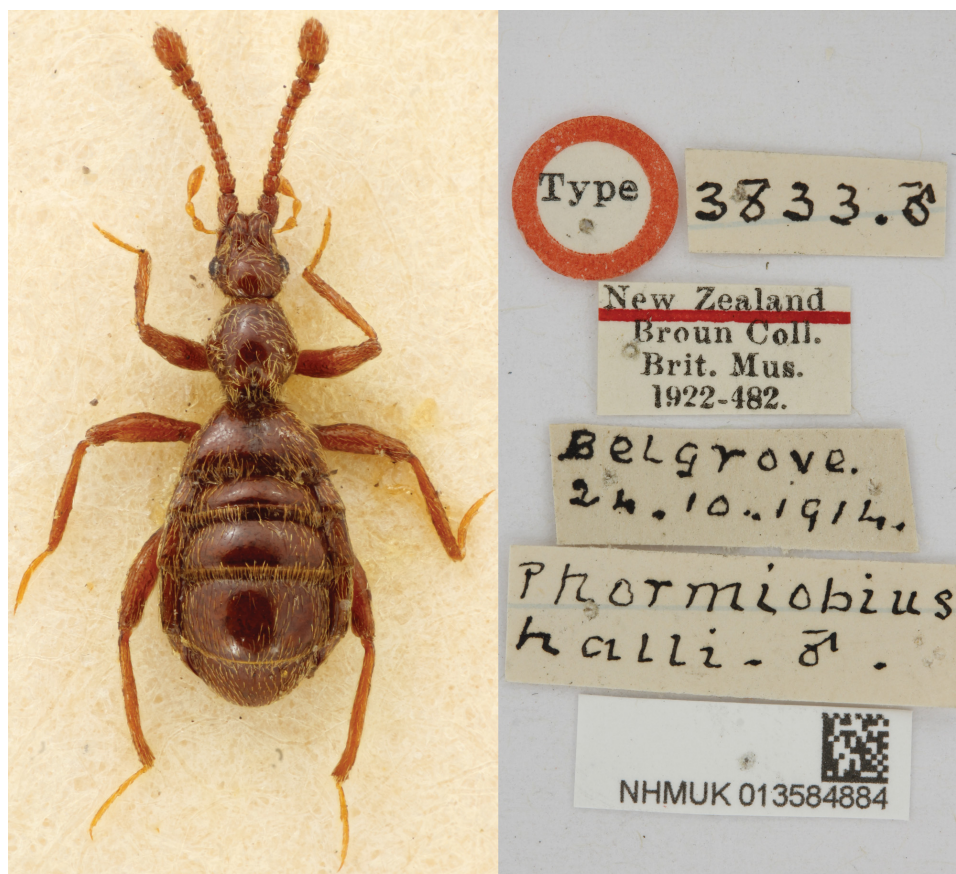


Fig. 9. Lectotype and its labels of *Phormiobius halli* Broun, 1917.

Metatrochanter (Fig. 8C) with inner face concave with well-developed longitudinal carina; metafemora weakly curved at apex; metatibia (Fig. 8D) with small apical spine. Tergite 5 about $1.5\times$ wider than long, broadly rounded.

Female. Eyes with 14 facets.

Differential diagnosis. This species can be easily distinguished from its congeners by males having a well-developed concavity on V1 and metatrochanter with inner face concave with a well-developed longitudinal carina. It is most like *P. graceae* sp. nov. by C3 lacking apical spines but can be separated from it by the metatrochanteral process having the concave inner face and V1 lacking a concavity. Additional male characters that characterize this species are as follows: C2 deep and polished with edge conspicuously demarcated with side rims and without apical spines and metatibia without small apical spine.

Etymology. This species is dedicated to Graham Ramsay, entomologist, and collector of the new species; it is a noun in genitive singular.

Distribution. North Island: WO.

Appendix

Unidentified females associated with *P. graceae* sp. nov., and *P. pseudhalli* sp. nov.

Material examined (48 ♀♀, all NZAC): **NORTH ISLAND:** BP: 1, Orete Forest, Te Puia Hut, 26/04/1993, G. Hall, Sifted litter, 93/96; 1, Orete Forest, Te Puia Hut, 13/04/1992, G. Hall, litter, 92/43; 2, Orete Forest,

Te Puia Hut Bush, 19/10/1992, J.S. Dugdale, litter, moss and liverworts, 92/67; 4, Te Koau, 125m, 02/05/1993, R.C. Henderson, litter, 93/107; 1, Te Koau, 130m, 15/03/1993, J.S. Dugdale, litter, 93/45; 1, Rereauria, 26/01/1993, J.S. Dugdale, litter, 93/05; 1, Motu River, Bay of Plenty, 03/1928, A.E. Brookes Collection; 1, Kaimai Range, Matamata, Okauia, 03/04/1920, A. E. Brookes, A.E. Brookes Collection; 1, Lower Kaimai, 14/03/1930, A.E. Brookes Collection; 1, Mamaku Bush, 11/01/1931, A.E. Brookes Collection; 2, Urewera Range, 2500ft, 03/03/1967, B.M. May. **GB:** 1, Murapara Road, 717m, 22/11/2005, in decayed wood, 38°44.405S, 177°05.806E, J. Nunn. **HB:** 2, Balls Clearing S.R., 21/10/1984, C.F. Butcher, sifted litter and rotten wood, 84/72; 1, Balls Clearing S.R., 13/03/1980, C.F. Butcher, litter, 80/33; 2, Kaweka Range, Makahu Saddle, 1280m, 13/03/1980, C.F. Butcher, litter, 80/31; 2, Kaweka Range, Makahu Hut, 975m, 13/03/1980, C. F. Butcher, litter, 80/38. **RI:** 2, northeast of Ohingaiti, Mangamako Road, Paki-iti Farm, 23/08/1985, C.T. Duval, litter, 85/45; 1, Ruahine Ra., Armstrong Saddle, 1250m, 08/02/1980, C.F. Butcher, ex. *Senecio bidwillii*; 1, Utiku, main trunk, 24/08/1917, J. Ford Collection, A.E. Brookes Collection. **WA:** 1, Pipinui Waterfall Scenic Reserve, 06/02/1989, J. Nunn; 1, W.A. Miller Reserve, Kaiparoro, 15/03/1966, CLW, J. Nunn; 1, Castle hill/Haunui area, southeast of Puketoi Range, 03/2010, J. Nunn; 1, Makuri Gorge, 01/02/1989, J. Nunn; 1, Kiriwhakapapa, 06/03/1966, CLW. **WN:** 2, Tararua Range, Mangatainoka Valley, track to Herepai Hut, 40°40'51"S, 175°32'52"E, 326m, sifted leaf litter and moss, 25/11/2018, J. Shen, JWS081; 3, Orongorongo Reserve Station, 21/05/1969, J.S. Dugdale, litter; 1, Mt. Holdsworth, start of Interior Track, 30/01/1985, H.P. McColl, litter, 85/3; 1, Trentham, 13/02/1910, 3833, T. Broun Collection, A.E. Brookes Collection; 2, Days Bay, 15/05/1988, J. Nunn, in forest floor litter; 1, Rimutaka Ra., 08/11/1954, R. Hornabrook; 1, Coll. A.C. O'Connor, Rimutaka Ra., 10/1949, leaf mould, A.E. Brookes Collection; 1, Mt Holdsworth, 10/11/1952, R. Hornabrook; 1, west of Lake Wararapa Reserve, 10/04/1994, J. Nunn, leaf litter; 1, Pakuratahi Forks, Kaitoke, in *Astelia* litter, 18/07/1993, J. Nunn; 1, west of Lake Wairarapa Scenic Reserve, 10/04/1994, J. Nunn.

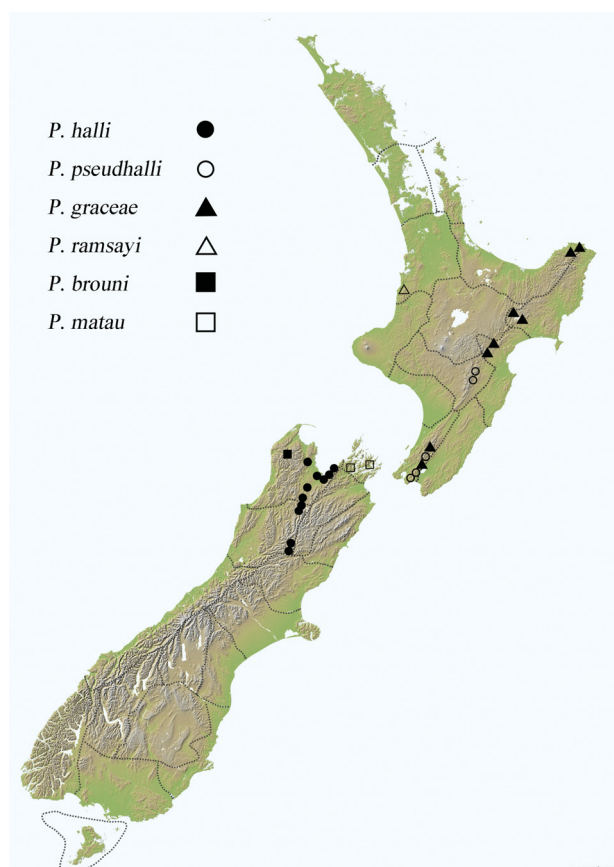


Fig. 10. Geographic distribution of *Phormiobius brouni* sp. nov., *P. graceae* sp. nov., *P. halli* Broun, 1917, *P. matau* sp. nov., *P. pseudhalli* sp. nov. and *P. ramsayi* sp. nov.

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