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Two new species of *Philopteroides* (Phthiraptera: Ischnocera: Philopteridae) of the *beckeri* species-group, from New Guinean painted berrypeckers (Aves: Passeriformes: Paramythiidae)

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Abstract

Two new species of the louse genus *Philopteroides* Mey, 2004 are described and illustrated from two host species of painted berrypeckers, endemic to New Guinea: *Philopteroides sinancorellus* **n. sp.** *ex Oreocharis arfaki* (Meyer, 1875) (tit berrypecker), and *Philopteroides gigas* **n. sp.** *ex Paramythia montium* De Vis, 1892 (crested berrypecker). Both louse species belong to the *beckeri* species-group based on their short, broad preantennal areas, and shallow median indentations of the hyaline margin. The description of these two new species brings the total number of *Philopteroides* species to 15. An amended key to the *beckeri* species-group is included.

Key words: Phthiraptera, Ischnocera, Philopteridae, *Philopteroides*, *beckeri* species-group, lice, new species, Passeriformes, Paramythiidae, berrypeckers, New Guinea

Introduction

Currently, the genus *Philopteroides* Mey, 2004 includes 13 species divided into two species-groups which differ in the dimensions of the preantennal area and depth of the median indentation of the hyaline margin (Valim & Palma 2013: 73). Only two species are placed in the *beckeri* species-group, ten species are placed in the *mitsusui* species-group, and one (*Philopteroides lineatus* (Giebel, 1874)) is of uncertain status due to unavailability of type specimens or material from the type host (Valim & Palma 2013: 74).

Philopteroides was not previously known from the bird family Paramythiidae or from New Guinea. Until now, species of this genus were known from nine families of birds distributed over seven countries in Africa, Asia, Micronesia and Australasia, as follows: *Philopteroides beckeri* (Mey, 2004) (type host *Platysteira cyanea nyansae*, Platysteiridae) from Uganda, and *Ph. pilgrimi* Valim & Palma, 2013 (type host *Gerygone igata igata*, Acanthizidae) from New Zealand, both placed in the *beckeri* species-group. *Philopteroides mitsusui* (Uchida, 1948) (type host *Myzomela rubratra dichromata*, Meliphagidae) from the Caroline Islands; *Ph. terpsiphoni* Najer & Sychra, 2012 (type host *Terpsiphone viridi*s, Monarchidae) from Senegal; *Ph. kayanobori* (Uchida, 1948) (type host *Spizixos semitorques cinereicapillus*, Pycnonotidae) from Taiwan; *Ph. sclerotifrons* (Tandan, 1955) (type host *Cinnyris asiaticus asiaticus*, Nectariniidae) from India; *Ph. cucphuongensis* Mey, 2004 (type host *Pycnonotus finlaysoni eous*, Pycnonotidae) and *Ph. flavala* Najer & Sychra, 2012 (type host *Hemixos flavala*, Pycnonotidae) both from Vietnam; and *Ph. novaezelandiae* Mey, 2004 (type host *Acanthisitta chloris chloris*, Acanthisittidae), *Ph. xenicus* Mey, 2004 (type host *Xenicus longipes longipes*, Acanthisittidae), *Ph. fuliginosus* Valim & Palma, 2013 (type host *Rhipidura fuliginosa placabilis*, Rhipiduridae) and *Ph. macrocephalus* Valim & Palma, 2013 (type host *Petroica macrocephala macrocephala*, Petroicidae) from New Zealand, in the *mitsusui* species-group (Valim & Palma 2013).

Both the geographical range and the host distribution of this louse genus are extended with the two new species

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described in this paper, from the only two species currently placed in the Paramythiidae (see Clements *et al*. 2015). All other specimens of *Philopteroides* from New Guinea examined by us belong to the *mitsusui* species-group, suggesting either that the host distribution of the *beckeri* species-group may be limited in New Guinea, or that this species-group is paraphyletic and based on characters that are not phylogenetically informative. No comprehensive phylogeny of the *Philopterus* complex has yet been published, and relationships within *Philopteroides*, as well as between this genus and the other members of the complex (see Mey 2004), are therefore unknown.

Material and methods

All examined specimens were mounted on slides in Canada balsam, and are deposited in the Natural History Museum, London, United Kingdom (NHML). The figures were drawn using light microscope CX31RBSF (Olympus, Tokyo, Japan), fitted with a drawing tube, then edited using Adobe Illustrator CS6 on a tablet PTZ-930 (Wacom, China).

Dimensions taken (Table 5, with mean values in parentheses) follow Valim & Palma (2013), but some abbreviations have been changed, as follows: APLL = anterior dorsal plate lateral length; PAW = preantennal width; PAL = preantennal length; PMCL = premarginal carina length; POL = postantennal length; SGPW = subgenital plate width. In addition, we also took the following dimensions: *dsms* = length of dorsal submarginal setae; *pas* = length of preantennal setae; *pcs* = length of preconal head setae; AL = abdomen length. All dimensions are given in millimeters and were taken using an optical scale in a CX21FS1 light microscope (Olympus, Tokyo, Japan) between the points as shown in Figs 1A–D and 2. Head chaetotaxy follows Clay (1951), as modified by Mey (1994) for the *pos* and *mts* 1–5; the head sensilla follow Valim & Silveira (2014), with our tentative interpretation as given in Fig. 1D. Thoracic chaetotaxy follows Mey (1994). Female terminalia terminology (inner genital sclerite, subvulval sclerites) follows Clay (1958) and is showed in Fig. 1C.

We propose a new system of naming leg setae for the *Philopterus*-complex, but comparisons with the *Brueelia*-complex (Gustafsson & Bush *in prep*.) show that accurate homology of leg chaetotaxy may be difficult. A descriptive system may be necessary for each group of closely related louse genera, until a broader study of leg chaetotaxy within the Ischnocera is performed. The following standardized abbreviations were used for leg chaetotaxy, as shown in Figs 5–6: *c* = coxa; *t* = trochanter; *f* = femur; *a* = anterior setae; *d* = dorsal setae; *dm* = dorsal marginal setae; *p* = posterior setae; *v* = ventral setae. Setal numbers and terminology for thorax and abdomen follow Valim & Palma (2013), with the difference that there are no spine-like setae present in the new species described here, so the letters *l* and *s* in the code of sternal setae mean long and short, without any difference in shape. We regard as pleural setae those placed on the lateral sides of the tergo-pleurites, in this case visible mainly from the ventral side. The short and long trichoid setae on each side of the pterothorax are called metapleural setae. Host taxonomy follows Clements *et al*. (2015).

In our previous papers (Najer *et al.* 2012a, b) describing new species of *Philopteroides*, we used the terms "metanotum" and "metathorax" referring to the last segment of the thorax. However, since all ischnoceran lice have the mesothorax and the metathorax fused together in one segment called "pterothorax", we have now adopted this terminology. However, since the mesosternum and metasternum are not fused in species of *Philopteroides*, we have continued using these terms separately.

For setal counts, we believe that besides the minimum–maximum range, the "mode" is an important parameter, although it has been previously neglected. This statistic expresses the fact that all setal counts for a given range in each segment are not equally common, and that the most common number of setae in a series of specimens does not often correspond (especially where large samples have been examined) with the mean value. We continue presenting mean values, as the dimensions seem to be relatively more consistent than numbers of setae.

Systematics

Order PHTHIRAPTERA Haeckel, 1896

Suborder Ischnocera Kellogg, 1896

Family Philopteridae Burmeister, 1838

Philopterus-complex (*sensu* Mey 2004)

Philopteroides Mey, 2004: 173
Type species: *Philopteroides novaezelandiae* Mey, 2004: 174, by original designation.

"*beckeri* species-group"

Philopteroides sinancorellus Najer, Gustafsson & Sychra, new species
(Figs 3, 5, 7A–B. Tables 1–2, 5)

Type host. *Oreocharis arfaki* (Meyer, 1875) (Passeriformes: Paramythiidae)—tit berrypecker.

Type locality. Morobe District, Papua New Guinea.

Diagnosis. *Philopteroides sinancorellus* keys out to *Ph. beckeri* (Mey, 2004) in Valim & Palma's (2013) key, but our new species differs from *Ph. beckeri* in the following characters: (1) marginal carina interrupted laterally in *Ph. sinancorellus* (Fig. 3C), not in *Ph. beckeri*; (2) spine-like sternal setae absent in *Ph. sinancorellus* (Figs 3A, E), present in *Ph. beckeri*; (3) male genitalia more elongated in *Ph. sinancorellus* (Fig. 3D) than in *Ph. beckeri*. Furthermore, *Philopteroides sinancorellus* differs from *Ph. gigas* new species (see below), in the following characters: (1) fewer setae on thoracic and abdominal segments of *Ph. sinancorellus* (Tables 1, 2) than on those of *Ph. gigas* (Tables 3, 4); (2) parameres very small, visible as slight protuberances in *Ph. sinancorellus* (Fig. 3D) but long and conical in *Ph. gigas* (Fig. 4D); (3) dorsal anterior plate as in Fig. 3B in *Ph. sinancorellus*, with oblique and slightly concave postero-lateral margins; (4) ventral head plate quadrangular with concave lateral margins in *Ph. sinancorellus* (Figs 3A–C, E) but trapezoidal in *Ph. gigas* (Figs 4A–C, E); (5) frons without any visible sclerotization in *Ph. sinancorellus* (Figs 3A–C, E) but sclerotized in *Ph. gigas* (Figs 4A–C, E); (6) smaller dimensions in *Ph. sinancorellus* than those of *Ph. gigas* (Table 5); (7) female sternites entire, without any visible lateral sternites in *Ph. sinancorellus* (Fig. 3E), with lateral sternites in *Ph. gigas* (Fig. 4E); (8) fewer and shorter sternal setae in *Ph. sinancorellus* (Figs 3A, E; Tables 1, 2) than in *Ph. gigas* (Fig. 4A, E; Tables 3, 4); (9) female subgenital plate of *Ph. sinancorellus* shaped as in Figs 3E, F, with posterior and lateral margin connected in apparent right angle, long setae present on this angle always with gap between them on each side, but those of *Ph. gigas* shaped as in Figs 4E, F, with oblique, slightly concave postero-lateral margin, without any apparent angle and with the setae close to each other.

TABLE 1. Abdominal chaetotaxy for male *Philopteroides sinancorellus* **n. sp.** Numbers in parentheses are modes. Due to the condition of some specimens, it was not possible to count all the setae. Digits separated by a plus sign denote segments that have two sets of setae (anterior and posterior for tergocentral; long and short for sternal). Sternal code: l = long; s = short; s/l = variable length. Letters in parentheses under sternal code refer to missing setae in some specimens.

Segment	Tergocentral	Paratergal	Sternal number	Sternal code
II	1–2 + 1–3 (1 + ?)	0	3–4 + 2–2 (3 + 2)	lls–sl(l)
III	3–4	0	2–3 + 1–2 (? + 2)	ls–sl(l)
IV	4	1–2 (2)	3 + 1–2	ll(s)–sl
V	2–3 (3)	1–3	2 + 0	ll–ll
VI	4	3	1–2 + 0	l(l)–(l)l
VII	3–4	2–3 (3)	-	-
VIII	2–3 (2)	3	-	-
IX + X	1	-	-	-

Descriptions. *Both sexes.* Head as in Fig. 3C, broadly triangular as long as wide, with both frons and occiput slightly concave, preantennal region with slightly concave lateral margin approximately as long as the postantennal margin. Marginal carina interrupted at feeding canal as well as in lateral part, which is divided into pre- and postmarginal carinae. Hyaline margin with slight indentation and without sclerotization. Dorsal anterior plate as in Fig. 3B, with arcuate dorsal sclerotization in anterior part, concave anterior margin and slightly concave or straight ventral margin and anterior part of lateral margin (Figs 3A–C, E). Ventral anterior plate as in Figs 3A, C, E, quadrangular, with slightly concave anterior, concave lateral and slightly convex posterior margin. Postnodal setae and sensilla *s3–s4* median and posterior. Prothorax as in Figs 3A, E shorter than wide, with 1 short medial *ppss* on each side and convex lateral sides. Prosternum without setae. Mesosternum quadrangular, without setae, with straight anterior margin, and lateral concave posterior margin. Metasternum not visible, with 2 setae on each side. Pterothorax wider than long, lateral margins convex, posterior margin distally pointed, reaching behind the level of spiracles on segment II. Tergopleurites II–VIII, divided medianly, sternites II–VI entire and well developed, transverse and continuous in both sexes (Figs 3A, E). Pleural incrassations relatively broad, with pleural head enlarged medianly, typically reaching to the level of the spiracle in the preceding segment.

Male. Habitus as in Fig. 3A, head as in Fig. 3C. One long and 3 short setae (*mms*) on each side of pterothorax, metapleurite with 1 long and 1 minute seta on each side. Thoracic and abdominal chaetotaxy as in Fig. 3A and Table 1. Tergopleurites: II–IX+X divided medially; all with long most lateral seta; two pairs of long most medial setae on tergite III, and long most medial pair on tergite IV–V; other tergopleural setae short, not reaching the anterior margin of the following segment. Sternal setae short with lateral setae longer than median setae. Subgenital plate consisting of sternites VII–IX+X, fused only in a narrow central part, with deep lateral indentations on both sides of the plate. Posterior margin of subgenital plate not clear; one long seta behind the postero-lateral margin. Genitalia as in Fig. 3D. Basal apodeme long and quadrangular, lateral margins concave. Parameres very small and only visible as slight protuberances, mesosome long and slender with thicker postero-median end, pointed and bent upwards. One sensillum on each side of posterior margin. Leg chaetotaxy as in Fig. 5A, without dorsal setae on all coxae. Measurements as in Table 5.

Female. Habitus as in Fig. 3E. Pterothorax with 3–4 medium-long setae (*mms*) on each side. Metapleurite with 1 short seta on each side. Thoracic and abdominal chaetotaxy as in Fig. 3E and Table 2; tergopleural setae long or medium-sized with the lateral pair longest. Sternal setae short with lateral setae relatively longer than median setae on each side. Subgenital plate (Fig. 3F) formed by fused sternites VII–VIII, with scale-like pattern on its posterior half, 2 long lateral setae and no median setae (except for one specimen with 1 short setae). Vestigial sternite VIII, sub-vulval sclerites, vulval margin, and associated chaetotaxy as in Fig. 3F. Without inner genital sclerites, but with one short and wide transverse sclerite present anterior of vulval opening with 8 microsetae and 6 short, slender scattered setae. Leg chaetotaxy as in Fig. 5B. Measurements as in Table 1 (the genital chamber was not visible in any of the specimens examined, so its measurements were not taken for this species).

Etymology. The species epithet derives from Latin “*sine*” = “without”, and “*ancor*” = “anchor”, with the diminutive ending “-*ellus*”. The name refers to the hardly noticeable parameres, which at first appear as missing , making the male genitalia look like a useless anchor.

Type material. Ex *Oreocharis arfaki*: Holotype ♂ (Fig. 7A), Bulldog Road, 12 miles S of Edie Creek, elev. 2405 m, Morobe District, Papua New Guinea, 30 Jun. 1966, O.R. Wilkes, BBM-NG-5222b. **Paratypes:** 1♂, 1♀ (Fig. 7B), same data as holotype; 1♀, Mount Kaindi, elev. 2300 m, Morobe District, Papua New Guinea, 17 Jun. 1967, A.C. Ziegler, BBM-NG-29174; 2♀, same location as previous sample, 6 Jul. 1967, A.C. Ziegler, BBM-NG-53461.

TABLE 2. Abdominal chaetotaxy for female *Philopteroides sinancorellus* **n. sp.** (explanatory notes as in Table 1)

Segment	Tergocentral	Paratergal	Sternal number	Sternal code
II	1 + 3–4 (1 + 4)	0	4–6 + 2 (4 + 2)	(l)lls–sll(l)
III	4–5 (4)	0	3–5 + 2–3 (4 + 2)	(l)lls–ss/ll
IV	3–4 (4)	1–2 (2)	4–6 + 2 (4 + 2)	(l)lls–sll(l)
V	4–5 (4)	2	2–5 + 1–2 (? + 1)	(l)ls–s/ll(l)
VI	4	4	4–6 + 0 (4 + 0)	(l)ll–ll(l)
VII	4	3–4 (3)	-	-
VIII	1–3 (2)	2–3 (3)	-	-
IX + X	1	-	-	-

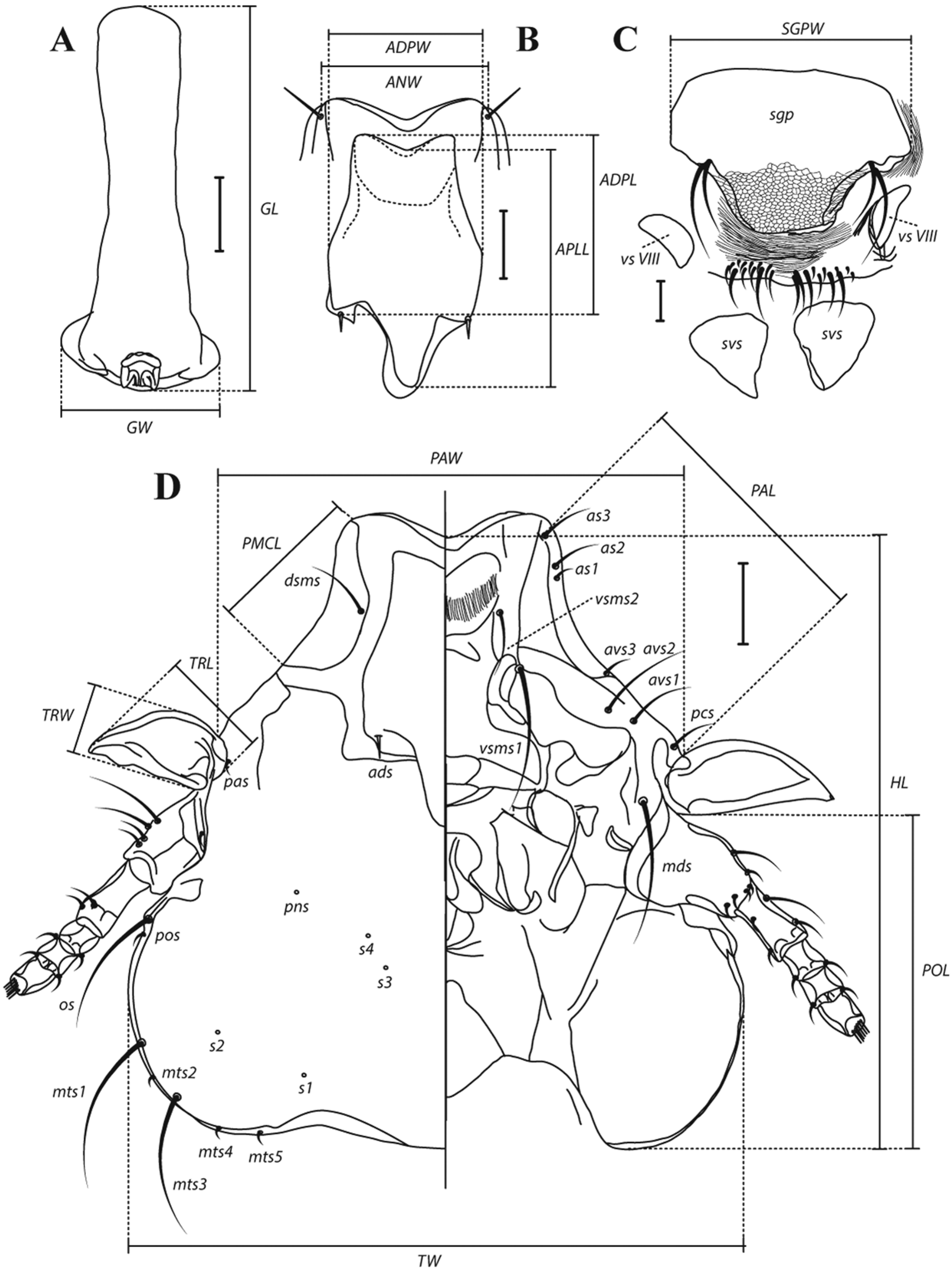

FIGURE 1. *Philopteroides gigas* **n. sp.** ex *Paramythia montium montium*: Points of measurements and nomenclature of sclerites and setae. **A**, male genitalia; **B**, male dorsal preantennal plate; **C**, female subgenital plate and ventral terminalia; **D**, male head. Scales = 0.1 mm.

Abbreviations. Sclerites: *sgp* = subgenital plate; *svs* = subvulvar sclerite; *vs VIII* = vestigial sternite VIII. **Setae:** *ads* = anterior dorsal seta; *as* = anterior seta; *avs* = anterior ventral seta; *dsms* = dorsal submarginal seta; *mds* = mandibular seta; *mts* = marginal temporal seta; *os* = ocular seta; *pas* = preantennal seta; *pcs* = preconal seta; *pns* = postnodal seta; *pts* = postemporal seta; *vsms* = ventral submarginal seta. **Measurements:** *ADPL* = anterior dorsal plate length; *APLL* = anterior dorsal plate lateral length; *ADPW* = anterior dorsal plate width; *ANW* = anterior notch width; *GL* = male genitalia length; *GW* = male genitalia width; *HL* = head length; *PAL* = preantennal length; *PAW* = preantennal width; *PMCL* = premarginal carina length; *POL* = postantennal length; *TRL* = trabecula length; *TRW* = trabecula width; *TW* = temporal width; *SGPW* = subgenital plate width.

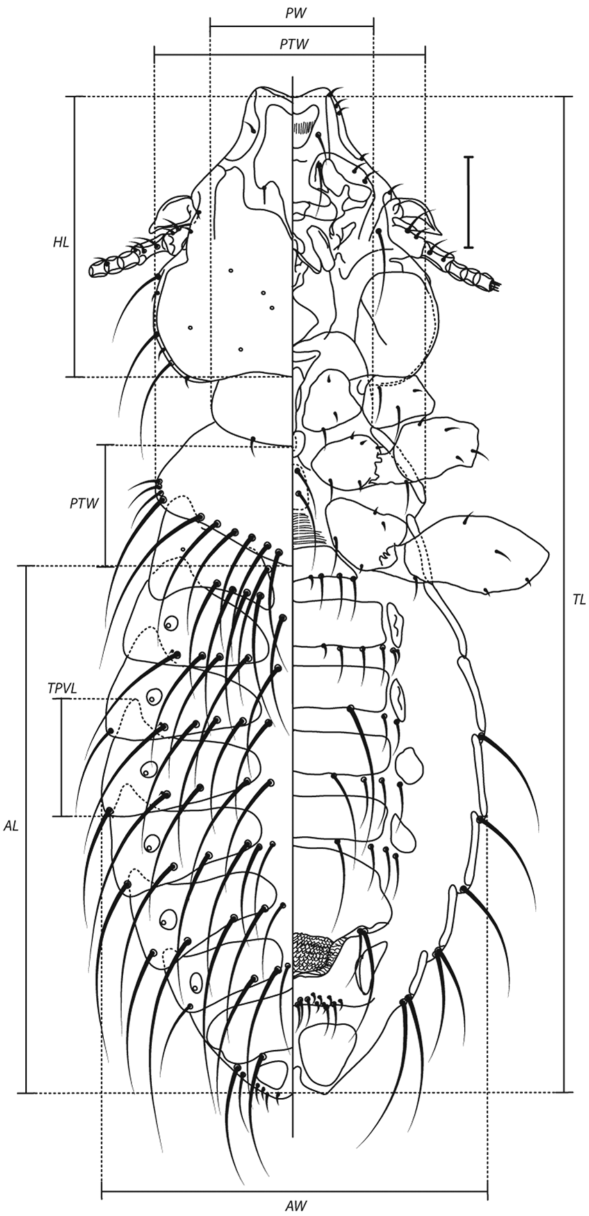

FIGURE 2. *Philopteroides gigas* **n. sp.** ex *Paramythia montium montium*: Female habitus showing points of measurements. Scale 0.1 mm. **Abbreviations:** *AL* = length of abdomen; *AW* = maximal width of abdomen; *HL* = head length; *PTL* = pterothorax length; *PTW* = pterothorax width; *PW* = prothorax width; *TL* = total length; *TPVL* = tergal plate V length.

Remarks. The male genitalia of the holotype and the paratype male differ in their appearance. The parameres of the holotype are not visible, but they are probably bent against the basal apodeme due to the slide-mounting process. However, in the paratype they can be seen as slight protuberances on the postero-lateral corners of the genitalia. A better assessment of the male genitalia will only be possible when more specimens become available.

Philopteroides gigas **Najer, Gustafsson, and Sychra, new species**
(Figs 1–2, 4, 6, 7C–D. Tables 3–5)

Type host. *Paramythia montium montium* De Vis, 1892 (Passeriformes: Paramythiidae)—crested berrypecker.

Type locality. Mur Mur Pass, Western Highlands District, Papua New Guinea.

Other host. *Paramythia montium brevicauda* Mayr & Gilliard, 1954 (Passeriformes: Paramythiidae)—crested berrypecker.

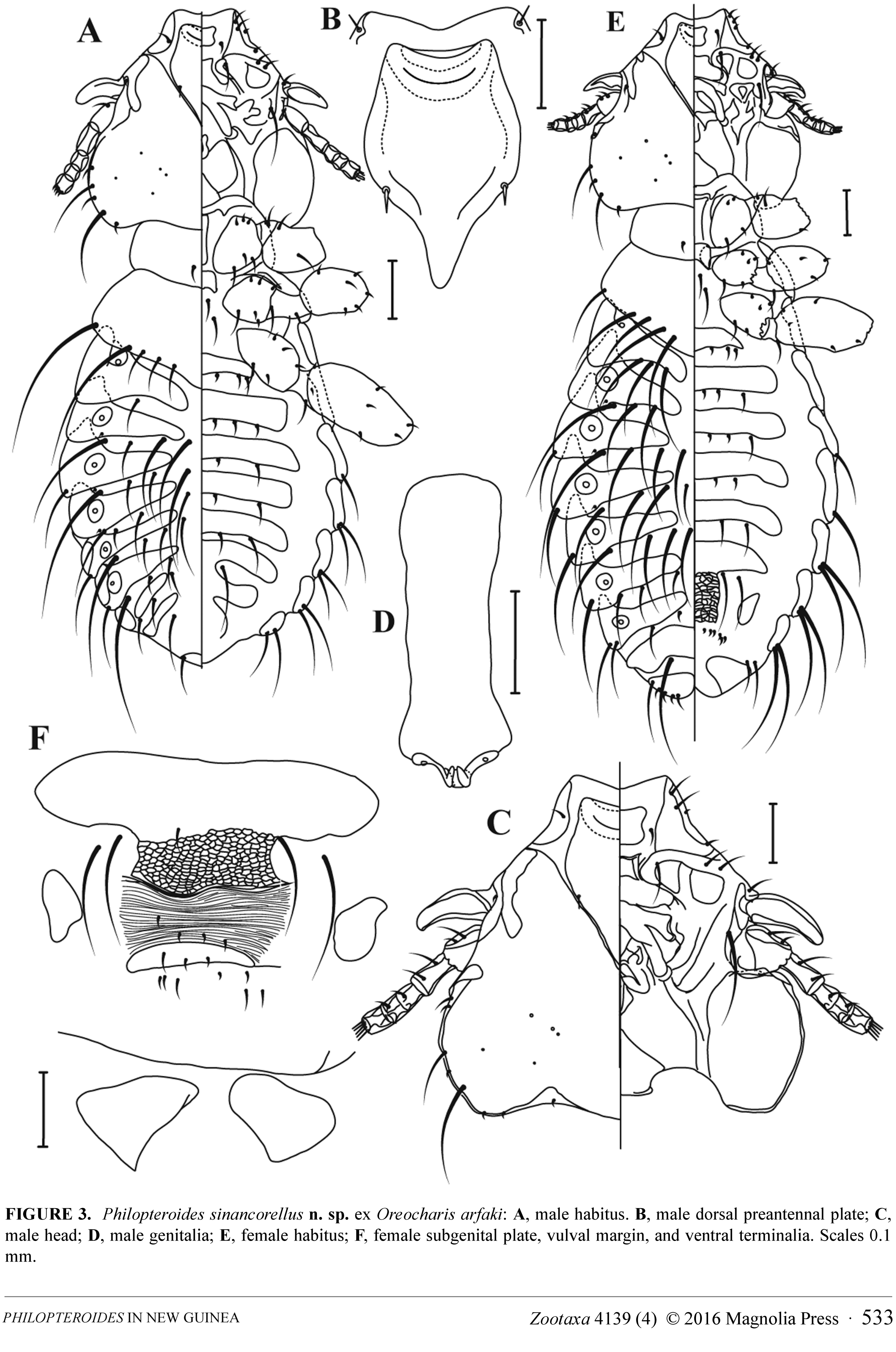

FIGURE 3. *Philopteroides sinancorellus* **n. sp.** ex *Oreocharis arfaki*: **A**, male habitus. **B**, male dorsal preantennal plate; **C**, male head; **D**, male genitalia; **E**, female habitus; **F**, female subgenital plate, vulval margin, and ventral terminalia. Scales 0.1 mm.

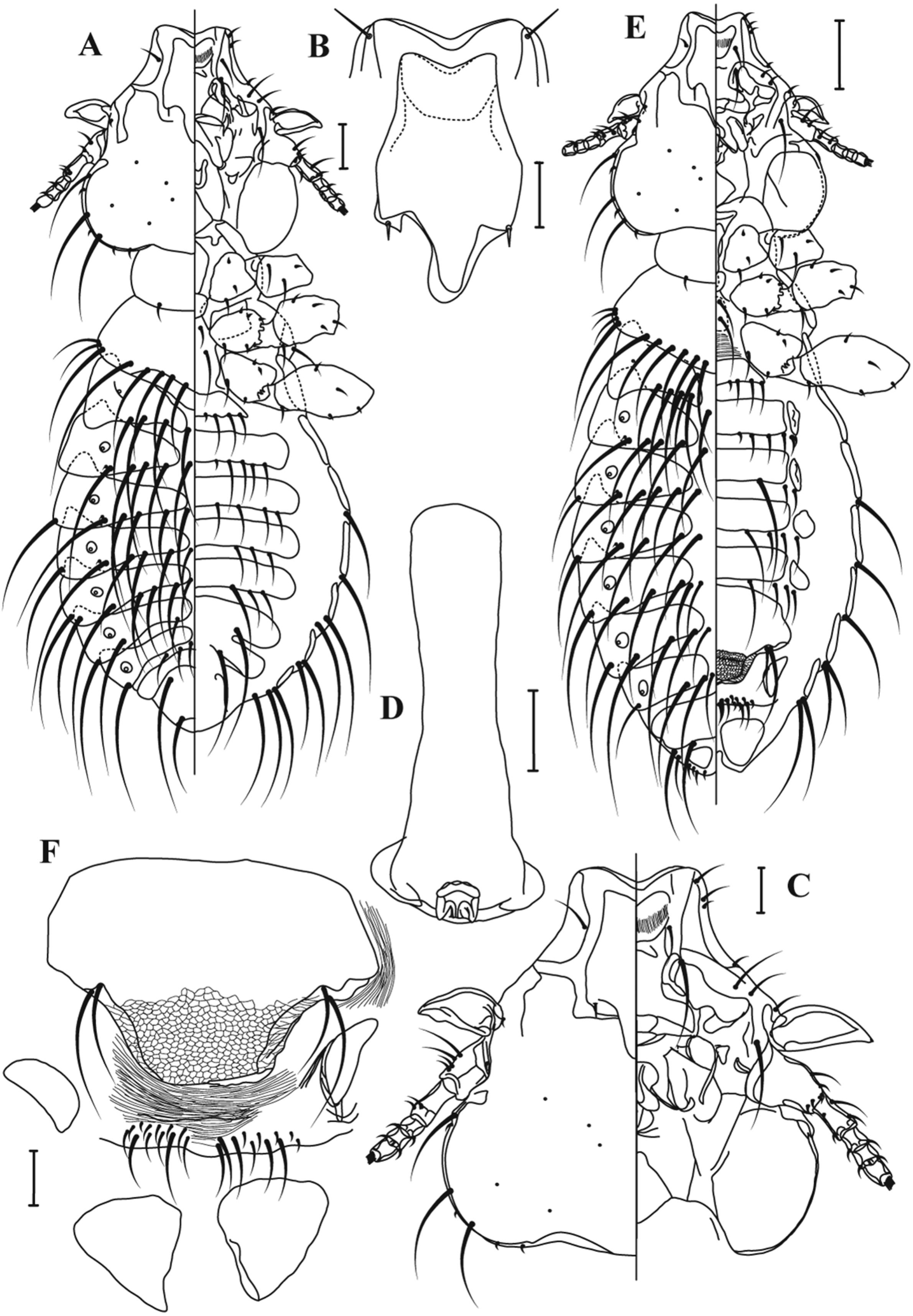

FIGURE 4. *Philopteroides gigas* **n. sp.** ex *Paramythia montium montium*: **A**, male habitus. **B**, male dorsal preantennal plate; **C**, male head; **D**, male genitalia. **E**, female habitus. **F**, female subgenital plate, vulval margin, and ventral terminalia. Scales 0.1 mm.

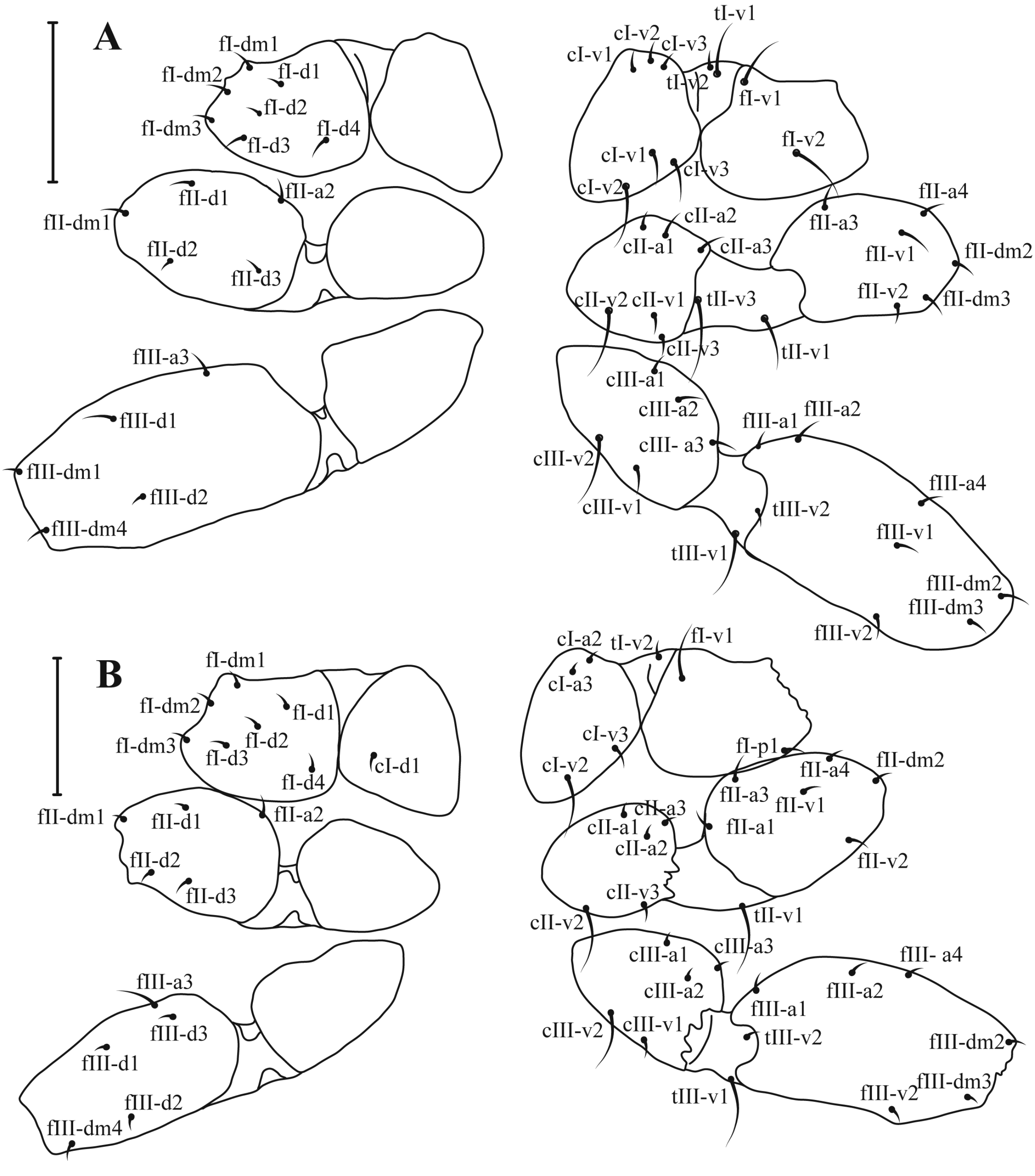

FIGURE 5. *Philopteroides sinancorellus* **n. sp.** ex *Oreocharis arfaki*. Nomenclature of leg chaetotaxy: **A**; males; **B**, females. Scales 0.1 mm. **Abbreviations.** *C* = coxa; *t* = trochanter; *f* = femur; *dm* = distal marginal setae; *d* = dorsal setae; *a* = anterior setae; *p* = posterior setae; *v* = ventral setae. **Note:** Numbers of legs are referred to in Roman numerals, while numbers of setae are in Arabic numerals. Example: fII-a4 = fourth anterior seta of second leg femur.

Diagnosis. *Philopteroides gigas* is easily identifiable at first sight for its very large size when compared with other species of the genus (see Table 5). This species keys out to *Ph. beckeri* in Valim & Palma's (2013) key, but differs from *Ph. beckeri* in the following characters: (1) marginal carina interrupted laterally in *Ph. gigas* (Fig. 4C), not in *Ph. beckeri*; (2) spine-like sternal setae absent in *Ph. gigas* (Figs 4A, E), present in *Ph. beckeri*; (3) male genitalia more elongated in *Ph. gigas* (Fig. 4E) than in *Ph. beckeri*. For differences between *Philopteroides gigas* and *Ph. sinancorellus*, see above under Diagnosis of the *Ph. sinancorellus*.

Descriptions. *Both sexes.* Head as in Figs 1D, 2, 4C, triangular, slightly longer than wide, with frons as well as occiput slightly concave, preantennal region as long as the postantennal, with concave lateral margins. Marginal carina divided medianly into a longer and thicker premarginal part, than the postmarginal. Hyaline margin with moderate central indentation and sclerotization along most of frons. Dorsal anterior plate as in Figs 4A–C, E, elongated, with anterior margin slightly indented centrally, anterior lateral margins concave with posterior lateral margins convex and with distinct indentations on its postero-lateral corners. Ventral anterior plate trapezoidal with concave anterior and oblique postero-lateral margin as in Figs 4A, C, E. Prothorax shorter than wide, one *ppss* sublaterally on each side. Prosternum without setae. Mesosternum oval, with slightly convex anterior and strongly convex posterior margin. Pterothorax wider than long with slightly convex lateral margins, moderately convex posterior margin with a median point at the same level as spiracle II; *mms* reaching level of spiracle IV, with the most lateral noticeably longer than the others. Tergopleurites II–VIII divided medianly, with setae noticeably long, always reaching at least to the level of spiracle of next segment. Tergopleural setae in both sexes very long, reaching behind the margin of next segment, with the most lateral pair longest. Pleural incrassations relatively narrow, streaky, equally wide in all their length. Leg chaetotaxy as in Fig. 6.

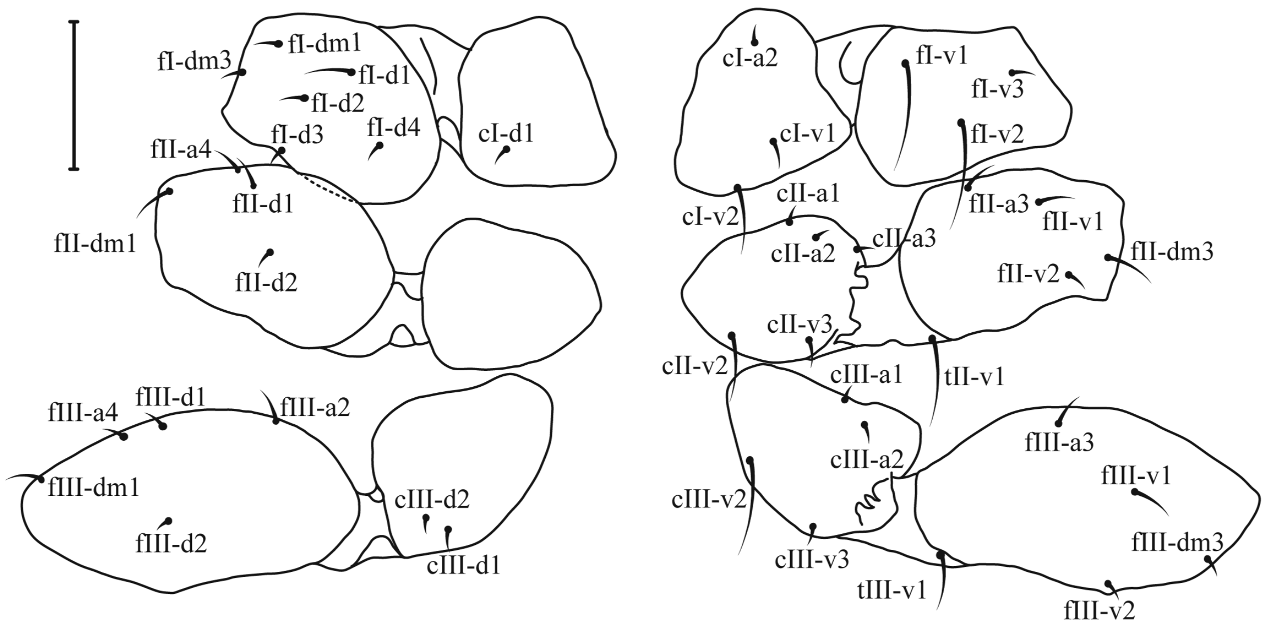

FIGURE 6. *Philopteroides gigas* **n. sp.** ex *Paramythia montium montium*. Nomenclature of leg chaetotaxy. Scale 0.1 mm. **Abbreviations.** *C* = coxa; *t* = trochanter; *f* = femur; *dm* = distal marginal setae; *d* = dorsal setae; *a* = anterior setae; *p* = posterior setae; *v* = ventral setae. **Note:** Numbers of legs are referred to in Roman numerals, while numbers of setae are in Arabic numerals. Example: tIII-v1 = first ventral seta of third leg trochanter.

TABLE 3. Abdominal chaetotaxy for male *Philopteroides gigas* **n. sp.** (explanatory notes as in Table 1)

Segment	Tergocentral	Paratergal	Sternal number	Sternal code
II	0–1 + 4–6 (1 + 4)	0	4–9 + 0–4 (6 + 2)	ls/lls/l(s/l)–s/lll(l)
III	4–6 (5)	0	6–10 + 0–2 (6 + 2)	llls/l(l)–(l)s/llll(l)
IV	3–6 (5)	1–3 (3)	5–9 + 0–2 (6 + 2)	s/lll(ll)–s/llll
V	4–6 (5)	2–3 (3)	6–9 + 0 (6 + 0)	lll(l)–(ll)lll
VI	3–6 (5)	2–4 (4)	6–8 + 0 (6 + 0)	lll(l)–(l)lll
VII	3–5 (5)	2–4 (3)	-	-
VIII	2–4 (3)	3–4 (3)	-	-
IX + X	1	-	-	-

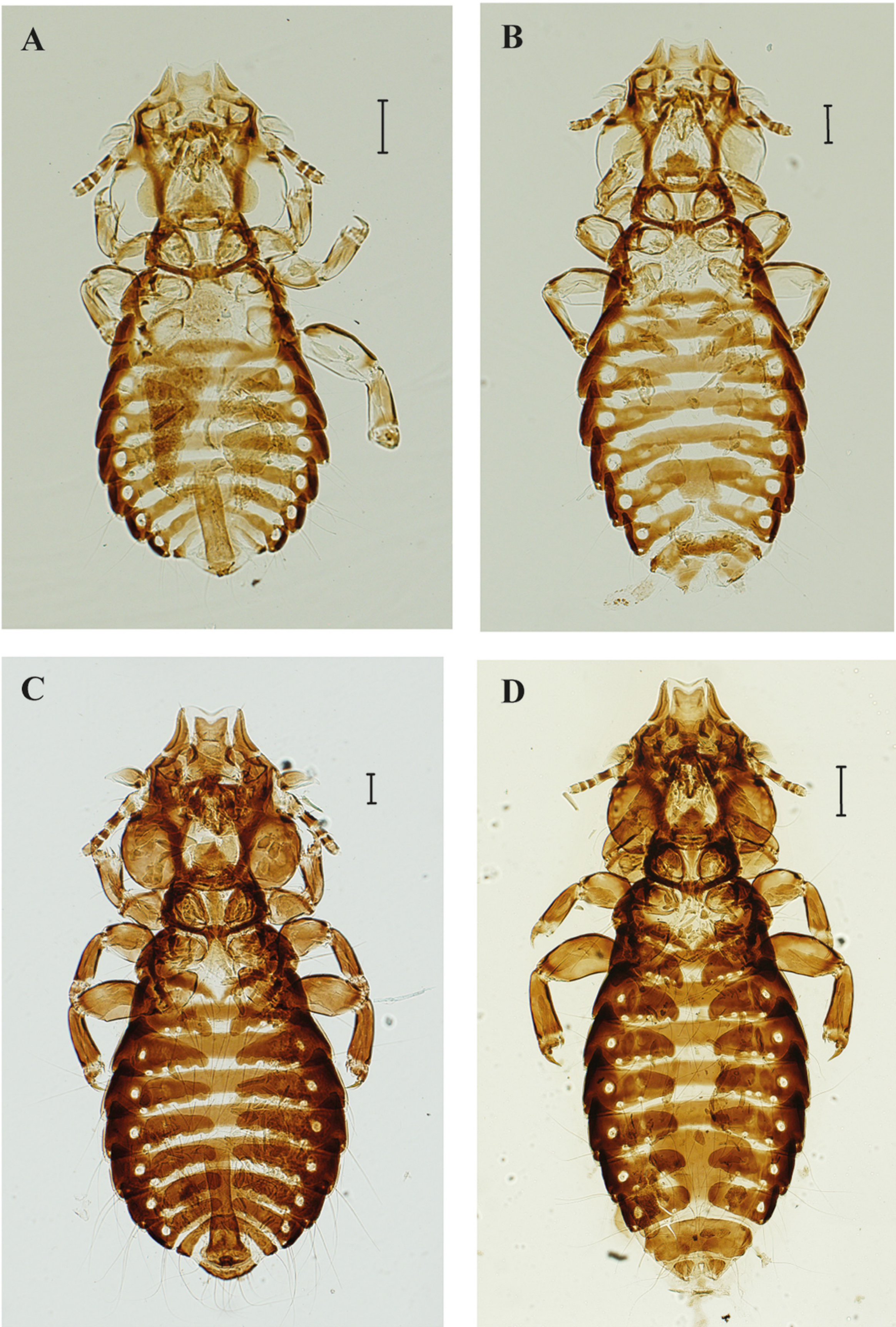

FIGURE 7. *Philopteroides sinancorellus* **n. sp.**: **A**, male holotype; **B**, female paratype (from Bulldog Road, BBM-NG-5222b). *Philopteroides gigas* **n. sp.**: **C**, male holotype; **D**, female paratype (from Mur Mur Pass, BBM-NG 60810). Scales 0.1 mm.

TABLE 4. Abdominal chaetotaxy for female *Philopteroides gigas* **n. sp.** (explanatory notes as in Table 1)

Segment	Tergocentral	Paratergal	Sternal number	Sternal code
II	1 + 4–5 (1 + 4)	0–1 (0)	4–8 + 1–3 (6 + 2)	(l)lls–s/lls/ll(l)
III	5–7 (5)	0–1 (0)	3–8 + 2–5 (6 + 2)	(l)s/lls/ls–sll(s/ll)
IV	4–6 (5)	1–4 (3)	6–9 + 0–2 (7 + 0)	(l)llll/s–s/llll
V	4–6 (4)	2–3 (3)	5–8 + 0–2 (8 + 0)	ls/lls/l–lll(l)
VI	4–5 (5)	2–4 (3)	6–8 + 0 (8 + 0)	(l)lll–lll(l)
VII	3–5 (4)	2–4 (4)	-	-
VIII	2–4 (3)	2–3 (3)	-	-
IX + X	1–2 (1)	-	-	-

TABLE 5. Measurements of *Philopteroides sinancorellus* **n. sp.** and *Philopteroides gigas* **n. sp.** Ranges with mean values in parentheses. Abbreviations and points of measurement follow Valim & Palma (2013) except for: APLL = anterior dorsal plate lateral length; PAL = preantennal length; PAW = preantennal width; PMCL = premarginal carina length; POL = postantennal length (PMCL and POL taken as in Fig. 1D); SGPW = female subgenital plate width (taken as in Fig. 1C).

	Philopteroides sinancorellus **n. sp.**		*Philopteroides gigas* **n. sp.**	
	Male	Female	Male	Female
as3	0.0275–0.0300 (0.0294)	0.0250–0.0275 (0.0306)	0.0250–0.0400 (0.0375)	0.0300–0.0550 (0.0370)
dsms	0.0100–0.0200 (0.0131)	0.0150–0.0300 (0.0222)	0.0175–0.0575 (0.0366)	0.0275–0.0550 (0.0425)
pas	0.0063–0.0075 (0.0072)	0.0050–0.0075 (0.0056)	0.0025–0.0100 (0.0053)	0.0025–0.0100 (0.0058)
pcs	0.0250–0.0325 (0.0281)	0.0150–0.0250 (0.0216)	0.0200–0.0425 (0.0337)	0.0300–0.0450 (0.0372)
ADPL	0.1700–0.1875 (0.1788)	0.1750–0.1925 (0.1831)	0.2025–0.2375 (0.2246)	0.2250–0.2725 (0.2463)
APLL	0.1075–0.1125 (0.1100)	0.1225–0.1375 (0.1288)	0.1550–0.1775 (0.1682)	0.1650–0.1975 (0.1835)
ADPW	0.1150	0.1275–0.1425 (0.1363)	0.1400–0.1500 (0.1455)	0.1550–0.1775 (0.1665)
ANW	0.1025–0.1150 (0.1088)	0.1250–0.1325 (0.1281)	0.1425–0.1625 (0.1516)	0.1480–0.1775 (0.1638)
AW	0.5050–0.5150 (0.5100)	0.4725–0.6550 (0.5806)	0.6300–0.7225 (0.6898)	0.7000–0.8550 (0.7955)
AL	0.4750–0.4925 (0.4838)	0.6975–0.7875 (0.7525)	0.7400–0.8425 (0.7939)	1.0050–1.4175 (1.1470)
EWG	-	-	-	0.0750–0.0825 (0.0800)
GL	0.2125–0.2250 (0.2188)	-	0.3100–0.3825 (0.3457)	-
GW	0.0625–0.0825 (0.0725)	-	0.1075–0.1500 (0.1214)	-
HL	0.3650–0.3675 (0.3663)	0.4000–0.4400 (0.4225)	0.4925–0.5400 (0.5184)	0.5380–0.6125 (0.5755)
IWG	-	-	-	0.0525–0.0600 (0.0558)
PAL	0.1600–0.1650 (0.1625)	0.1550–0.1750 (0.1644)	0.2075–0.2250 (0.2173)	0.2325–0.2550 (0.2415)
PAW	0.2825–0.2900 (0.2863)	0.3175–0.3500 (0.3294)	0.3750–0.4125 (0.3934)	0.4100–0.4600 (0.4380)
PMCL	0.0725–0.0750 (0.0744)	0.0750–0.0925 (0.0841)	0.1275–0.1525 (0.1380)	0.1275–0.1675 (0.1500)
POL	0.1550–0.1625 (0.1588)	0.1875–0.2150 (0.1981)	0.1750–0.2450 (0.2152)	0.1925–0.2775 (0.2308)
PTW	0.3725–0.3775 (0.3750)	0.4200–0.4650 (0.4463)	0.4425–0.5100 (0.4746)	0.5075–0.6000 (0.5428)
PTL	0.1575–0.1700 (0.1638)	0.2100–0.2525 (0.2269)	0.1950–0.2425 (0.2152)	0.2425–0.2875 (0.2580)
PW	0.2525–0.2575 (0.2550)	0.2800–0.3050 (0.2963)	0.2825–0.3200 (0.3089)	0.3125–0.3700 (0.3453)
SGPW	-	0.3100–0.3375 (0.3244)	-	0.3575–0.4250 (0.3978)
TL	1.1225	1.4675–1.5675 (1.5206)	1.4025–1.7300 (1.6211)	1.9325–2.2150 (2.0808)
TPVL	0.0975–0.1225 (0.1100)	0.1675–0.2000 (0.1881)	0.1800–0.2100 (0.1911)	0.2175–0.2700 (0.2445)
TRL	0.0910–0.0938 (0.0925)	0.1000–0.1030 (0.1013)	0.1180–0.1300 (0.1239)	0.1250–0.1350 (0.1315)
TRW	0.0300–0.0350 (0.0325)	0.0350–0.0425 (0.0381)	0.0510–0.0600 (0.0574)	0.0580–0.0688 (0.0633)
TW	0.3950–0.4000 (0.3975)	0.4575–0.5050 (0.4775)	0.5025–0.5350 (0.5186)	0.5450–0.6150 (0.5895)

Male. Habitus as in Fig. 4A. Metasternum not visible, with 2 setae on each side. Pterothorax with 4–6 *mms*, the most lateral seta long, the others medium-long, reaching the spiracle of tergopleurite III. Metapleurite with 1 long and 2 short setae on each side. Thoracic and abdominal chaetotaxy as in Fig. 4A and Table 3. Sternites II–VI well developed and entire (Fig. 4A). Median-most setae on sternite VI long, other sternal setae medium-sized, in some individuals (mainly submedian setae) do not extend beyond the posterior margin of next segment. Subgenital plate consisting of sternites VII–IX+X, with lateral indentations equivalent to spaces between sternites reaching to approximately quarter of their width, with one long seta present in each indentation. Genitalia as in Fig. 4D, basal apodeme elongated, quadrangular, with concave lateral margins and the distal end wider than the proximal. Parameres fused with the basal plate with just quarter of length remaining free, and distal ends pointed. Mesosome fused to basal apodeme, with bowed anterior, with lateral ends sinuous, and with latero-anterior parts wider than medio-posterior parts. Measurements as in Table 5.

Female. Habitus as in Figs 2, 4E. Metasternum hardly visible, with 2 setae on each side. Pterothorax with 5–7 *mms* on each side, the most lateral setae longer than the rest, which reach the spiracle of tergopleurites III. Metapleurite with 1 long and 3 short setae, anterior metasternum rounded, with straight posterior margin and 1 short and 1 medium-sized setae on each side. Thoracic and abdominal chaetotaxy as in Fig. 4E and Table 4. Sternites II–VI well developed, with small lateral plates (Fig. 4E). Sternal setae medium-sized, except for median setae on sternites IV–VI, which are long. Inner genital sclerites missing. Female subgenital plate, vestigial sternites VIII, subvulval sclerites, vulval margin and chaetotaxy as in Fig. 4F. Subgenital plate (Fig. 4F) formed by sternites VII–VIII, with scale-like pattern on its posterior half, and postero-lateral margin slightly concave with 2 long setae sublaterally on each side, and no median setae. Vulval margin with an anterior row of approximately 10 short setae and a posterior row of approximately 10 medium-sized setae (Fig. 4F). Measurements as in Table 5.

Etymology. The species epithet derives from Latin "*gigas*" = "giant", referring to the large size of this species.

Type material. Ex *Paramythia montium montium*: Holotype ♂ (Fig. 7C): Mur Mur Pass, elev. 2808 m, Western Highlands, Papua New Guinea, 3 Jan. 1968, Nadchatram & Mirza, BBM-NG 60810. **Paratypes:** 4♂, 3♀ (Fig. 7D), same data as holotype; 2♂, 2♀, same location as holotype, 29 Dec. 1967; 2♂, 3♀, Mt. Wilhelm, elev. 3200 m, Chimbu District, Papua New Guinea, 2 Jul. 1963, J.H. Sedlacek, BBM-NG 20050; 2♂, 2♀, Lake Louise, 17 miles WNW of Telefomin, elev. 2800 m, West Sepik, Papua New Guinea, 16–18 Apr. 1971, A.B. Mirza, BBMNG 100035 and 100050; 9♂, 11♀, Lake Louise, 17 miles WNW of Telefomin, elev. 2800 m, West Sepik, Papua New Guinea, 16–19 April 1971, A.B. Mirza, BBMNG 100036-37, 100050, 100053, 100056, 100076, 100078-79, 100081 and 100101; 6♂, 5♀, vic[inity of] Tambul, Mur Mur Pass, elev. 2808 m, Western Highlands, Papua New Guinea, 29 Dec. 1967 and 3 Jan. 1968, Nadchatram & Mirza, BBM-NG 60810 and 60714; 1♂, 1♀, Mt. Wilhelm, elev. 3200 m, Chimbu District, Papua New Guinea, 2 Jul. 1963, J.H. Sedlacek, BBM-NG20050; 1♀, Mt. Giluwe, elev. 3330 m, Southern Highlands District, Papua New Guinea, 1 Jun. 1963, J.H. Sedlacek, BBM-NG 20265.

Additional material examined

Ex *Paramythia montium montium*: 15N, Lake Louise, 17 miles WNW of Telefomin, elev. 2800 m, West Sepik, Papua New Guinea, 16–19 April 1971, A.B. Mirza, BBMNG 100036-37, 100050, 100053, 100056, 100076, 100078-79, 100081 and 100101; 1N, Kawongu, elev. 7200 feet, Western Highlands, Papua New Guinea, 16 Jun. 1963, H. Clissold, BBMNG 28140.

Ex *Paramythia montium brevicauda*: 5♂, 1♀, 4N, Bulldog Road, 12 miles from Edie Creek, elev. 2500 m, Morobe district, Papua New Guinea, 30 Oct. 1967, P.H. Colman, BBM-NG 54730 and 54734; 2♂, 1♀, Saruwaged range, 20 miles SW of Kabwum, elev. 2880 m, Morobe District, O.R. Wilkes, 5 Aug. 1966, BBMNG 52755 and 52757; 4♂, 1♀, 1N, Saruwaged range, 20 miles SW of Kabwum, elev. 3300 m, Morobe District, Papua New Guinea, R.M. Mitchell & O.R. Wilkes, 5 Aug. 1966, BBM-NG 52672; 1♀, Kililo, Saruwaged Range, elev. 2100 m, Morobe District, Papua New Guinea, 5 Aug. 1966, R.M. Mitchell & O.R. Wilkes, BBM-NG 52765; 1♂, 1♀, SW Kabwum, elev. 2550 m, Morobe District, Papua New Guinea, 11 Aug. 1966, R.M. Mitchell, BBM-NG 52837.

Key to species of the *beckeri* species-group of *Philopteroides* Mey, 2004 (adults only)

Numbering and characters of initial couplets taken from Valim & Palma (2013: 87)

2. Sternite V without spine-like setae. Females: posterior setae on tergite IX+X situated outside plate, inner genital sclerite missing 2a

\- Sternite V with spine-like setae. Females: posterior setae on tergite IX+X situated on plate, inner genital sclerite present . . . . *Philopteroides pilgrimi* Valim and Palma, 2013

2a. Lateral parts of marginal carina not interrupted. Spine-like setae present on sternites II, III and IV. Males: genitalia short and rounded, not more than twice as long as wide. Females: subgenital plate with median setae . . . . *Philopteroides beckeri* (Mey, 2004)

\- Lateral marginal carina interrupted, divided into pre- and postmarginal carina (Fig. 1D). No spine-like setae on sternites, sternal setae differ only in length. Males: genitalia elongated, at least twice as long as wide. Females: subgenital plate without median setae (Figs 3F, 4F) 2b

2b. Dorsal anterior plate with convex lateral margins, without any distinct indentation (Fig. 3B). Moderate dimensions, as in Table 5. Sternal setae short, not reaching the hind margin of next sternite (Figs 3A, E). Male genitalia with slightly developed hardly visible parameres, and basal plate of similar width (Fig. 3D). . . . . *Philopteroides sinancorellus* **n. sp.**

\- Dorsal head plate with concave lateral margins on its anterior part, and with pronounced posterolateral indentations (Fig. 4B). Large dimensions, as in Table 5. At least some long sternal setae, clearly exceeding the hind margin of next sternite (Figs 4A, E). Male genitalia with long conical parameres, and basal plate tapering towards its proximal end (Fig. 4D) . . . . *Philopteroides gigas* n. sp.

Discussion

The known geographical distribution of the 15 described species of *Philopteroides* is as follows: New Zealand (five species), New Guinea and Vietnam (two species each), India, Taiwan, Micronesia, Senegal, Uganda (one species each), and one from the Indo-Malayan Region according to the distribution of its host (Valim & Palma 2013). Considering this geographical distribution, it is likely that further species of *Philopteroides* will be found in Australasia and South East Asia. Also, most species are known from islands or mountainous areas with high levels of endemism. However, the two African records are puzzling and would need further research.

Considering that at least one species of the *beckeri* species-group (*Ph. pilgrimi* Valim & Palma, 2013) has a sympatric distribution with four other species belonging to the *mitsusui* species-group within New Zealand (Valim & Palma 2013), and that the other species of the *beckeri* species-group is one of only two records of this genus from Africa, it would appear that the different species-groups are not structured geographically. Furthermore, neither the genus nor the proposed species-groups are distinctively host specific because all described species parasitise members of at least 10 avian families, with the four species of the *beckeri* species-group parasitizing three families. However, in some cases, morphologically similar species of *Philopteroides* parasitise hosts of the same family (i.e. those from Acanthisittidae, Pycnonotidae and Paramythiidae), suggesting that, when more species become known, a pattern of host family-louse relationships may emerge.

The two new species of *Philopteroides* described in this paper differ from *Ph. beckeri* (the type of the species-group), in several characters, including some clearly obvious, as the very large size of *Ph. gigas*. This would indicate that the *beckeri* species-group may prove to be artificial after more species are discovered and described. Also, *Philopteroides* is in much need of molecular studies to elucidate relationships among species as well as between species-groups, and indeed among all genera of the *Philopterus*-complex. Obviously, fresh material collected from suitable hosts occurring in Asia, Australasia, other Pacific Islands and Africa is needed for such studies.

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