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A new genus and two new species of feather lice (Phthiraptera: Ischnocera: Philopteridae) from New Zealand endemic passerines (Aves: Passeriformes)

MICHEL P. VALIM¹ & RICARDO L. PALMA^{2,3}

¹Museu de Zoologia da USP, Av. Nazaré, 481, Ipiranga, São Paulo, SP 04263-000, Brazil. E-mail: mpvalim@gmail.com

²Museum of New Zealand Te Papa Tongarewa, P.O. Box 467, Wellington, New Zealand. E-mail: ricardop@tepapa.govt.nz

³Corresponding author

Abstract

The first descriptions of New Zealand endemic feather lice belonging to the *Brueelia*-complex (Phthiraptera: Ischnocera: Philopteridae) are given. The new genus *Melibrueelia* and new species *M. novaeelandiae* are described, illustrated and compared with morphologically close taxa within the complex. The type host of *M. novaeelandiae* is the tui, *Prosthemadera novaeseelandiae* (Gmelin, 1788), and an additional host is the bellbird, *Anthornis melanura* (Sparrman, 1786) (Passeriformes: Meliphagidae), both endemic to New Zealand. Also, the new species *Brueelia callaeincola* is described and illustrated from four endemic bird species belonging to two endemic genera and an endemic family: *Philesturnus carunculatus* (Gmelin, 1789) (the type host), *Ph. rufusater* (Lesson, 1828), *Callaeas cinerea* (Gmelin, 1788) and *C. wilsoni* (Bonaparte, 1851) (Passeriformes: Callaeidae). Brief discussions on possible evolutionary histories of the new taxa are included.

Key words: *Brueelia*-complex, *Melibrueelia*, *Brueelia*, Philopteridae, new genus, new species, Passeriformes, Callaeidae, Meliphagidae, endemic, New Zealand

Introduction

Currently, published records of New Zealand feather lice belonging to the speciose genus *Brueelia* (Phthiraptera: Ischnocera: Philopteridae) are several identified louse species introduced by human agency with their hosts, and a number of introduced and endemic species identified to genus only (e.g. Pilgrim & Palma 1982: 27; Palma 1999: 382). This paper is the first to include descriptions of New Zealand endemic species of lice included in the *Brueelia*-complex of genera (Clay 1951; Clay & Tandan 1967). We describe one new genus and two new species of lice from six species of New Zealand endemic birds, two in the honeyeater family Meliphagidae, and four in the wattle-bird family Callaeidae.

Probably as a result of parallel evolution, characters of the head show considerable diversity among the large number of species presently placed in *Brueelia*, as discussed by Clay (1951: 186) and Clay & Tandan (1967: 34). Therefore, it is difficult to clearly separate genera within the *Brueelia*-complex based solely on head characters, a fact that has produced very different opinions on the number of genera which should be recognised within this complex, from just three genera as in Clay (1951: 187) and Hopkins & Clay (1952: 52, 1953: 435) to more than 10 as in Eichler (1963: 177) and Złotorzycka (1964; 1977: 38), and over 20 as in Mey & Barker (2014: 81).

However, if other characters such as abdominal chaetotaxy are also considered, a more reliable generic separation on morphological grounds can be achieved within the *Brueelia*-complex. Thus, based on morphological characters common to both sexes, those exclusive to males or females, and the geographical and host distributions, we believe that erecting a new genus within the *Brueelia*-complex to include ischnoceran lice parasitic on New Zealand meliphagids is justified (see Table 1).

TABLE 1. Comparison of morphological characters of four *Brueelia* generic groups with *Melibrueelia*

	<i>Brueelia</i> Kéler sensu	<i>Brueelia</i> sensu lato**	<i>Corvinirmus</i> Eichler***	<i>Turdinirmus</i> Eichler***	<i>Melibrueelia</i> new genus****
Praeantennal region	Elongate	Sub-oval	Sub-spherical	Sub-spherical	Sub-triangular
Post-nodal setae	Absent	Present	Present	Present	Present
Male antennal scapus	Not swollen	Weakly swollen	Swollen °	Not swollen	Swollen
Male distal antennal flagellomeres	Not swollen (as in females)	Not swollen (as in females)	Not swollen (as in females)	Not swollen (as in females)	Swollen and dorsally unsclerotized
Post-spiracular setae	VI–VII	IV–VII	II–VII	IV–VII	V–VII
Accessory setae to post-spiracular	Absent	III–VII (absent in females)	II–VII (absent in females)	Absent	(absent in females)
Sternal plates III–VI	Without incraspations	With lateral incraspations	Without incraspations	Without incraspations	Without incraspations
Pleural chaetotaxy	III–VIII	III–VIII	III–VIII	IV–VIII	IV–VIII
Pleural setae on male segment IX+X	< 10	> 10	> 10	< 10	< 10
Female tergite XI	Not fused with IX+X	Not fused with IX+X	Not fused with IX+X	Fused with IX+X	Fused with IX+X
Female subgenital plate	Not Reticulated	Reticulated	Not Reticulated	Not Reticulated	Reticulated
Sclerotization of the vulvar margin ("cross piece")	Thin	Thick	Thin	Absent	Thick

* Type species: *Brueelia rossitensis* Kéler, 1936 = *Brueelia brachylhorax* (Giebel, 1874).

** *Brueelia* species included from hosts of family Timaliidae: "longisternus-subgroup": *Brueelia longisternus* Ansari, 1956a; *B. sternotransversa* Ansari, 1956a; *B. ventratum* Ansari, 1956a.

*** Type species: *Nirmus uncinatus* Burmeister, 1838 = *Corvinirmus uncinatus* (Burmeister, 1838). Species included: *Corvinirmus afzali* (Ansari, 1957a) new combination; *C. argulus* (Burmeister, 1838); *C. atherae* (Ansari, 1957a); *C. biguttatus* (Kellogg & Paine, 1914); *C. biocellatus* (Piaget, 1880); *C. lanifasciatus* (Piaget, 1880); *C. leucocephalus* (Nitzsch [in Giebel], 1866); *C. multipunctatus* (Clay, 1936); *C. quadrangularis* (Rudow, 1869); *C. rotundatus* (Osborn, 1896); *C. varius* (Burmeister, 1838).

**** Type species: *Nirmus meruleensis* Denny, 1842 = *Turdinirmus meruleensis* (Denny, 1842). Species included: *Turdinirmus concavus* Eichler, 1936; *T. daumae* (Clay, 1936) new combination; *T. eichleri* May, 1982a; *T. neodanumae* (Najer & Sychra, 2012) new combination; *T. stresemanni* (Clay, 1936) new combination.

**** Type species: *Melibrueelia novaezealandiae* Valim & Palma new species.

° Less swollen in *C. biocellatus*, *C. koslovae* and *C. multipunctatus*.

† Accessory setae are also absent in males of these species: *C. atherae*, *C. biguttatus*, *C. biocellatus*, *C. koslovae*, *C. multipunctatus* and *C. varius*.

Materials and methods

All specimens examined belong to the Museum of New Zealand Te Papa Tongarewa, Wellington, N.Z. (MONZ), except for some paratypes deposited in the Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil (MZUSP), and some specimens deposited in the New Zealand Arthropod Collection, Auckland, N.Z. (NZAC) as indicated below.

All measurements are in millimeters, taken from digitalized images from slide-mounted specimens using the software *Leica Application Suite* (LAS), and identified by the following abbreviations: HL, head length (from occipital margin to tip of marginal carina); POW, preocular width (at coni level); TW, temporal width (at its widest point); ADHPL, anterior dorsal head plate length (from visible posterior margin at most anterior point on one side of the plate); ADHPW, anterior dorsal head plate width (from each visible lateral margins at its widest point); PW, pronotal width (at its widest point); PTW, pterothorax width (at its postero-lateral margins); AW, abdominal width (at segment V); GL, male genitalia total length (from the visible proximal margin of basal apodema to tip of one paramere); PrL, paramere length (from the proximal margin of its 'head' to its distal tip); TL, total length. ANT-Sca.L, antennal scapus length; ANT-Sca.W, antennal scapus width; ANT-Ped.L, antennal pedicel length; ANT-Ped.W, antennal pedicel width; ANT-FlaI.L, antennal flagellomere I length; ANT-FlaI.W, antennal flagellomere I width; ANT-FlaII.L, antennal flagellomere II length; ANT-FlaII.W, antennal flagellomere II width; ANT-FlaIII.L, antennal flagellomere III length; ANT-FlaIII.W, antennal flagellomere III width.

The nomenclature of head features and setae follows Clay (1951), as amended by Mey (1994), with the exception of head sensilla (*s1–s4*) which follows Valim & Silveira (2014). Abdominal chaetotaxy patterns are described following those in Cicchino & Castro (1996) and Cicchino & Valim (2008). Classification, nomenclature and vernacular names of bird hosts have been taken from Checklist Committee (2010).

Systematics

PHTHIRAPTERA Haeckel, 1896

Ischnocera Kellogg, 1896

Philopteridae Burmeister, 1838

The *Brueelia*-complex

At present, the *Brueelia*-complex includes the following genera: *Brueelia* Kéler, 1936, *Bizarrifrons* Eichler, 1938, *Penenirmus* Clay & Meinertzhagen, 1938, *Pseudocophorus* Carriker, 1940, *Debeauxoecus* Conci, 1941b, *Meropsiella* Conci, 1941a, *Corvonirmus* Eichler, 1944, *Sturnidoecus* Eichler, 1944, *Picophilopterus* Ansari, 1947, *Traihoriella* Ansari, 1947, *Turdinirmus* Eichler, 1951, *Formicaphagus* Carriker, 1957, *Formicaricola* Carriker, 1957, *Hirundiniella* Carriker, 1963, *Maculinirmus* Złotorzycka, 1964, *Rostrinirmus* Złotorzycka, 1964, *Buerelius* Clay & Tandan, 1967, *Osculanirmus* Mey, 1982b, *Motmotnirmus* Mey & Barker, 2014, and *Nitzschnirmus* Mey & Barker, 2014 (see Mey & Barker 2014: 81). Clay & Tandan (1967: 34) defined the *Brueelia*-complex by giving an exhaustive list of characters, which allow placing the genera mentioned above within the complex. For brevity, we do not repeat that list of characters here.

Although Valim & Palma (2012: 29) and Mey & Barker (2014: 81) included *Furnariphilus* Price & Clayton, 1995 as a member of this complex, the shape of the ventral carina, the pterothoracic chaetotaxy, the shape of tergal plates, and the position of the male genital opening in species of this genus do not agree within the definition of the *Brueelia*-complex as given by Clay & Tandan (1967: 34). Also, we disagree with Mey & Barker (2014: 81) regarding the inclusion of *Penenirmus*, *Picophilopterus* and *Rostrinirmus* in the *Brueelia*-complex. In our opinion, these features: (1) tergites fused medially in both sexes, (2) anterior setae on tergites II, (3) male genital opening ventrally, (4) male parameres fused with basal plate, and (5) male subgenital plate with setae, exclude those three genera from the *Brueelia*-complex. Furthermore, based on DNA evidence, Johnson *et al.* (2001) clearly showed that *Penenirmus* is more closely related to the *Philopterus*- and *Rallicola*-complexes than to the *Brueelia*-complex. Also, we believe that the genus *Debeauxoecus* belongs in the *Philopterus*-complex based on morphology of the head and molecular evidence (Eichler 1963: 177; M.P. Valim unpublished data).

Conversely, other genera such as *Paragoniocotes* Cummings, 1916 and *Meropoecus* Eichler, 1940 should also be included in the *Brueelia*-complex because they possess the key characters listed by Clay & Tandan (1967: 34). Species of *Paragoniocotes* have thick setae situated postero-laterally to the subgenital plate, as in species of the *Rallicola*-complex, but in the former genus those setae are situated on the 'gonapophyses' as in species of the *Brueelia* complex, and not between the gonapophyses and the vulvar margin as in species of the *Rallicola*-complex.

***Melibrueelia* Valim & Palma new genus**

Type species: *Melibrueelia novaezealandiae* new species.

Diagnosis. The new genus is morphologically close to some species of *Brueelia* from Timaliidae, *Corvonirmus* from Corvidae, and *Turdinirmus* from Turdidae (see Table 1). However, both sexes of *Melibrueelia* can be distinguished from them by this combination of characters: (1) a well formed anterior dorsal head plate, (2) a lateral split of the marginal carina, (3) a seta accessory to the post-spiracular seta on segments III–VII, (4) tergopleurites II without anterior setae, (5) male head shape, (6) male antennae with scapus and last two distal flagellomeres enlarged, (7) female tergite XI fused with IX+X, and (8) reticulation in the subgenital plate.

Males of *Melibrueelia* have the distal antennal flagellomeres swollen and dorsally unsclerotized, but still showing a line of division, appearing as a "pseudo-fusion". Males of some species of *Corvonirmus* and *Paragoniocotes* have an enlarged scapus, but the flagellomeres are uniformly sclerotized and not enlarged. As in *Melibrueelia*, some species of *Brueelia* parasitizing the passerine families Timaliidae (e.g. *B. antennatus* Ansari, 1956b, *B. mahrastran* Ansari, 1956b, *B. longisternus* Ansari, 1956b) and Estrildidae (e.g. *B. stenozona* Kellogg & Chapman, 1902) also have sexually dimorphic antennae with an enlarged scapus in males (Ansari 1956b, 1957a), but males of *Melibrueelia* also have swollen distal antennal flagellomeres, and a tuft of less than 10 pleural distal setae on each side of segments IX+X. Furthermore, both sexes in species of *Corvonirmus* have a sub-spherical head shape with a convex preantennal margin, and accessory setae to the post-spiracular seta on tergites II–VII (Ansari 1956a, 1957a). The male genitalia of *Melibrueelia* are similar to those found in some species of *Brueelia* from Timaliidae (e.g. Ansari 1956b: figs 24–26).

Regarding females, species of *Corvonirmus* and those of the *Brueelia* "longisternus subgroup" from Timaliidae have tergites IX+X not fused with XI, unlike *Melibrueelia* which has tergites IX+X+XI fused (see Table 1). However, females of *Turdinirmus* do have tergites IX+X fused with XI, but can be separated from those of *Melibrueelia* either by their subgenital plate being nearly square distally (i.e. not forming a "cross piece") or by the presence of post-spiracular setae on segments IV–VII (see Table 1).

Females of some *Brueelia* sensu lato (e.g. *B. grandalae* (Clay, 1936), *B. antennatus* Ansari, 1956b, *B. effronte* Ansari, 1956b, *B. impressifrons* Ansari, 1956b, *B. novofacies* Ansari, 1956b) have a fused terminal tergite (IX+X+XI), but those species differ from *Melibrueelia* either by the shape of preantennal region or by not having sexually dimorphic antennae.

Females of some species of *Meropsiella* (e.g. *Meropsiella erythropteri* (Piaget, 1885) **new combination** and *M. bullockoda* (Williams, 1981) **new combination**) also have tergite XI fused with IX+X, but both sexes of *Meropsiella* are distinct from those of *Melibrueelia* in head features and by having 4 setae on sternites VI (usually only 2 setae on most genera of the *Brueelia*-complex) and no post-spiracular setae on segment III.

Females of species of *Formicaricola* and *Formicaphagus* have tergite XI fused with IX+X, but they differ from those of *Melibrueelia* by not having: (1) reticulation in the subgenital plate, (2) tergopleural setae and accessory seta to the post-spiracular seta on III, and (3) a distal "cross piece" in the subgenital plate. Males of *Formicaricola* and *Formicaphagus* lack: (1) both tergopleural setae and accessory seta to the post-spiracular seta on III, and (2) antennal swellings.

Description. Both sexes. Head: symmetric, with triangular preantennal region (Figs 1A,B–2); dorsal preantennal region with well-formed dorsal anterior plate well delineated; marginal carina interrupted in the midline with its extremes joined by a hyaline margin, but *dsms* (dorsal submarginal seta) arises from an unsclerotized area which divides the marginal carina forming a discrete lateral division, and the dorsal preantennal suture arises from this discrete division laterally from the marginal carina (Fig. 2). Ventral carina interrupted

medially and fused anteriorly on each side with marginal carina; each half of the divided carina entirely sclerotized and with a flattened portion to which the lobe of the pulvinus is attached (Fig. 2B). Pulvinus with definite lateral lobes attached to flattened parts of the ventral carinae. Ocular and preocular setae short, preocular seta set submarginally and posterior to eye lens. Anterior ventral setae (*av*s): two long (*av*s₂₋₃), one medium (*av*s₁). Postantennal region without sutures or developed temporal carina; both post-nodal seta (*pns*) and post-temporal seta (*pts*) very reduced. Head sensilla present (*s*_{1-s}₄), each bearing a very reduced seta. Marginal temporal seta 3 (*mts*₃) very long, all others (*mts*₁₋₂, *mts*₄₋₅) very short (Figs 2A,B). Occipital carina present, weakly sclerotized. Gular plate roughly pentagonal in shape and well sclerotized (Fig. 3).

Thorax: As in Fig. 1A,B. Prothorax roughly rectangular, with one pair of medium-long post-spiracular setae; pterothorax without signs of division between meso- and metathorax, and with one spine-like, one trichoid, and ca. 6 setae each side of its posterior margin. Legs without distinctive features.

Abdomen: Distinctly sexually dimorphic (Figs 1A,B, 3), but with similar chaetotaxy pattern in both sexes; pleural setae present on IV–VIII; accessory to post-spiracular seta present on III–VII; post-spiracular setae present on V–VII. Porotaxy: sensilla present on tergites II–V and sternites II–VI (laterad to pair of setae).

Male. First antennal segment (scapus) very enlarged, and last three flagellomeres swollen (Figs 1A, 2A). Ventral surface of distal three flagellomeres normally sclerotized and clearly divided, but dorsally unsclerotized from distal end of flagellomere I to flagellomere IV, and faintly divided. Abdomen ovoid (Figs 1A, 3A). Tergopleural plates roughly triangular. Anal and genital openings (and anal setae) close together on the dorsal surface. Tergal plates IX+X fused, distinct and medially divided. Tergite XI as a thin transverse band sclerotized on each side but not in the middle line (Fig. 1A). Genitalia as in Figs 1C, 6A–C.

Female. Abdomen elongated (Figs 1B, 3B) and antennae filiform (Fig. 2B). Subgenital plate reticulated medially (Figs 1B, 3B, 7B), with sclerotization on distal vulvar margin ("cross piece" of Ansari 1956b). Tergites IX–X–XI fused in a single plate (Fig. 7A).

Etymology. The name *Melibrueelia* is formed with the prefix *Meli-* (Greek) = honey, referring to the host family Meliphagidae, and the suffix *-brueelia* referring to the widespread and closely related genus *Brueelia*. Gender: feminine.

Remark. Considering that the new genus is at present monotypic, it is difficult to ascertain the boundaries of its range of morphological variation. It is expected that some the features described above for the genus may prove to be useful for species-level differentiation only.

***Melibrueelia novaeseelandiae* Valim & Palma new species**

(Figs 1–3, 6A–C, 7A,B)

Brueelia sp. nov.; Watt 1971: 235, 244.

Brueelia sp.; Pilgrim & Palma 1982: 27.

Brueelia sp.; Murray *et al.* 2001: 1263.

Brueelia sp.; Palma 2010: 408.

Type host. *Prosthemadera novaeseelandiae* (Gmelin, 1788)—tui (Meliphagidae).

Type locality. Reefton, South Island, New Zealand.

Other hosts. *Anthornis melanura melanura* (Sparrman, 1786)—bellbird; *Anthornis melanura obscura* Falla, 1948—Three Kings bellbird; *Anthornis melanura oneho* Bartle & Sagar, 1987—Poor Knights bellbird (Meliphagidae).

Diagnosis. *Melibrueelia novaeseelandiae* is morphologically close to some *Corvonirmus* species from members of the Corvidae and *Brueelia* species from members of the Timaliidae. In particular, it is close to *Corvonirmus argulus* (Burmeister, 1838), *C. leucocephalus* (Nitzsch [in Giebel], 1866), *C. quadrangularis* (Rudow, 1869) and *C. afzali* (Ansari, 1957a) from several *Corvus* species, by having the same general body chaetotaxy, swollen antennal scapus in males, and similar pattern of male genitalia (Ansari 1957a). However, they can be distinguished by the generic characters discussed above (see Table 1). Also, *M. novaeseelandiae* is close to four *Brueelia* species from Timaliidae belonging to the *pengya*-group (*sensu* Ansari 1956b: 135), here regarded as the “*longisternus*-subgroup” (i.e. *Brueelia longisternus* Ansari, 1956b, *B. sternotransversa* Ansari, 1956b, *B. sternotypicus* Ansari, 1956b, and *B. ventratum* Ansari, 1956b) by having similar: chaetotaxy in both sexes,

mesosomal sclerite in the male genitalia, width of the "cross piece" (sensu Ansari 1956b), and reticulated pattern in the female subgenital plate (see Table 1). However, both sexes of *M. novaeelandiae* can be distinguished from species of the *longisternus*-subgroup by having: a complete medial interruption of the marginal carina; a slight interruption of the lateral side of marginal carina (entire in the *longisternus*-subgroup); no pleural setae on segment III (present in the *longisternus*-subgroup); a well-developed anterior dorsal head plate (absent in the *pengyag*-group); and sternites III–VI without lateral incrasations ("well developed antero-lateral regions" of Ansari, 1956b; present in the *longisternus*-subgroup). Furthermore, males of *M. novaeelandiae* differ from those of the *longisternus*-subgroup by having the scapus and the last antennal flagellomeres distinctly swollen, while the scapus is only slightly swollen in the *longisternus*-subgroup. Also, females of *M. novaeelandiae* differ from those of the *longisternus*-subgroup by having tergal plate XI fused with IX+X (see Table 1).

Description. Male. Habitus as in Figs 1A, 3A. Body pigmentation light-brown, except for the head marginal carina and the antennal pedicel which are slightly darker (Fig. 3A). Flagellomeres colourless dorsally.

Head as in Figs 1A, 2A, 3A. Preatennal region triangular, occipital and preantennal margins almost straight, and marginal temporal margins slightly convex. Small and almost straight hyaline margin between tips of the pre-marginal carina each side (Fig. 2A); anterior dorsal head plate with posterior margin straight, lateral margins convex, deeply concave anteriorly, and completely surrounded by the dorsal preantennal suture (Fig. 2A). Preatennal margin with internal incrasation almost straight (Fig. 2A). Frontoclypeal suture indistinct, its nodal area irregular in shape and well sclerotized. Gular plate roughly pentagonal, uniformly pigmented. Temples forming an almost square angle at *mts3* level; marginal temporal carina darker pigmented and thin, with its inner margin straight and narrowing from *mts3* level to prothorax level (Fig. 2A).

Thorax: As in Figs 1A. Pterothorax with 6 marginal setae on each side (rarely 7 in one or both sides); pterothoracic apodeme well developed and with internal end narrow, reaching the lateral margins of the segment. Meso- and metasternal plates not fused, the former slightly longer than wide, and the latter square-shaped and slightly more pigmented, both plates bearing a pair of long setae each.

Abdomen: As in Fig. 1A. Tergites uniformly pigmented, except for a narrow area around spiracles (Fig. 3A). Tergal chaetotaxy: postspiracular long on V–VII; accessory setae long on III–VII; and one medium long sutural seta on II–VII. Porotaxy: present on tergites II–V and sternites II–VI. Tergite VIII: trichoid lateral setae thin and medium long, and two setae sub-equal in length to trichoid setae. Tergite IX+X medially divided, with 2 medium long and 2–3 short setae. Paratergal chaetotaxy: II–III 0; IV–V 2; VI–VIII 3. Sternal plates II–VI ribbon-shaped and well pigmented, each with one pair of long setae. Subgenital plate sub-triangular, wide anteriorly, tapering towards its distal end and uniformly pigmented (Figs 1A, 3A).

Genitalia: As in Figs 1C, 6A–C. Basal plate wide, with thickened and sub-parallel lateral margins; base of parameres curved and forming a well-defined head, then slightly curved and tapering distally, each bearing one subapical small seta and one sensillum at the tip; mesosomal complex reaches distally the mid-length of the parameres, with small dorsal reticulations, bearing 2 pairs of sensilla each side and a gonopore in the centre, which joins the endomeres through a long sclerotized tube (Fig. 1C).

Female. Habitus as in Figs 1B, 3B. Pigmentation darker than male, especially the tergopleural plates. Abdomen much longer than in male and with almost parallel sides; terminalia and tergal chaetotaxy distinct. Pterothorax with 5 marginal setae on each side (rarely 6, less often 4 in one side). Tergites II–VIII divided medially, with internal end of each half plate almost square; tergites IX–X–XI fused and uniformly pigmented (Fig. 7A). Tergal chaetotaxy: postspiracular long on V–VII, and one medium long sutural seta on II–VII. Porotaxy: present on tergites II–V and sternites II–VII. Tergite VIII: each side with one thin trichoid lateral seta, one postero-medial seta and one sutural seta. Paratergal chaetotaxy: II–III 0; IV–V 2; VI–VIII 3. Sternal plates rectangular and well pigmented, with same chaetotaxy as in males (Figs 1B, 3B).

Subgenital plate with strong reticulations medially, a wide vulvar margin with small medio-posterior notch, and 3–6 small setae on each side (Fig. 7B). Gonapophysis with 6–10 medium long setae (Fig. 1B). Vulva with 14–22 short spiniform setae and 8–12 long thin setae on its distal margin (Figs 1B, 7B).

Measurements as in Table 2.

Etymology. The species epithet *novaelandiae* (Latin) = New Zealand, refers to both the name of the country of origin and the species name of the type host of this louse.

TABLE 2. Morphometric data from the two host populations of *Melibruelia novaeseelandiae*
Abbreviations for characters measured are explained in Materials and methods

Characters	Host: Prosthemadera novaeseelandiae				Host: Anthornis melanura			
	$\delta\delta$ n = 30		$\varphi\varphi$ n = 42		$\delta\delta$ n = 10		$\varphi\varphi$ n = 15	
	Range	Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD	Range	Mean \pm SD
HL	0.33–0.37	0.34 \pm 0.010	0.38–0.45	0.41 \pm 0.014	0.32–0.36	0.33 \pm 0.009	0.37–0.40	0.39 \pm 0.010
POW	0.27–0.35	0.30 \pm 0.017	0.31–0.35	0.33 \pm 0.010	0.26–0.28	0.27 \pm 0.008	0.27–0.31	0.30 \pm 0.011
TW	0.36–0.41	0.38 \pm 0.012	0.40–0.46	0.42 \pm 0.012	0.34–0.36	0.35 \pm 0.006	0.36–0.40	0.39 \pm 0.010
ADHPL	0.06–0.07	0.06 \pm 0.002	0.06–0.10	0.08 \pm 0.006	0.06–0.07	0.06 \pm 0.004	0.07–0.08	0.08 \pm 0.003
ADHPW	0.08–0.09	0.09 \pm 0.004	0.09–0.11	0.10 \pm 0.005	0.07–0.08	0.08 \pm 0.002	0.08–0.10	0.09 \pm 0.005
PW	0.20–0.24	0.22 \pm 0.011	0.23–0.27	0.24 \pm 0.010	0.20–0.23	0.21 \pm 0.009	0.21–0.24	0.22 \pm 0.007
PTW	0.34–0.41	0.37 \pm 0.016	0.36–0.43	0.39 \pm 0.015	0.32–0.35	0.34 \pm 0.008	0.34–0.37	0.35 \pm 0.011
AW-v	0.45–0.55	0.49 \pm 0.020	0.44–0.57	0.52 \pm 0.029	0.44–0.48	0.46 \pm 0.012	0.44–0.52	0.47 \pm 0.023
GL	0.24–0.29	0.26 \pm 0.013	–	–	0.25–0.27	0.26 \pm 0.006	–	–
PrL	0.07–0.09	0.08 \pm 0.006	–	–	0.07–0.08	0.08 \pm 0.002	–	–
TL	1.10–1.35	1.20 \pm 0.048	1.54–2.02	1.74 \pm 0.089	1.07–1.23	1.14 \pm 0.048	1.52–1.78	1.66 \pm 0.067
ANT-Sca.L	0.08–0.09	0.08 \pm 0.004	0.04–0.05	0.04 \pm 0.003	0.06–0.09	0.08 \pm 0.006	0.04–0.05	0.04 \pm 0.003
ANT-Sca.W	0.05–0.06	0.05 \pm 0.003	0.03–0.04	0.03 \pm 0.002	0.05–0.06	0.05 \pm 0.003	0.03–0.04	0.03 \pm 0.003
ANT-Ped.L	0.04–0.06	0.05 \pm 0.003	0.04–0.05	0.04 \pm 0.003	0.04–0.05	0.05 \pm 0.004	0.04–0.05	0.04 \pm 0.003
ANT-Ped.W	0.03–0.04	0.03 \pm 0.002	0.02–0.04	0.03 \pm 0.003	0.03–0.04	0.03 \pm 0.002	0.02–0.03	0.02 \pm 0.002
ANT-FlaLL	0.03–0.05	0.04 \pm 0.003	0.02–0.03	0.03 \pm 0.002	0.03–0.04	0.04 \pm 0.004	0.02–0.03	0.02 \pm 0.002
ANT-FlaIW	0.03–0.04	0.03 \pm 0.002	0.02–0.03	0.02 \pm 0.002	0.03–0.04	0.03 \pm 0.002	0.02–0.03	0.02 \pm 0.002
ANT-FlaIL	0.03–0.04	0.04 \pm 0.004	0.02–0.03	0.03 \pm 0.002	0.03–0.04	0.03 \pm 0.004	0.02–0.03	0.02 \pm 0.002
ANT-FlaHW	0.04–0.04	0.04 \pm 0.002	0.02–0.03	0.03 \pm 0.002	0.03–0.04	0.04 \pm 0.004	0.02–0.03	0.02 \pm 0.002
ANT-FlaHL	0.02–0.04	0.03 \pm 0.006	0.03–0.05	0.04 \pm 0.004	0.02–0.05	0.03 \pm 0.007	0.03–0.04	0.04 \pm 0.003
ANT-FlaHW	0.03–0.04	0.04 \pm 0.002	0.02–0.03	0.03 \pm 0.002	0.03–0.04	0.04 \pm 0.002	0.02–0.03	0.02 \pm 0.001

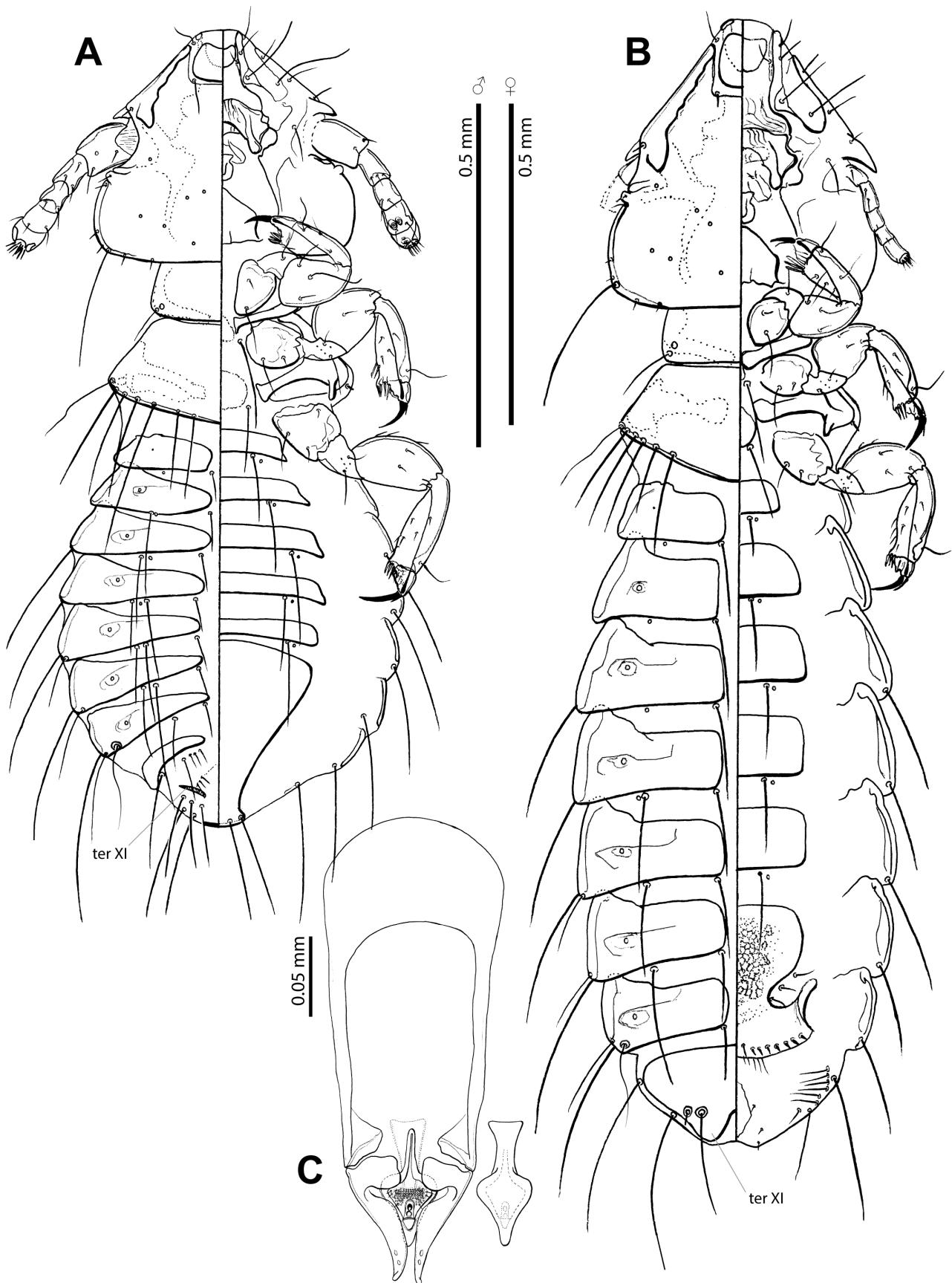


FIGURE 1. *Melibrueliea novaeelandiae*: (A) male habitus in dorso/ventral views; (B) female habitus in dorso/ventral views; (C) male genitalia. Abbreviation: ter XI = Tergite XI.

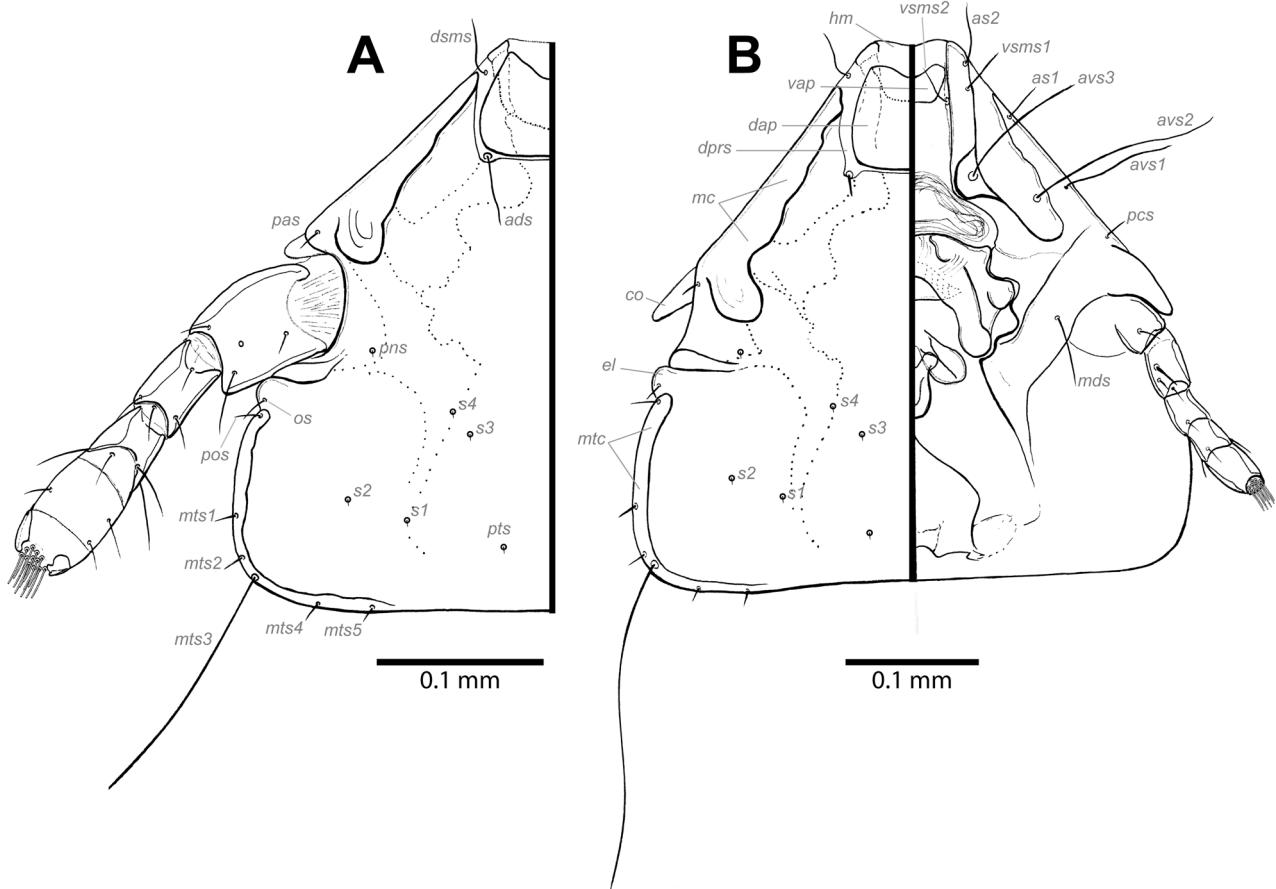


FIGURE 2. *Melibrueliea novaeelandiae*: (A) male head in dorsal view; (B) female head in dorso/ventral views. Abbreviations: *as*, anterior seta; *ads*, anterior dorsal seta; *avs*, anterior ventral seta; *co*, conus; *dap*, dorsal anterior plate; *dprs*, dorsal preantennal suture; *dsms*, dorsal submarginal seta; *el*, eye lens; *hm*, hyaline margin; *mc*, marginal carina; *mds*, mandibular seta; *mtc*, marginal temporal carina; *mts*, marginal temporal seta; *os*, ocular seta; *pas*, preantennal seta; *pcs*, preconal seta; *pns*, postnodal seta; *pos*, preocular seta; *pts*, posttemporal seta; *s*, sensilla; *vap*, ventral anterior plate; *vsms*, ventral submarginal seta.

Type material. Ex *Prosthemadera novaeelandiae novaeelandiae*: Holotype ♂, Rahu Saddle Reefton, Buller, N.Z., 21 Nov. 1977, P. Grant (MONZ AI.032893). Paratypes: 8♂, 15♀, same data as for the holotype (MONZ AI.015776); 2♂, 2♀, same data as for the holotype (MZUSP #5984–#5985).

Additional material examined (non-types). Ex *Prosthemadera novaeelandiae novaeelandiae*: 1♀, Mahinapua, Westland, South Island, N.Z., 1 Jan. 1965, J.R. Jackson (MONZ AI.015766); 1♂, Low flat, Raoul Island, Kermadec Is, N.Z., 24 Dec. 1966, D.S.I.R., D22333 (NZAC); 3♀, Raoul Island, Kermadec Is, N.Z., 25 Dec. 1966, D.S.I.R (NZAC); 1♂, 4♀, Otira, N.Z., 29 Sep. 1970, R.L. Pilgrim (MONZ AI.015770); 1♂, 1♀, Otira, N.Z., 29 Nov. 1970, J.R. Jackson (MONZ AI.015769); 7♀, Rotorua, N.Z., 14 Aug. 1972, P.A. Oppenheim (MONZ AI.020612); 3♂, 3♀, Ranui Cove, Auckland Island, N.Z., 5 Feb. 1973, D.S. Horning (MONZ AI.015771); 1♂, 2♀ Raoul Island, Kermadec Is, N.Z., 23 May 1973, J. Ireland (NZAC); 3♂, 3♀, Orongorongo Valley, N.Z., 18 Feb. 1976, B.M. Fitzgerald, A.I-2030 (MONZ AI.015773); 33♂, 31♀, Lower Hutt, Wellington, N.Z., 10 Jul. 1977, M. Bar-Brown (MONZ AI.015774); 1♀, Western Springs, Auckland, N.Z., 23 Oct. 1977, A. Nordhof (NZAC); 1♂, 5♀, Little Barrier Island, CL, N.Z., 1 Feb. 1979, C.R. Veitch (MONZ AI.015777); 1♂, 5♀, Karamea, Westland, N.Z., no date, T.P. Fisher (MONZ AI.015778).

Ex *Anthornis melanura melanura*: 3♂, 4♀, Turiwhati, Westland, N.Z., 13 Oct. 1970, J.R. Jackson (MONZ AI.015779); 2♀, 1N, Ranui Cove, Auckland Island, N.Z., 30 Jan. 1973, D.S. Horning (MONZ AI.015781); 1♂, 1♀, Whataroa River, West Coast, N.Z., 14 Jan. 1975, D.J. Greenwood (MONZ AI.015782); 1♂, 4♀, Orongorongo Valley, N.Z., 18 May 1976, B.M. Fitzgerald, A.3.1020 (MONZ AI.015783); 3♂, 9♀, Auckland Islands, N.Z., no date, E. Jennings, Otago Museum A.03.118 (MONZ AI.015788).

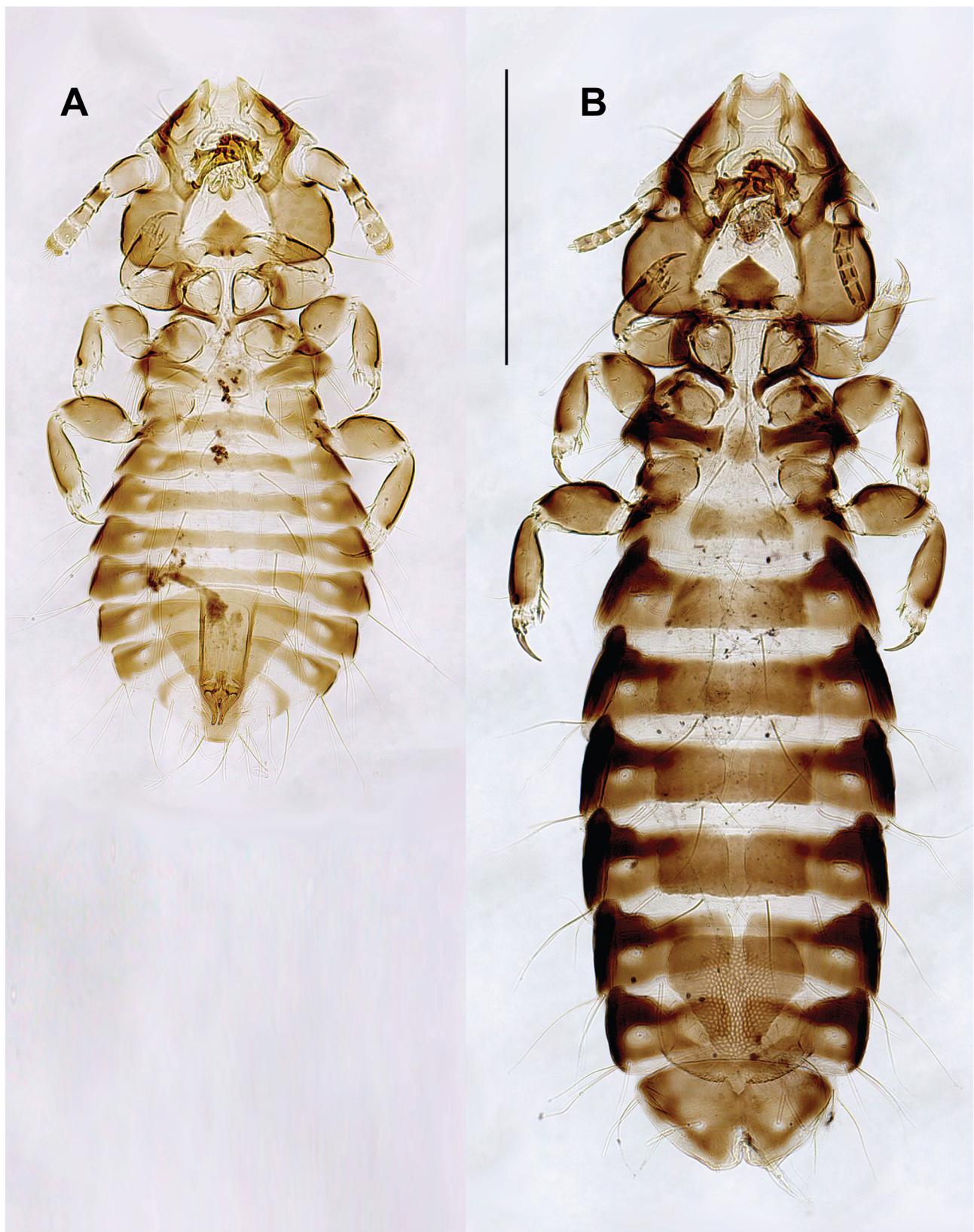


FIGURE 3. *Melibrueelia novaeelandiae*: (A) male habitus in ventral view; (B) female habitus in ventral view. Scale bar = 0.5 mm

Ex *Anthornis melanura obscura*: 10♂, 6♀, Great Island, Three Kings Islands, N.Z., 1 Nov. 1970, J.C. Watt, D.S.I.R. (NZAC; MONZ AI. 015790).

Ex *Anthornis melanura oneho*: 5♂, 6♀, Aorangi Island, Poor Knights Islands, N.Z., Mar. 1980, J.A. Bartle

(MONZ AI.015784); 1♀, Tawhiti Rahi, Poor Knights Islands, N.Z., 5 Dec. 1980, R.H. Kleinpaste (MONZ AI.015785); 1♀, same locality, 6 Dec. 1980, R.H. Kleinpaste (MONZ AI.015786); 1♂, same locality, 10 Dec. 1980, R.H. Kleinpaste (MONZ AI.015787).

Remarks. No significant qualitative differences were found among all the populations of *Melibrueelia novaeelandiae* (80♂, 117♀) examined from the two species (four subspecies) of regular hosts listed above. A comparison of measurements between the populations from the two host genera shows that there is a complete overlap of the ranges (Table 2). Although mean values of lice collected from *Anthornis melanura* are somewhat smaller than those from the type host (Table 2), we do not regard those differences as significant to justify the division of *Melibrueelia novaeelandiae* into two taxa; instead, they could represent another example of Harrison's Rule (Johnson *et al.* 2005), considering that *P. novaeelandiae* is larger and heavier (length 27–32 cm; weight 85 to 120 g) than *A. melanura* (length 17–20 cm; weight 25 to 32.5 g) (Marks 2001: 1173, 1191).

The family Meliphagidae comprises 175–180 species distributed over Australasia, Indonesia and other Pacific Islands (Joseph *et al.* 2014). Several records of “*Brueelia* sp.” have been published from Australian meliphagid hosts (Murray *et al.* 2001: 1262) but, to the best of our knowledge, none has been described and named yet. Hence, a comparison of *Melibrueelia novaeelandiae* with species which are likely to be the closest relatives is not possible at present.

We can only compare *Melibrueelia novaeelandiae* with described species which share morphological similarities with it, but those similarities are more likely to be the result of convergent evolution than an indication of a close phylogenetic relationship. For example, the chaetotaxy and general morphology of *M. novaeelandiae* is similar to those of some species of *Brueelia* parasitic on Corvidae and Timaliidae (Table 1) (Ansari 1956a,b, 1957). Also, the genitalia show a similar pattern to those of some species from Timaliidae (see genus diagnosis above). However, Gardner *et al.* (2010: 1093) concluded that four other avian families—not Corvidae or Timaliidae—were the closest relations to the Meliphagidae, placing them all in the superfamily Meliphagoidea. Considering that there are no *Brueelia* species known from those four families (Acanthizidae, Dasyornithidae, Maluridae and Pardalotidae; see Price *et al.* 2003, Mey & Barker 2014), again, it is not possible to even speculate about which louse could be the closest relative of *M. novaeelandiae*. Future genetic studies of *M. novaeelandiae* and its similar species from Corvidae and Timaliidae, in addition to samples of “*Brueelia*” from members of Meliphagoidea, may reveal their true relationships.

Although there is no molecular data of the louse populations living on *Anthornis* and *Prosthemadera* to assess their age and relationship, the New Zealand meliphagid lineage appears to have diverged from the Australian sister taxon (genus *Pycnopygius* Salvadori, 1880) about 12 million years ago (Joseph *et al.* 2014: fig. 1). Judging from the position of the node where the New Zealand genera diverged from each other and the length of the branches, *Anthornis* and *Prosthemadera* would at least be about 6 million years old (Joseph *et al.* 2014: fig. 1). Therefore, some morphological variation between the two *Melibrueelia* populations would have been expected if they had remained completely isolated from each other. However, the lack of such morphological variation would imply that there has been continuous gene flow between the *Melibrueelia* lice living on tuis and bellbirds, preventing their speciation. Such gene flow may have been facilitated by dispersal of lice by parasitic louse-flies which move from one host to another (phoresy) regardless of the host relationships, as Johnson *et al.* (2002: 245) have shown for lice of the genus *Brueelia*.

***Brueelia* Kéler, 1936**

Brüelia Kéler, 1936: 257. Type species: *Brüelia rossitensis* Kéler, 1936 = *Brueelia brachythorax* (Giebel, 1874) (by original designation).

***Brueelia callaeincola* Valim & Palma new species**

(Figs 4, 5, 6D, 7C,D)

Brueelia sp.; Pilgrim & Palma, 1982: 28.

Brueelia sp.; Murray *et al.* 2006: 1958.

Brueelia sp.; Palma 2010: 408.

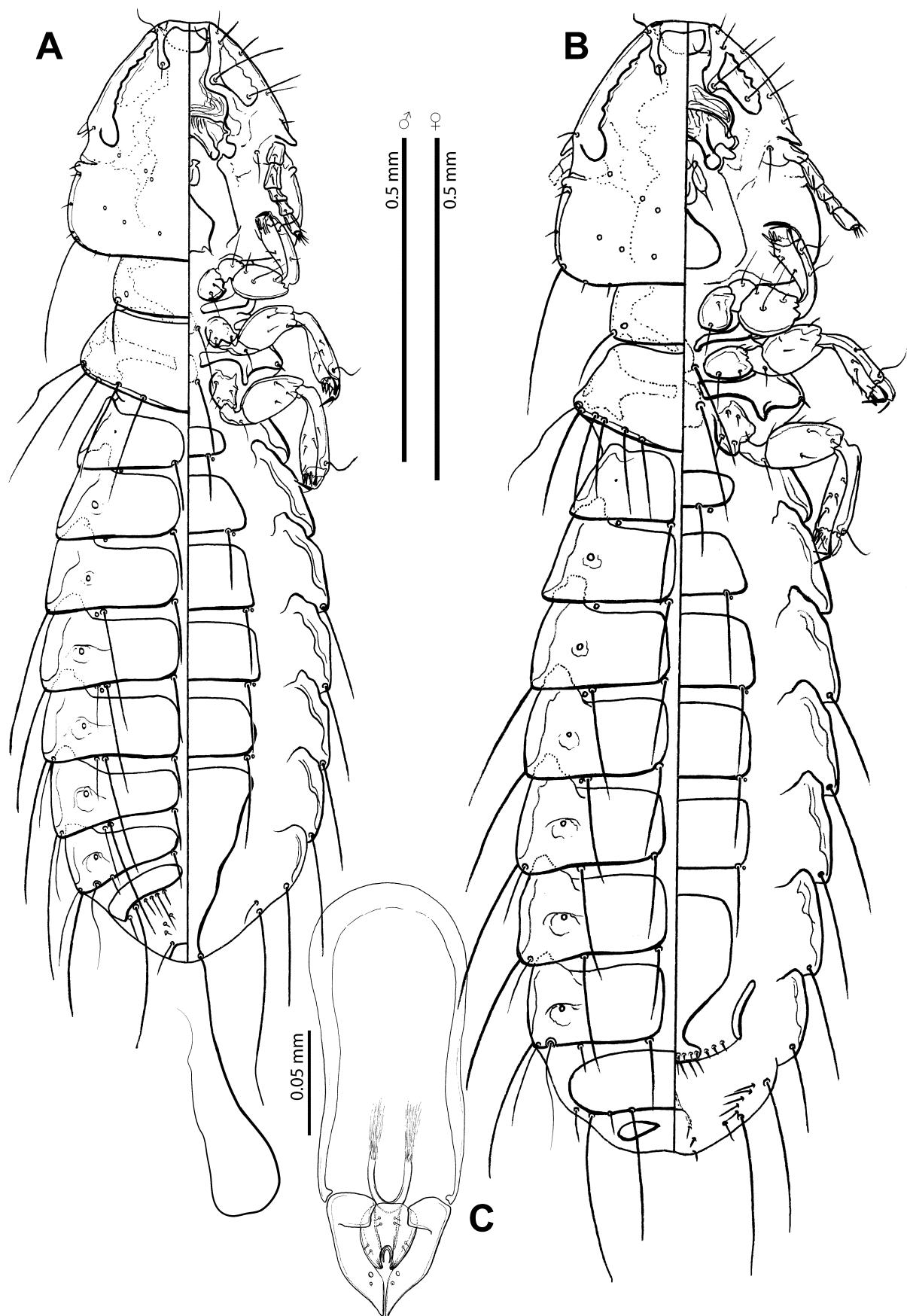


FIGURE 4. *Brueelia callaeincola*: (A) male habitus in dorso/ventral views; (B) female habitus in dorso/ventral views; (C) male genitalia.

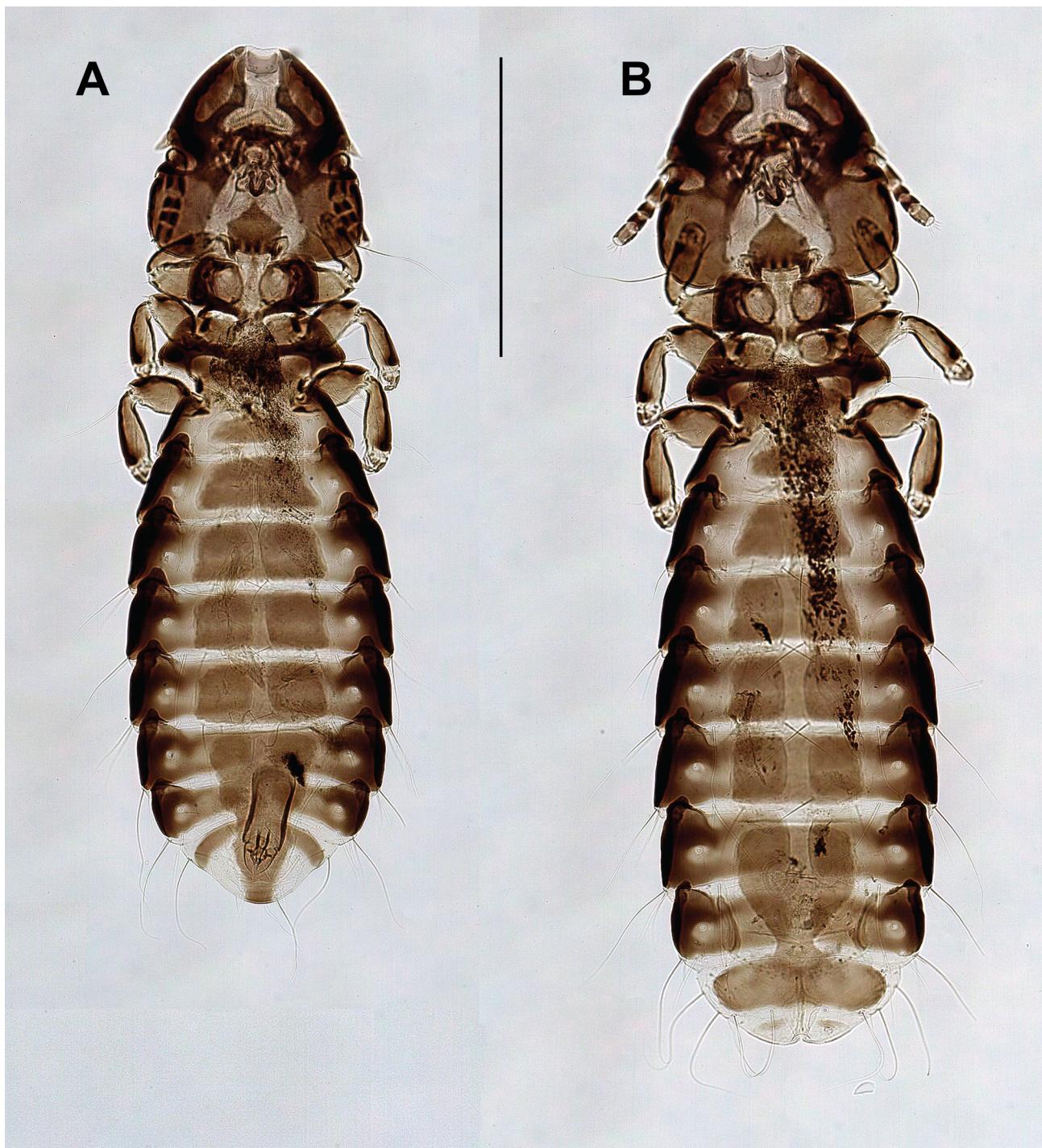


FIGURE 5. *Brueelia callaeincola*: (A) male habitus in ventral view; (B) female habitus in ventral view. Scale bar = 0.5 mm

Type host. *Philesturnus rufusater* (Lesson, 1828)—North Island saddleback (Callaeidae).

Type locality. Taranga Island (= Hen Island), North Island, New Zealand.

Other hosts. *Philesturnus carunculatus* (Gmelin, 1789)—South Island saddleback; *Callaeas cinerea* (Gmelin, 1788)—South Island kokako; *Callaeas wilsoni* (Bonaparte, 1851)—North Island kokako (Callaeidae).

Diagnosis. *Brueelia callaeincola* exhibits similarities with a number of species infesting thrushes (Turdidae): *Brueelia turdinulae* Ansari, 1956c, *B. antiqua* Ansari, 1956c, *B. zeropunctata* Ansari, 1957b, *B. myiophoneae* (Clay, 1936), and *B. oudhensis* Ansari, 1956c. These species share several characteristics with *Brueelia callaeincola* including the same pattern of abdominal chaetotaxy, similar male genitalia and, especially, the female subgenital plate with the posterior sclerotization of the vulvar margin not reaching the lateral sides of the vulva.

However, differences in the shape of the preantennal region, the male genitalia, and especially the shape of the dorsal anterior plate, separate *B. callaeincola* from the Turdidae-infesting species mentioned above.

Considering the morphological similarity of *B. callaeincola* with species of *Brueelia* from Turdidae species, we need to compare it against two similar species of *Brueelia* introduced to New Zealand by human agency with the introduction of the hosts *Turdus merula* and *Turdus philomelos* in the 1860's (Checklist Committee 2010: 313), i.e. *B. turdinulae* and *B. amsel* (Eichler, 1951) (see Palma 1999: 382). *Brueelia callaeincola* clearly differs from *B. amsel* in features of the head (size, shape of the preantennal region and of the dorsal anterior plate) and of the genitalia, which have a very different mesosomal complex and shape of parameres. Although *B. callaeincola* is very similar to *B. turdinulae*, it differs from it in details of the mesosomal complex and the shape of the preantennal region of the head.

Description. Male. Habitus as in Figs 4A, 5A. Body with contrasting pigmentation: lateral sides of head, thorax and abdomen dark brown, medial areas much lighter.

Head: As in Figs 4A, 5A. Preantennal region nearly rounded. Small hyaline margin distinguishable; anterior dorsal head plate not completely surrounded by the dorsal preantennal suture. Marginal carina thickened with its inner margin weakly sinuate, and completely pigmented. Lateral interruption of marginal carina incomplete, conspicuous only in dorsal view. Frontoclypeal suture with its nodal area well defined and reaching the middle of antennal fossa. Attachments of mandibular adductor muscles marked. Gular plate well pigmented and pentagonal shaped. Temples forming a rounded angle at marginal temporal setae 3 (*mts3*) level; temporal carina thin and slightly sinuate, reaching at most the *mts3*; eye only slightly embedded in marginal temporal carina. Conus reaching at most the posterior end of scapus. Setae *pns* and *pts* very reduced, with 4 sensilla (*s1–s4*) located between them.

Thorax: As in Figs 4A, 5A. Pterothorax with 4–6 marginal setae on each side (spiniform and trichoid setae not included); pterothoracic apodeme well developed, reaching the lateral margin of pterothorax. Mesosternal and metasternal plates partially fused and weakly sclerotized, both slightly longer than wide, both plates bearing two long setae each.

Abdomen: As in Figs 4A, 5a. Segments II–VIII pigmented as in Fig. 5A. Tergal chaetotaxy: postspiracular setae long on IV–VII; one small accessory seta on V–VII (atypical specimens with only one seta in one side), and one sutural seta on II–VII. Tergite VIII with its lateral trichoid seta, plus one postero-medial and one sutural setae. Tergite IX+X not medially connected, and chaetotaxy (from lateral side to mid-line) with 1 short, 1 long, 1–2 short, 1 long, and 1 short setae. Paratergal chaetotaxy: II–III 0; IV–V 2; VI–VIII 3. Sternal plates II–VI uniformly pigmented, typically with one pair of setae on each, subgenital plate also uniformly pigmented. Porotaxy: present on tergites II–V and sternites II–VI (laterad to pair of setae). Sternal pores (= sensilla placodea) are difficult to see, except for those on sternite II (Fig. 4A,B), but they are present at least on one side of each segment.

Genitalia: As in Figs 4C, 6D. Basal plate wide, with slightly concave lateral margins; parameres wide, tapering abruptly to fine-pointed tips; lateral sclerites of mesosomal complex short (1/3 of paramere length) and subconical with smooth lateral sides, bearing three sensilla on each lateral margin, one postero-dorsally (laterad to gonopore), and two antero-dorsally. The gonopore arises from an ejaculatory duct well supported by tendons of the extrusor muscle, forming a long U-shaped structure above the pore (Fig. 4C).

Measurements, ex Philesturnus rufusater (n = 7): HL, 0.35–0.37; POW, 0.28–0.30; TW, 0.34–0.36; ADHPW, 0.07–0.08; PW, 0.20–0.22; PTW, 0.30–0.33; AW 0.41–0.43; GL, 0.17–0.19; PrT, 0.04–0.06; and TL, 1.32–1.45.

Measurements, ex Callaeas cinerea (n = 1): HL, 0.40; POW, 0.36; TW, 0.41; ADHPW, 0.09; PW, 0.26; PTW, 0.37; AW 0.53; and TL, 1.61.

Female. Habitus as in Figs 4B, 5B. Pigmentation of head, thorax and abdomen as in Fig. 5B, differing from male in body size, terminalia and tergal chaetotaxy (one long postspiracular seta on IV–VII, plus one sutural seta on II–VIII). Pterothorax with 5–6 marginal setae on each side. Tergites II–VIII divided medially; tergite VIII as in male; IX–X entire and uniformly pigmented (Fig. 7C), with 1 long, 1 short, and 1 long setae each side (Fig. 4B, 7C). Paratergal chaetotaxy as for males, except one abnormal specimen with 1 seta on I–II in both sides. Subgenital plate uniformly pigmented, but distal sclerotization (= "cross piece") does not reach the lateral sides of the vulvar margin (Fig. 7D), without postero-medial notch, with 3–5 (rarely 2 in one side) small setae each side (Figs 4B, 7D). Gonapophyses with 6–9 (rarely 3–4 on one side) short setae on each side (Fig. 4B). Vulva with 12–16 (very few with 3 or 5 on one side) short and spiniform setae, 4–8 long and thin setae, and 1 pair of medium-long setae situated medially and proximally to spiniform row of setae (Fig. 4B).

Measurements, ex *Philesturnus rufusater* (n = 10): HL, 0.38–0.41 (0.40±0.012); POW, 0.31–0.35 (0.33±0.011); TW, 0.36–0.40 (0.39±0.014); ADHPW, 0.07–0.09 (0.08±0.006); PW, 0.22–0.25 (0.24±0.010); PTW, 0.32–0.36 (0.34±0.012); AW 0.44–0.53 (0.48±0.027); and TL, 1.57–1.83 (1.67±0.080).

Measurements, ex *Callaeas wilsoni* (n = 1): HL, 0.40; POW, 0.35; TW, 0.39; ADHPW, 0.06; PW, 0.24; PTW, 0.35; AW 0.52; GL, 0.24; PrT, 0.06; and TL, 1.49.

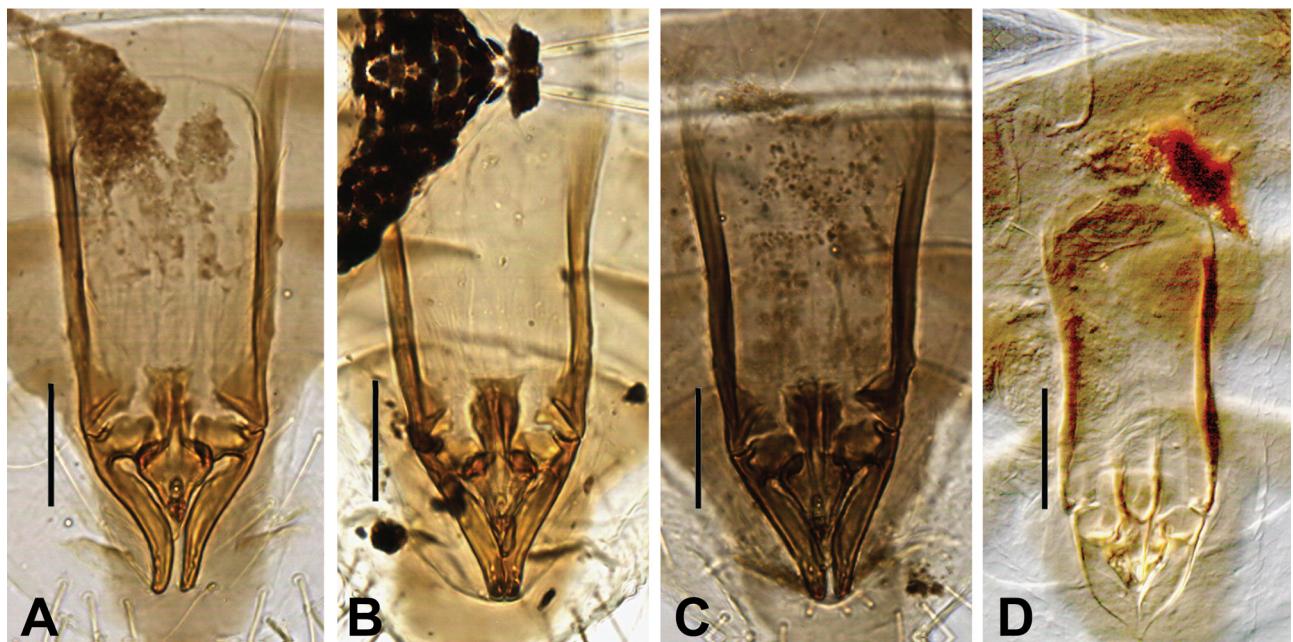


FIGURE 6. Male genitalia. *Melibrueliea novaezealandiae*: (A) holotype; (B, C) two paratypes. *Brueelia callaeincola*: (D) holotype. Scale bars = 0.05 mm.

Etymology. The species name *callaeincola* is formed by the prefix *callae-* referring to Callaeidae, the family name that the hosts belong to, and the suffix *-incola* (Latin) = an inhabitant.

Type material. Ex *Philesturnus rufusater*: Holotype ♂, Taranga Island, N.Z., Sep. 1903, A.T. Pycroft (MONZ AI.032894). Paratypes: 4♂, 11♀, same data as for the holotype (MONZ AI.015796); 1♂, 3♀, same data as for the holotype (MZUSP #5986–#5987).

Additional material examined (non-types). Ex *Philesturnus rufusater*: 2♀, Cuvier Island, N.Z., 15 Jan. 1977, C.R. Veitch (MONZ AI.015797); 1♀, same data, 17 Jan. 1977, C.R. Veitch (MONZ AI.018054); 1♂, 2♀, Tiritiri Matangi Island, AK, N.Z., 9 Sep. 1989 (MONZ AI.015798); 2♀, Little Barrier Island, N.Z., 21 May 1990, A.J.D. Tennyson (MONZ AI.015799).

Ex *Philesturnus carunculatus*: 4♂, 4♀, South Island, N.Z., 1892, Buller Collection, Canterbury Museum Skin (MONZ AI.015800).

Ex *Callaeas cinerea*: 1♂, Preservation Inlet, Fiordland, N.Z., 30 Jun. 1902, Smyth Collection, Canterbury Museum Skin 1118 (MONZ AI.015791).

Ex *Callaeas wilsoni*: 1♀, North Island, N.Z., no date, N.M. 17651 (MONZ AI.015792).

Remarks. No significant qualitative differences were found among the populations of *Brueelia callaeincola* (totals of slide-mounted specimens: 12♂, 26♀) from the four species of regular hosts listed above. Considering that we only have a single male and a single female from *Callaeas*, no conclusion can be drawn from a comparison of their dimensions with those from *Philesturnus* lice. At present, we are confident that all the material examined belongs to the same species.

The New Zealand endemic Callaeidae is a strong monophyletic family with no clear close relatives, comprising three genera and five species (Shepherd & Lambert 2007). One species, the huia (*Heteralocha acutirostris* (Gould, 1837)) is extinct and with no *Brueelia* lice recorded from it (Pilgrim & Palma 1982: 28). Considering the uniqueness of this family of birds, it is both surprising and puzzling to find that *Brueelia callaeincola* bears so much resemblance to species parasitic on thrushes (Turdidae). If these two families of birds have diverged so long ago, as the ornithological evidence indicates (Shepherd & Lambert 2007), this is a case of either a remarkable morphological convergence among their *Brueelia* lice, or a relatively recent host switch of lice

from a turdid to the Callaeidae or their ancestor. Although there is no evidence of any native turdid species having lived in New Zealand, the island thrush (*Turdus poliocephalus* Latham, 1802) is widespread on islands of the tropical Pacific Ocean, including Norfolk Island in the New Zealand Subregion (Checklist Committee 2010: 313). Perhaps *Turdus poliocephalus* or its ancestor may have coexisted with the Callaeidae or their ancestor, thus allowing for a transfer of *Brueelia* from a species of Turdidae onto one of Callaeidae.

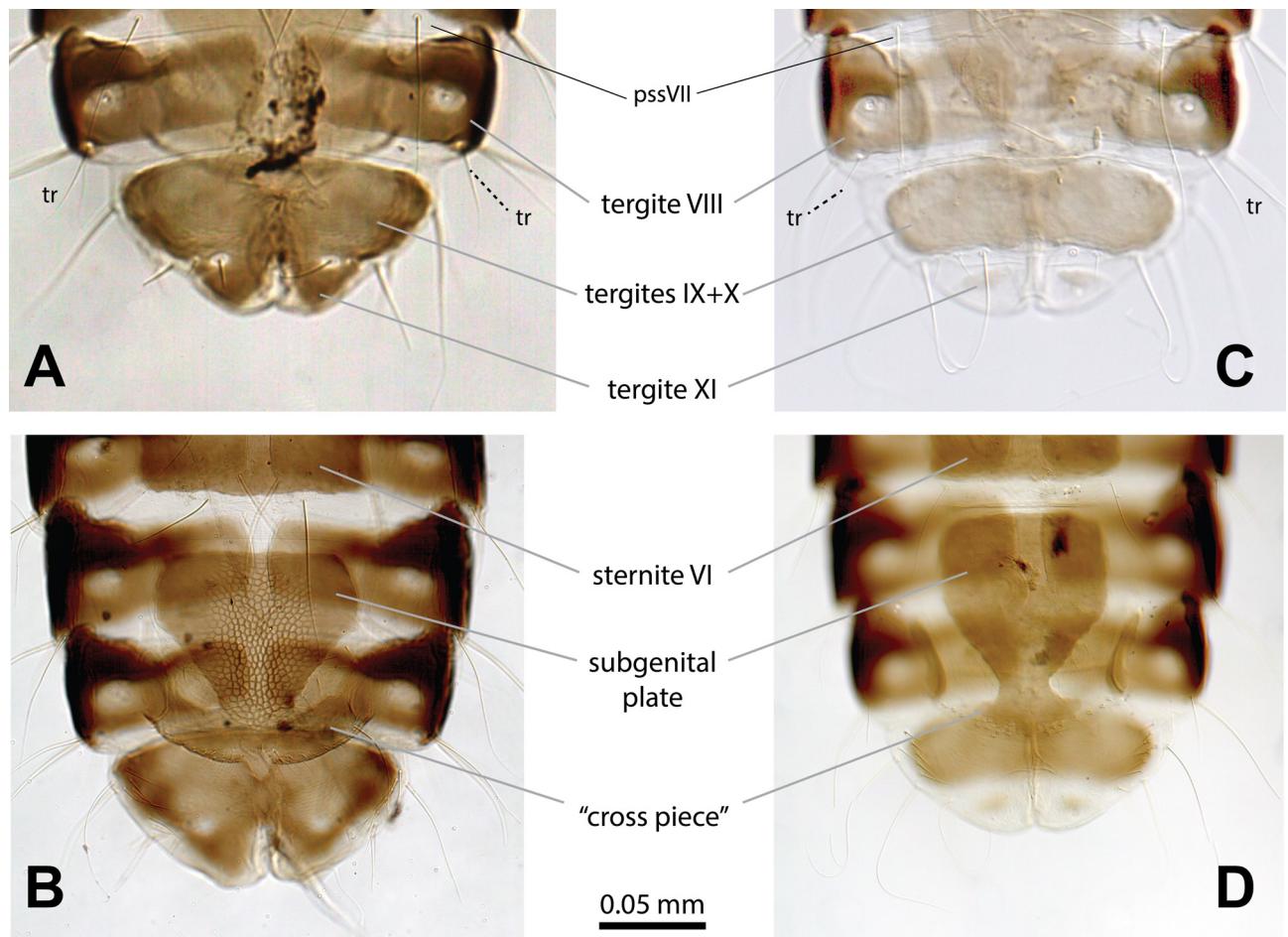


FIGURE 7. Female terminalia. *Melibrueelia novaeseelandiae*: (A) dorsal view; (B) ventral view. *Brueelia callaeincola*: (C) dorsal view; (D) ventral view. Abbreviations: pssVII, postspiracular seta of tergite VII; tr, trichoid seta of the tergite VIII.

The probability that *Brueelia callaeincola* might be the result of a host switch from any of the two species of *Turdus* introduced to New Zealand by humans in the 1860's, i.e. *T. merula* and *T. philomelos* (Checklist Committee 2010: 313) is extremely low. The widespread geographical and host distribution of *B. callaeincola*, the short time elapsed between the introduction of *T. merula* and *T. philomelos* and the earliest collection date of *B. callaeincola* (see above), and the differences, admittedly subtle, between *B. callaeincola* and *B. turdinulae*, exclude that scenario.

The absence of morphological differentiation between *Brueelia* populations from two apparently very different host genera—*Callaeas* and *Philesturnus*—is also surprising given the considerable genetic divergence between these two avian taxa (10% and 13% divergence for the cytochrome b and cytochrome c oxidase subunit I [COI], respectively; L.D. Shepherd pers. comm. June 2014). It seems most likely that the lack of differentiation between the *Brueelia* populations living on kokakos and saddlebacks results from continuous gene flow. Several species of *Brueelia* have been frequently recorded as dispersing by means of parasitic louse-flies which move from one host to another (phoresy) regardless of the host relationships (Johnson *et al.* 2002: 245). Indeed, we have examined two females and one male *Brueelia callaeincola* attached to the abdomen of a louse-fly (Diptera: Hippoboscidae: *Ornithoica* sp.) collected from a live North Island saddleback (*Philesturnus rufusater*) on Tiritiri Matangi Island, Hauraki Gulf, N.Z., in June 2003 by K. Hale (AI.032857, MONZ). This is tangible evidence that this louse species does disperse by phoresy.

The lack of speciation between the *Brueelia* populations from *Callaeas* and *Philesturnus* is analogous to that between the *Melibrueelia* populations from *Prosthemadera* and *Anthornis*, as discussed above in this paper. As mentioned above under *Melibrueelia novaeseelandiae*, genetic studies of *Brueelia callaeincola* and similar species from Turdidae as well as other *Brueelia* from families believed to be close to the Callaeidae, may reveal the true relationships of these lice.

Acknowledgements

We are indebted to Trevor Worthy (Flinders University, Adelaide, Australia), Lara Shepherd (MONZ) and Alan J.D. Tennyson (MONZ) for their assistance and fruitful discussions regarding the phylogeny of the Meliphagidae and the Callaeidae. We thank Daniel R. Gustafsson (Department of Biology, University of Utah, Salt Lake City, U.S.A.) and an anonymous referee for their reviews of our manuscript and their useful comments to improve it. This study was partially supported by FAPESP—São Paulo Research Foundation (MPV: 2011/11420-5 and 2012/06951-4).

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